5.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

This chapter describes the potential environmental consequences of the proposed TRU waste activities, including construction and operation of the TRU Waste Facility (TWF), Building 269-H, in H-Area and in the burial grounds at SRP. In describing the potential environmental consequences from these proposed activities, the following items are considered:

- construction-related impacts;
- changes in air and water quality as a result of normal operation;
- exposure of the general public and operating personnel to nonradiatiive pollutants emitted during normal operations;
- exposure of the general public and operating personnel to radiation from emissions during normal operations;
- exposure of the general public and operating personnel to nonradioactive pollutants and radiation from emissions during abnormal operations (accidents);

- transportation related impacts.

Extensive environmental measurement and surveillance programs have been maintained at the Savannah River Plant since 1951 (before SRP startup). Ongoing programs in radiation biology, ecology, surface water hydrology, groundwater monitoring, and meteorology measure effluents and emissions and allow calculation of environmental effects from operations at the SRP site. The results from these programs have been published annually since 1951. A recent report was the Savannah River Plant Environmental Report for 1985, DPSPU-86-30-1.

5.1 CONSTRUCTION EFFECTS

5.1.1 LAND USE AND SOCIOECONOMICS

The TWF facility will occupy an enclosed area of four and a half acres on SRP. This area includes the space necessary for the proposed TWF process building, Building 269-H, a new roadway, walks, and a parking area. The proposed site is adjacent to an existing SRP operating area, H-Area, and its perimeter fence will be relocated to include the TWF facility.

No additional land or new structures will be required for waste retrieval activities in SRP burial grounds. No indirect land use impacts are expected. The site is mostly open land. There will be no impacts on historical sites or archaeological sites. Impacts on traffic on SRP from the small construction workforce are expected to be negligible.

The TWF facility construction is expected to begin in 1991 and to conclude in 1994 with peak construction employment of 28 workers occurring in 1993. Direct and composite impacts are negligible compared to the total SRP employment of approximately 15,000 people.

5.1.2 WATER QUALITY AND ECOLOGY

Effective erosion control measures will be implemented to mitigate potential erosion and sediment impacts from rainfall during the construction of the TWF. Standard erosion control measures such as hay bales, grass, diversion ditches, and sediment basins will be used if necessary. The proposed TWF facility site is essentially unused land containing grasses, bushes, and some trees.

Because of the site's nearness to H-Area, construction activities are expected to have a negligible impact on wildlife. No wetlands areas exist on the proposed site or in the burial grounds. No endangered or protected plant or animal species are found on the proposed site or in the burial grounds.

5.1.3 AIR QUALITY AND NOISE

During construction of the TWF facility, the sources of air pollution will be construction equipment, truck traffic, and site disturbances consisting of small quantities of carbon monoxide and hydrocarbons from engine exhausts as well as suspended particulates or dust from ground surface disturbance. Dust will be controlled during dry weather by wetting the ground surfaces. Other air pollutants might be released during the burning of construction debris and solid wastes, as permitted by applicable State of South Carolina air pollution regulations. Because extensive clearing and excessive earthmoving are not required, air quality impacts are expected to be negligible.

Noise levels caused by the construction at the TWF will be similar to those caused by the construction of other industrial projects. However, the long distance from the construction area to the SRP boundary (7 miles) will ensure that no increase in offsite sound levels occurs.

5.2 OPERATIONAL EFFECTS

5.2.1 LAND USE AND SOCIOECONOMICS

During TWF facility operation the SRP work force will increase by 40 people. Since most of these are already employed at SRP, little additional socioeconomic impacts are expected on the SRP surrounding area. No operational impacts are expected on historic or archaeological sites or other existing land uses at SRP.

5.2.2 WATER QUALITY AND ECOLOGY

No surface water will be used during operation of the TWF facility. All TWF facility water will be obtained from the Black Creek and Middendorf Formations using existing wells in H-Area and the existing water distribution system. The withdrawal of groundwater for TRU waste activities will not affect the offsite water levels in the aquifer.

Small amounts of low level radioactive waste water will be generated from personnel decontamination. They will be collected in a waste holding tank, sampled to determine contamination levels and sent to existing low level waste tanks for disposal. Sanitary wastewater from the TWF facility will be sent to existing H-Area waste treatment facilities. There will be no releases to plant streams or routine releases of radioactive liquids from the TWF facility.

5.2.3 AIR QUALITY AND NOISE

During routine operations the impact of atmospheric releases from TRU waste activities will be negligible. Any releases from the TWF facility and activities, plus all other SRP releases, will be well below applicable State and Federal standards. There will be very small routine air releases from TRU waste processes and activities. A NESHAP permit for possible radionuclide air releases from the TWF facility will be obtained from EPA to meet 40 CFR 61 requirements for facility construction.

The normal operation of the TRU waste facility will have a very low radiological impact. Occupational exposure for personnel involved in TRU waste activities will be monitored and controlled to be as low as reasonably achievable.

Plutonium 238 and 239 will be the major radionuclides released to the atmosphere during normal operations. The annual release to the atmosphere is estimated to be less than 6.7E-05 Ci of Pu 239 and/or Pu 238. The radiological doses to the maximally exposed individual members of the public at the SRP boundary, 7 miles from the TRU waste facility, and to the general population have been calculated using methods described in ICRP Publication 30 and others. The dose commitments are summarized in Table 5-1. Radiation doses due to normal atmospheric releases are expected to result in a maximum individual pathway dose of 3.5E-04 mrem per year effective dose equivalent. The SRP releases, including this small increment, are well below the DOE limit of 100 mrem/yr from all exposure pathways established for the public in the vicinity of DOE facilities (DOE Order 5480.1B) and also significantly below the EPA standard of 25 mrem/yr to members of the general public from airborne emissions (40 CFR 61). The collective effective dose equivalent is estimated to be 1.2E-02 person-rem/yr which translates to approximately 1×10^{-6} latent cancer fatalities (LCF) per year. The number of latent cancer fatalities may be estimated by multiplying by the dose conversion factor of 1.0×10^{-4} LCFs/person-rem (ICRP 1977). These values are also small compared with background whole-body doses of 93 mrem per year to the maximum individual and 5.1E+04 person-rem per year to the population within 50 miles.

Routine TRU waste retrieval and processing operations will result in insignificant amounts of radiation exposure to the operating personnel. Occupational dose estimates for normal

TABLE 5-1: Offsite Dose Consequences from Normal Atmospheric Releases[a,b]

SOURCE	DOSE			
	Effective Dose Equivalent	Bone Marrow	Bone Surfaces	Liver
Maximum individual (mrem/yr)	3.5E-04	5.0E-04	6.3E-03	1.4E-03
50-mile population (person-rem/yr)[c] Atmospheric releases	1.2E-02	1.8E-02	2.3E-01	4.9E-02

---

a Routine atmospheric releases of plutonium were estimated as follows:

- Each 55-gallon drum or container was assumed to contain 0.5 curies of Pu-239 and the annual throughput is estimated to be 20,000 ft^3 (2720 drums) (Du Pont, 1983; Wierzbicki, 1986).
- All of the material in the drum is released to the containment cabinet.
- 0.001% of the original material becomes airborne in the cabinet and is released through the cabinet exhaust system (Stoddard, 1982).
- 0.49% of the original material passes through the HEPA filter to the atmosphere and is respirable (Lee, 1979).
- To be conservative doses were calculated for Pu-239 since its dose factor is about 11 percent higher than Pu-238. Effective dose factor equivalents are 510 rem/uCi for Pu-239 and 460 rem/uCi for Pu-238.

b Background doses are estimated to be 93 mrem/yr to the maximum individual located at the SRP boundary and 51,000 person-rem per year to the population within 80 kilometers.

c A 50-Year Environmental Dose Commitment. The number of latent cancer fatalities (LCF's) may be estimated by multiplying by the dose conversion factor of 1.E-04 LCF's/person-rem (ICRP, 1977).

operations were based on overall occupational doses experienced at the SRP. Because the work that will be done in the TWF facility will involve less potential for radiation exposure than most other SRP facilities, this approach is expected to overestimate occupational radiation exposures. The average occupational dose during TRU waste normal operation was estimated to be 0.22 rem per year, well within the Federal occupational limit of 5 rem per year as stated in DOE Order 5480.1A, Chapter 11.

5.2.4 SOLID WASTE

Nonradiological solid wastes, consisting of trash, rags, plastic bags and gloves, will be disposed of in an SRP sanitary landfill that is operated in accordance with permits issued by South Carolina Department of Health and Environmental Control. There will be no hazardous solid wastes. Solid waste containing very low levels of radioactivity will be transported to the SRP burial ground facilities for disposal.

5.2.5 TRANSPORTATION

Nonradiological impacts of transporting nuclear materials are the same as those resulting from transporting non-nuclear materials. That is, the nonradiological impacts do not consider the characteristics of the cargo. Studies were performed in 1982 by Rao to calculate health effects that result from exposure to air pollutants generated during incident-free transport. Unit consequence factors that were calculated for truck and rail modes are shown in Table 5-2.

TABLE 5-2: Nonradiological Unit Consequence Factors[a]

Source	Truck	Rail
Pollutants	1.0E-07[a] (urban travel only)	1.3E-07[a] (urban travel only)
	0.5E-08[b]	0.65E-08[b]

Notes:

[a]Calculated upper limit of mortalities per km of vehicle operation, caused by SO_x and particulates released (Rao, 1982).

[b]These factors may be used if urban travel distance is assumed as 5% of the total travel distance with 90% in rural areas and 5% in suburban as discussed in reference NRC, 1977.

Accidents involving trucks or trains may cause injury or death, regardless of type of cargo. Truck and rail accident statistics for general commerce compiled from DOT data are shown in Table 5-3.

TABLE 5-3: Nonradiological Risk Factors for Accidents (Bodily harm due to vehicle collisions)

Mode	Injuries/km	Fatalities/km
Truck	5.1E-07[a]	3.0E-08[a,b]
Rail	4.6E-07[a]	3.4E-8[a,b]

Notes:

[a]Data from Tables 6 and 7 of reference Rao, 1982. Injuries were calculated by multiplying fatality factors by ratios of injuries to deaths.

[b]Deaths at the scene of an accident or during initial hospital treatment.

Table 5-4 shows the cumulative annual nonradiological risk for shipments from SRP to WIPP. Truck assumptions are 43 shipments per year with average shipping distance of 1605 miles. Rail assumptions are 21 shipments per year with an average shipping distance of 1946 miles.

TABLE 5-4: Cumulative Nonradiological Risk for Annual Shipments[a]

Mode	LCFs[b]	Fatalities	Injuries
Truck (43 shipments)	1.1E-03	6.6E-03	1.1E-01
Rail (21 shipments)	8.5E-04	4.6E-03	6.2E-02

Notes:

[a]Calculated risks include the impact of the return trip from WIPP to SRP, assuming 5% of travel in urban areas.

[b]LCF's represent the calculated upper limit of latent cancer fatalities; this assumes all mortalities from incremental emissions of SO_x and particulates during operation of trucks or trains are latent cancer fatalities.

In incident-free transport, the shipment arrives at its planned destination on time without releasing its contents and without loss of any required shielding. The exposure of the public and workers to radiation arises only from the radiation allowed by the standards to penetrate the package. The onsite and offsite population surrounding the route may be exposed to radiation at very low dose rates. One analytical tool for calculating exposures to population groups is the computer code RADTRAN II* as referenced in studies by Madsen, in 1983 and 1984, and Taylor, in 1977 and 1982. In RADTRAN II, the assessment of population dose during incident free (normal) transport is based on the assumption that the source of radiation is either a point or line source of external penetrating radiation. In general, data needed for this assessment include:

- Shipment packaging type
- Transport Index (or some other measure of radiation level outside the package)
- Transportation mode
- Transport mode characteristics (crew size, speeds, dimensions)
- Route characteristics (length, number of stops, roadway type, population zones, etc.)
- Number of shipments

For truck and rail shipments of TRU wastes the truck drivers, train crew and people along the route are potentially subjected to low levels of radiation exposure. The crew members, people in the vicinity of the transportation vehicle while it is stopped, people surrounding the transportation link on which the vehicle is moving, and people sharing the transportation link with the vehicle are used with the RADTRAN II code to compute the total doses in person-rem.

---

* Sandia National Laboratory has recently developed the RADTRAN III version of the transportation analysis code by making further refinements to RADTRAN II which include: 1) an updated rail model incorporating revised rail stop times, and 2) an ingestion pathway model considering the impacts from accidental release of radionuclides. According to the TAGR report, preliminary computer runs, using the new rail model indicated that public exposure will be significantly reduced (by a factor of 140), while occupational impacts increased by a factor of three, but remained very small. Preliminary analysis using the revised ingestion model indicate that the ingestion dose commitment ranges from approximately 0.02% to 0.1% of the total accident impact which is already negligible when compared to the risk from normal transportation. Due to the insignificant changes in the magnitude of the transportation risks associated with the revision of the RADTRAN code, the transportation impacts presented in this EA remain valid.

Input data used for RADTRAN II calculations for radiological impacts of SRP shipments to the WIPP are shown in Table 5-5. Inventory values are those referenced in a 1984 DOE report, DOE/EIS-0108. Cumulative radiological risks were calculated for normal (incident-free) transportation for two radiation exposure scenarios: 2.0 mrem/hr at one meter from the loaded TRUPACT and 0.1 mrem/hr at one meter from the TRUPACT. Estimated radiological risks for truck and rail shipments are shown in Table 5-6. For comparison, radiological risks for accidents are shown in Table 5-6. The greatest risk during transportation is from trauma during vehicle collisions/accidents.

5.3 FACILITY ACCIDENTS

This section summarizes the impacts to the onsite and offsite population and offsite maximum individual from postulated accidents during retrieval operations in the burial ground and accidents at the TWF facility. Because the offsite non-nuclear effects of accidents are negligible, only the radiological effects are described.

5.3.1 RETRIEVAL OPERATIONS

The analysis of potential accidents which could occur during burial ground TRU waste management activities is discussed in the draft safety analysis report for burial ground operations. Although the analysis for TWF retrieval operations has not yet been completed, it is assumed to be similar to current operations. The five phases of the analysis include initiators, methodology, frequency, consequences, and risk. For the purposes of this EA, only the consequences of the potential accidents and what effects they have on onsite population, offsite maximum individual and offsite population will be discussed.

Natural Phenomena

Extremes in nature such as high winds, which encompass straight winds, hurricanes and tornadoes, could adversely impact the retrieval operations in the burial ground. Transuranic wastes to be retrieved are stored above ground on concrete pads. A four-foot layer of soil was mounded over the containers until mid-1985. Since then, waste containers placed on TRU pads are covered with tornado netting. The total number of drums on a TRU pad is approximately 4,500 drums, but the drums at greatest risk from high winds are those potentially exposed on the perimeter of the pad, up to 420 drums during retrieval operations. According to the safety analysis report for burial ground operations, the threshold damage speed for straight winds is 100 mph. Winds in excess of 100 mph would cause some drum damage and partial release of contents. According to this report, straight winds of 100 - 150 mph would result in 10%, or 42 of the exposed drums being ruptured. An estimated 10% of the contents of the 42 drums (0.5 Ci/drum) would become airborne since the drums contain a variety of alpha-contaminated solid waste some of which is not likely to be dispersed. An estimated 1% (based on DPSTSA-200-10, Supp. 8) of that released would be

TABLE 5-5: RADTRAN II Input Data

Parameter[a]	TRU Waste	
	Truck	Rail
Package Type	TRUPACT	TRUPACT
Package Waste Volume, m^3	7.5	7.5
Packages/Shipments	1	2
Transport Index (TI), mrem/hr[b]		
Evaluation a	0.1	0.1
Evaluation b	2.0	2.0
Package Length Dimension, m	4.69	4.69
Number of Drivers or Train Crew	2	5
Distance from Source to Crew, m	5	152
Speed, km/hr		
Urban Population Zone	24	24
Suburban Population Zone	40	40
Rural Population Zone	88	64
Stop Time per Kilometer, hr/km	.011	.086
No. of People Exposed While Stopped	50	100
No. of People per Vehicle Passing		
Near the Shipment	2	3
Population Density, People/km^2		
Urban Population Zone	3861	3861
Suburban Population Zone	719	719
Rural Population Zone	6	6
Dispersibility Category[c]	5	5
Velocity of Deposition, m/sec	.01	.01
Average Distance SRP to WIPP (miles)	1605	1946
% of Time in Population Zone		
Urban Population Zone	1.4	1.4
Suburban Population Zone	26.3	18.9
Rural Population Zone	72.3	79.7
Ci Content per Type B Package[d]		
Pu^{239}	136	136
Pu^{238}	3090	3090

TABLE 5-5: RADTRAN II Input Data continued

Notes:

a Parameters are as defined in the RADTRAN II guide (Madsen 1983).

b A range of TI values were used for both the truck and rail cases. The Transport Index (TI) is the radiation exposure rate at one meter in mrem/hr as defined in 49 CFR 173.403.

c Dispersibility categories were specified in order to model potential accidents resulting in the release of waste material. The dispersibility category determines the assumed fraction of waste which escapes in aerosol form and the fraction of aerosol less than 10 microns in aerodynamic diameter, which is potentially respirable. Wastes were conservatively modeled as a fine loose powder (Category 5).

d Curie content per Type B package for TRU waste is principally based on average site specific characterization data presented in reference DOE 1984.

TABLE 5-6: Cumulative Radiological Risk for Annual [a,b] TRU Waste Shipments (person-rem)

	100% Truck		Maximum Rail	
	Nonoccupational	Occupational	Nonoccupational[c]	Occupational
TI = 2.0 mrem/hr (i.e., dose rate is 2.0 mrem/hr @ 1 meter from the overpack)				
238 Pu Waste				
Normal	3.9	3.4	64	1.2E-01
Accident	7.6E-02		3.5E-02	
239 Pu Waste				
Normal	3.9	3.0	64	1.2E-01
Accident	2.4E-03		1.1E-03	
TI = 0.1 mrem/hr (i.e., dose rate is 0.1 mrem/hr @ 1 meter from the overpack)				
238 Pu Waste				
Normal	2.0E-01	1.5E-01	3.2	6.2E-03
Accident	7.6E-02		3.5E-02	
239 Pu Waste				
Normal	2.0E-01	1.5E-01	3.2	6.2E-03
Accident	2.4E-03		1.1E-03	

a Cumulative radiological risks are presented in terms of person-rem for normal transportation and accident conditions. Equivalent whole-body doses are calculated for accident case dose commitments to individual organs following the recommendations of the International Commission on Radiological Protection, Publication 26, January 1977. The number of latent cancer fatalities (LCF'S) may be estimated by multiplying by the dose conversion factor of 1.0E-04 LCFS/person-rem (ICRP, 1977).

b Occupational impacts quantify the doses received by the truck drivers and train crews.

c Calculated using RADTRAN II. Rail values will be much lower using RADTRAN III as explained in the footnote on page 5-7.

respirable; therefore, this event would result in a release of 2.1E-02 Ci (assumed to be Pu-238). In the extreme case of winds over 150 mph, 20% of the face drums would be ruptured and 4.2E-02 Ci would be released.

Failure of concrete culverts is not assumed to occur in even a 150 mph wind. Hence, drums requiring storage in the culverts are assumed to retain their integrity.

According to the safety analysis report for burial ground operations, the threshold damage speed for tornado winds is 113 mph. According to this report, during tornadoes with wind speeds in excess of 113 mph, drums may become airborne for short distances causing some of them to rupture. A windspeed of 113-157 mph is conservatively assumed to rupture 12% of the drums on the face of a half-filled pad or 50.4 drums. A tornado of 158-206 mph would rupture 25% of the drums on the face, or 105 drums. Using the same assumptions as for straight winds, the consequences would be 2.5E-02 Ci and 5.3E-02 Ci, respectively. The probabilities of tornadoes occurring at SRP with these wind speeds are 4.5E-05/yr and 4.0E-06/yr, respectively.

See Table 5-7 for a summary of the consequences from accidents occurring in the burial ground as a result of natural phenomena.

Process Related Accidents

Process related accidents are the direct result of burial ground operations; for example, criticality, fires and drum ruptures.

No criticality incidents have ever occurred at SRP; however, where fissile materials are present, potential criticality incidents cannot be precluded. A nuclear excursion would be no worse than an explosion with respect to the dispersal of particulate matter; and in this respect, the offsite consequences would be less severe than for fires. The greatest hazard of a nuclear excursion would be direct radiation to the operating personnel. However, the overall frequency for a nuclear excursion is so small that the risk can be ignored when compared to the risks from other abnormal events.

No fires have occurred in any SRP TRU waste storage drums or culverts during operations to date. However, fire is a serious hazard in the burial grounds because of the types of waste which are disposed of there. Fires in drums could arise from spontaneous combustion, drum rupture, lightning, vehicle crashes, or aircraft crashes.

The release due to fires will depend upon the quantity of material involved. The TRU pad could have as many as 4500 drums at one time. The quantity of TRU radionuclides in a 55-gallon drum placed directly on the pad is limited to <0.5 Curie so that the maximum quantity of TRU radionuclides on the uncovered pad would be 2250 Ci. Although large quantities of

TABLE 5-7: Summary of Consequences from Postulated Accidents in the Burial Ground[a]

Accident	Curies Released	Effective Dose Equivalent: Onsite Population (person-rem)	Effective Dose Equivalent: Offsite Population (person-rem)	Effective Dose Equivalent: Offsite Maximum Individual (mrem)
Winds; 100 mph[b]	2.1E-02	1.6E-01	4.4	6.3E-02
Winds; >150 mph[b]	4.2E-02	2.2E-01	6.3	7.3E-02
Tornado; 113-157 mph	2.5E-02	9.3	1.6E+01	1.3E-02
Tornado; 158-206 mph	5.3E-02	2.1E+01	3.5E+01	2.7
Fire; Drum in Culvert	1.7	9.3E+03	2.0E+04	4.4E+03
Fire; Drum on TRU Pad	5.0E-03	2.8E+01	6.1E+01	1.3E+01
Drum Rupture; Internally Induced	5.0E-03	2.8E+01	6.1E+01	1.3E+01
Drum Rupture; Externally Induced	5.0E-05	2.8E-01	6.1E-01	1.3E-01

[a] Estimated from the analysis of potential burial ground accidents reported in DPSTSA-200-10, Supp. 8.

[b] Straight winds.

radionuclides might be on the pad, few containers would actually be involved in a fire. It has been assumed that one 55-gallon drum would be involved in a TRU pad fire. Previous studies have shown that in the event of fire, only those combustion products less than 10 microns are likely to travel beyond the plant boundary. Waste producing combustion products smaller than 10 microns represents approximately 1% of the total material at risk or 5.0E-3 Ci (0.5 Ci/drum).

If a fire occurred in a culvert, it would have a consequence only while the culvert lid is off to load additional drums. However this could occur only in the TWF facility because culverts remain intact during retrieval and transport into the TWF facility. It is assumed to involve only one drum containing an average of 167 Ci of Pu-238; therefore, the release is 1.7 Ci since again only 1% of the total material is at risk.

No ruptures have occurred in the history of TRU waste storage at SRP. Potential for rupture from internal pressure buildup is present in TRU waste drums containing alpha activity in contact with cellulosic material. If drum rupture occurred from such overpressurization, a medium energetic dispersion of radioactive material could take place. As in the case of an internal fire, the drum lid seal would fail, allowing the overpressure to be relieved. Airborne, respirable, radioactive material released should not exceed 1% of the drum contents. Conservatively assuming a drum contents to be 0.5 Ci ^{238}Pu, a worst case release to the atmosphere is estimated to be 0.005 Ci ^{238}Pu.

Drum damage can result from corrosion during storage or from mishandling during transport. Mishandling can result in drums being dropped, crushed, punctured, or dented. The release from such accidents would be localized since insufficient energy is available to disperse the radioactive nuclides. However, the potential for operator exposure remains. It is estimated that 1.0% of the contents of the damaged container would be released and 1.0% of the release would become airborne or 5.0E-5 Ci ^{238}Pu.

See Table 5-7 for a summary of releases and dose commitments. For the maximally exposed offsite individual, the accident in the burial ground which results in the highest exposure is a fire in a culvert. The effective dose equivalent for this accident was calculated to be 4.4 rem which is well below the DOE guide of 25 rem for postulated accidental releases for nonreactor nuclear facilities.

The upperbound latent cancer risk to the total onsite and offsite populations would be about 3 additional deaths among the total 50-mile population which is expected to experience about 110,000 cancer deaths during the same time frame from unrelated causes. The maximum individual risk offsite would represent less than a 1% increase in normal cancer risk. Consequences of all other postulated accidents are so much smaller than this example that they do not require analysis. If the probability of these accidents occurring are considered, the likely risks are much smaller.

5.3.2 TWF FACILITY OPERATIONS

A safety analysis report has not yet been written for the TWF facility; therefore, the following discussion of potential accidents in the TWF facility is based on the analysis of potential processing accidents reported in the Safety Analysis Report-200 Area, Savannah River Plant Burial Ground Operations, Waste Certification Facility, DPSTSA-200-17, Rev. 1.

Table 5-8 lists a typical inventory of ^{238}Pu and ^{239}Pu in an average group of 50 drums of TRU waste.* This same inventory is assumed to be present in the TWF facility during the following accident scenarios.

The categories of abnormal events analyzed are the same as those analyzed in Section 5.3.1: natural phenomena and process related accidents. An aircraft crash or a criticality accident are not considered credible accidents because of the extremely low frequency of either incident occurring. According to the safety analysis report for ETWAF/WCF operations, the threshold damage speed for straight winds and tornado winds is 100 mph. Winds in excess of 100 mph would cause some facility damage and releases.

---

*The first phase of ETWAF/WCF operation will involve only newly generated TRU waste in 55-gallon drums.

TABLE 5-8: Typical Fifty-Drum Inventory

No. of Drums	Mass per Drum, g		Activity Content per Drum, Ci	
	^{239}Pu	^{238}Pu	^{239}Pu	^{238}Pu
15	0.001		0.0001	
2	0.001 to 0.1		0.0001 to 0.006	
5	0.1 to 1.0		0.006 to 0.06	
3	1.0 to 10.0		0.06 to 0.63	
2	10 to 50		0.63 to 3.1	
1	50 to 100		3.1 to 6.3	
1	100 to 150		6.3 to 9.5	
1	150 to 195[a]		9.5 to 12.3	
12		0.0 to 0.1		0.0 to 1.7
1		0.1 to 1.0		1.7 to 17
3		1.0 to 10		17 to 170
4		10 to 32[b]		170 to 560

The largest plutonium mass represented by this typical 50-drum inventory is:

^{239}Pu	580 g (in 30 drums that contain ^{239}Pu) =		37 Ci
^{238}Pu	160 g (in 20 drums that contain ^{238}Pu) =		2,768 Ci
Total	740 g		2,805 Ci

The average plutonium mass per drum[c] is:

^{239}Pu	15.06 g (for 30 drums that contain ^{239}Pu) =		0.95 Ci
^{238}Pu	5.08 g (for 20 drums that contain ^{238}Pu) =		87.9 Ci
Total	20.14 g		88.85 Ci

a The maximum fissile content in any one drum in the lag storage at the ETWAF is 195 g ^{239}Pu.

b The maximum alpha activity in any one drum in lag storage at the ETWAF will be 554 Ci (32 g ^{238}Pu).

c In the analysis, every drum was assumed to contain the average of both Pu isotopes.

See Table 5-9 for a summary of the consequences from postulated accidents occurring in the TWF and resulting doses to the onsite and offsite population and offsite maximum individual. The accident in the TWF facility resulting in the highest exposure to an offsite individual was determined to be a tornado (> 200 mph). The effective dose equivalent was calculated to be 2.0 rem which is well below the DOE guide of 25 rem. The upperbound latent cancer risk to the total onsite and offsite populations would be about 2 additional deaths among the total 50-mile population which is expected to experience about 110,000 cancer deaths during the same time frame from unrelated causes.

These numbers are assumed to be conservative because in the TWF facility steps will be taken to mitigate the consequences of serious accidents; for example, explosion resistant storage and processing areas, administrative control of process inventory and appropriate personnel protection (respirators and filter masks). Facility design will provide safeguards to prevent uptakes and ventilation system reversals which could cause contamination of clean areas.

5.3.3 TRANSPORTATION

The impacts that would result from transportation accidents are also calculated with RADTRAN II (see Section 5.2.4). Accidents that could compromise TRU package integrity are divided into those involving shipments of nondispersible materials, and those involving shipments of dispersible materials. In the first case, only direct exposure from shielding loss is of interest. In the second case, five doses are evaluated and summed--groundshine (external exposure from deposited material), cloudshine (external exposure from passing cloud), resuspension (inhalation of material deposited and then resuspended), inhalation (internal inhalation exposure from aerosolized material) and food ingestion. The sets of input data used in the RADTRAN II model calculations for accident scenarios are summarized in Table 5-10. The DOE TAGR report describes assumptions and details of input parameters and calculations.

The hypothetical maximum exposure to an individual from incident-free transportation of waste was calculated from each of the storage and generator sites. The analysis includes the following conservative assumptions:

- The maximally-exposed individual lives 30 m from a rail line or highway.
- The individual is exposed to <u>every</u> waste shipment leaving a specific site or arriving at the WIPP.
- Every shipment passes by traveling at 24 km/hr.

For the calculational procedure to estimate the maximum Dose Rate (DR) see the TAGR report.

TABLE 5-9: Summary of Consequences From Postulated Accidents in the TWF[a]

Accident	Curies Released ^{238}Pu	Curies Released ^{239}Pu	Effective Dose Equivalent: Onsite Population (person-rem)	Effective Dose Equivalent: Offsite Population (person-rem)	Effective Dose Equivalent: Offsite Maximum Individual (mrem)
Winds[b]					
100-150 mph	4.3	4.7E-02	5.1E+01	7.3E+02	1.1E+01
>150 mph	8.8	9.5E-02	7.3E+01	1.1E+03	1.8E+01
Tornadoes					
100-200 mph	5.2	5.7E-02	1.9E+03	2.8E+03	2.5E+02
>200 mph	4.4E+01	4.7E-01	1.5E+04	2.3E+04	2.0E+03
Earthquakes					
0.09-0.2 g	4.3E-02	5.0E-04	3.4E+02	4.3E+02	1.1E+02
Vehicle Crash	2.2E-02	2.4E-04	1.7E+02	2.1E+02	5.5E+01
Fire	8.7E-03	9.5E-05	7.3E+01	9.3E+01	2.5E+01
Drum Rupture					
Internal Pressure	4.3E-03	4.7E-05	3.4E+01	4.2E+01	1.1E+01
External Pressure	4.3E-05	4.7E-07	3.5E-01	4.3E-01	1.1E-01

[a] Estimated from the analysis of potential ETWAF/WCF accidents reported in DPSTSA-200-17, Rev. 1.

[b] Straight winds.

The TAGR report presents calculations of radiological impacts per shipment to the occupational workers and the population along transport routes for incident-free transportation and accidents of various severities and their probability of occurrence. Also calculated are cumulative radiological risks for shipments from SRP to WIPP assuming average truck and rail distances. The summary of annual cumulative radiological risks for SRP shipments are shown in Table 5-6.

The calculated annual maximum exposure to the individual living near WIPP and exposed to every SRP shipment to WIPP is calculated to be

- 0.0033 mrem, if the radiation level is 2.0 mrem/hr at one meter from the transportation vehicle,
- 0.00016 mrem, if the radiation level is 0.1 mrem/hr at one meter from the transport vehicle.

5.4 EMERGENCY PLANNING

DOE has developed a series of emergency response plans with full cooperation of state and county agencies to comply with DOE Order 5500 series emergency preparedness orders to respond to onsite incidents at SRP. Individual site-specific Radiological Emergency Response Plans for SRP have been coordinated and prepared for the states of South Carolina and Georgia. County level emergency response plans have also been prepared for an emergency planning zone. These plans can be implemented if an unplanned event occurs with radiological consequences above preset levels.

As described in Section 3.1.3, TRU waste is transported in shipping containers designed to withstand the most severe accidents without releasing their contents. However, as an added precaution to protect public health and safety during waste shipments to WIPP, overall emergency response plans and procedures are being developed by WIPP for transportation accidents. Individual states have emergency response plans for transportation accidents involving potentially hazardous and radioactive materials.

5.5 DECONTAMINATION AND DECOMMISSIONING

After the stored TRU waste has been retrieved and processed for transportation to WIPP, DOE will be able to decommission the TRU pads and close all the burial grounds at SRP according to DOE directives. No decontamination and decommissioning of other equipment or facilities presently in operation is expected as a result of the proposed TRU waste management activities.

TABLE 5-10: RADTRAN II Accident Input Data for Waste Shipments[a]

Transport Mode[b]	Accidents Rates		
	Urban	Suburban	Rural
Truck (Accidents/km)[b]	1.6E-05	2.7E-06	1.4E-07
Rail (Accidents/Railcar-km)[b]	1.3E-05	3.0E-06	1.5E-07

	Accident Severity Categories							
	1	2	3	4	5	6	7	8
Severity Fraction[b]								
Truck								
Urban	5.8E-01	3.8E-01	2.8E-02	6.4E-03	7.4E-04	1.5E-04	1.1E-05	9.9E-07
Suburban	4.4E-01	2.9E-01	2.2E-01	5.1E-02	6.6E-03	1.7E-03	6.7E-05	5.9E-06
Rural	4.6E-01	3.0E-01	1.8E-01	4.0E-02	1.9E-02	6.5E-03	5.7E-04	1.1E-04
Rail								
Urban	5.7E-01	3.4E-01	7.7E-02	7.7E-02	5.1E-04	1.9E-05	8.6E-06	7.2E-07
Suburban	3.1E-01	1.9E-01	4.5E-01	4.5E-02	3.4E-02	1.6E-04	3.8E-05	3.1E-06
Rural	3.6E-01	2.1E-01	3.9E-01	3.9E-02	6.4E-03	6.5E-04	3.4E-04	6.4E-05
Release Fraction[c]								
TRU	0.0	0.0	1.0E-06	1.0E-05	1.0E-04	1.0E-03	1.0E-02	1.0E-01
Aerosol Fraction[d]	0.0	0.0	1.0E-01	1.0E-01	1.0E-01	1.0E-01	1.0E-01	1.0E-01
Respirable Aerosol[d] Fraction	0.0	0.0	5.0E-02	5.0E-02	5.0E-02	5.0E-02	5.0E-02	5.0E-02

TABLE 5-10: RADTRAN II Accident Input Data for Waste Shipments[a] (continued)

Notes:

[a]Numbers are expressed in abbreviated scientific notation:
1.6E-05 = 1.6×10^{-5}.

[b]Accident frequency factors and the distribution of accident severity categories by population zone are RADTRAN II default values and represent the best available data (DOE, 1986).

[c]Fraction of material released is based on discussion presented in text of TAGR.

[d]Aerosol and respirable fractions are RADTRAN II default values for fine, loose powder waste forms used to model all waste shipments.

After retrieval of the stored TRU waste from SRP burial grounds, the ground surface and underground would be returned to nearly their original condition using decontamination and dismantling. No special provisions for decontamination and decommissioning will be required for the TWF facility. Upon decommissioning, the TWF facility and its process equipment will be decontaminated, dismantled, and packaged for disposal.

5.6 SAFEGUARDS AND SECURITY

Safeguards considerations for H-Area and the burial grounds include physical security and material control and accountability. The principal requirements are contained in DOE Orders 5630.1, 5630.2, 5632.1, and 5632.2.

5.7 CUMULATIVE IMPACTS

The principal cumulative impact from the proposed TRU activities, including construction and operation of the TWF facility will be removal of radioactive TRU waste from storage pads and processing it for emplacement at WIPP, thus eliminating the risk of groundwater contamination or air emissions resulting from container failure, and reducing risks to the environment. The TWF facility will enable SRP to process TRU waste for shipment to WIPP and thus close all SRP burial grounds according to DOE directives. Increases in environmental effects during retrieval and processing operations will be negligible, and well below applicable State and Federal standards.