

# EA-1135; Environmental Assessment for Offsite Thermal Treatment of Low-level Mixed Waste

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## Summary

The US Department of Energy (DOE) needs to treat contact-handled low-level mixed waste (LLMW), containing polychlorinated biphenyls (PCBs) and other organics, to meet existing regulatory standards for eventual disposal. Part of the Hanford Site LLMW to be treated is being stored at Hanford Site's 200 West Area, and the rest will accumulate and be added to the stockpile between now and the year 2010. Treatment of the waste would reduce its volume by approximately 90 percent.

Treatment followed by land disposal would reduce long-term surveillance and maintenance burdens at Hanford Site and would be in compliance with interagency agreements. Allied Technology Group, Inc. (ATG), a commercial company, would transport the waste to its gasification and vitrification facility for treatment and return the treated waste to Hanford Site for disposal.

The proposed action and the no action alternative are analyzed in detail. Additional alternatives are discussed but not analyzed in detail because, for reasons identified, have been determined to be infeasible. These alternatives include the construction of a treatment facility at Hanford Site's 200 West Area; treatment of the waste at either an existing facility or at a proposed facility at the Idaho National Engineering Laboratory, Idaho Falls, Idaho; and treatment at a proposed

facility at Oak Ridge, Tennessee. All action alternatives include the assumption that the treated waste would be returned to Hanford Site for disposal, as under the proposed action.

Under the no-action alternative the waste would continue to be accumulated and stored at Hanford Site. The need to treat the waste so that it may be safely disposed of would not be met. A treatment facility that previously had been considered for Hanford Site would have reduced transport distances to near zero, but that proposal was rejected by DOE as being too costly. Transport of the waste to Idaho or Tennessee for treatment would increase the risk of public and worker exposure because of the increased transport distances.

The potential for individual and cumulative environmental impacts from the proposed action has been analyzed and no substantial adverse environmental effects have been identified. Analyses of postulated accident scenarios have concluded that accident risks associated with the proposed action would be small.

Quantitative evaluations were performed of dose and risk to the public and workers from radioactive materials or hazardous chemical releases during incident-free transport and normal operations. Evaluations were also performed of the dose and risk for accident scenarios for transport and treatment operations. These evaluations involved the use of modeling to predict environmental impacts.

Modeling of radiological exposures predicted that a member of the public receiving the maximum exposure during 10 years of incident-free transport would receive less than 0.01 percent of the maximum allowable dose from a licensed nuclear facility during one year of operation. Annual worker exposure is predicted to be less than 0.25 percent of the annual limit for workers. No observable health effects are predicted to result from incident-free transport. Predicted public and worker radiological exposures from an accident occurring along the rural transport route are small fractions of the regulatory limits. No observable health effects are expected to result from transport accidents. The predicted exposures for both incident-free and transportation accidents are based on the results of the transportation model RADTRAN 4.

Excess cumulative cancer risk for the maximally exposed individual member of the public and for workers from exposure to nonradiological chemical constituents in the building stack emissions are predicted to be less than one in a million. None of the modeled pollutant concentrations approach or exceed relevant state or federal air quality standards or ambient concentration guidelines. These conclusions are based on results from the air dispersion model ISCST3, maintained by the US EPA.

Ten years of normal processing is predicted to expose an individual member of the public to less than 0.02 percent of the annual regulatory radiological limit for air exposures (100 millirem) and less than 0.002 percent of the annual limit for total radiological exposure. Worker exposure is predicted to be less than 0.000004 percent of the annual regulatory limit for workers (5,000 millirem). As for transportation, no health effects that would be observable in the local population are expected to result from 10 years of normal processing. As for chemical exposures, the excess cumulative cancer risk was modeled for both residential and worker scenarios and was found to be less than one excess cancer per one million exposed population. This is less than the standard of significance, which is one excess cancer per 100,000 exposed population. These results are based on the results of the air dispersion model GENII developed at the Pacific Northwest National Laboratory.

Predicted exposures resulting from the accidental release of the entire contents of the main process chamber into the gasification and vitrification building, the worst-case credible accident scenario, are less than 0.01 percent of the limit established by the US Department of Energy for major credible accidents. As for transportation, no observable health effects are expected to result from a worst-case credible accident.

## **Section 1 Purpose and Need for Agency Action**

The US Department of Energy (DOE) needs to treat contact-handled low-level mixed waste (LLMW), containing polychlorinated biphenyls (PCBs) and other organics, to meet existing regulatory standards for eventual disposal.

### **1.1 Background**

Radioactive and hazardous waste is stored at DOE's Hanford Site located near Richland, Washington (Figure 1-1). The waste inventory includes contact-handled LLMW, which is made up of both low-level radioactive and hazardous constituents. Some of the Hanford Site LLMW contains organic constituents such as solvents and PCBs that require thermal treatment to meet regulatory standards for disposal. Thermal treatment by gasification and vitrification would also result in waste volume reduction and a highly stable form for disposal (Place 1993).

This Hanford Site waste was both generated at Hanford Site and received from other Department of Defense/DOE sites. Contact-handled LLMW is in containers with surface radiation dose rates below 200 mrem/hr (mrem per hour).

Approximately 810 m<sup>3</sup> (1,060 yd<sup>3</sup>) of such waste has accumulated and an additional estimated 4,310 m<sup>3</sup> (5,637 yd<sup>3</sup>) is expected to be added by 2010 from Hanford Site cleanup.

Thermal treatment before disposal is required for some constituents of this Hanford Site LLMW under the Resource Conservation and Recovery Act (RCRA) (42 United States Code 6901 et. seq.), State of Washington Administrative Code, Dangerous Waste Regulations (WAC 173-303), Washington State Hazardous Waste Management Act (WSHWMA) (Chapter 70.015, Revised Code of Washington [RCW]), and Toxic Substances Control Act (TSCA) (15 USC 2601 et. seq.). Under RCRA land disposal restrictions (40 Code of Federal Regulations [CFR] 268.50), some LLMW is suitable for land disposal only after thermal treatment and/or stabilization.

### [Figure 1-1 Project Area](#)

## 1.2 Supporting Studies

Several reports have been prepared to support the environmental analysis presented in this report. These reports include:

- Radiological Dose Assessment of ATG low-level Mixed Waste Facility (Leung 1996);
- ISCST3 Air Dispersion Modeling Results for the ATG Gasification and Vitrification Facility (Sculley 1996);
- RADTRAN 4 Modeling Results for Transport of LLMW from the Hanford Site 200 West Area to the ATG Gasification and Vitrification Facility (Deshler 1996);
- Low Level Mixed Waste Thermal Treatment Technical Basis Report (Place 1994);
- Emissions Data Summary for the PEAT TDR System Processing Contaminated Dunnage (Castellon and Taylor 1996a);
- Emissions Data Summary for the PEAT TDR System Processing Medical Waste (Castellon and Taylor 1996b); and
- Emissions Data Summary for the PEAT TDR System Processing Ash Waste (Castellon and Taylor 1996c).

The reports are available to review at the DOE Public Reading Room at Washington State University at Tri-Cities campus, Richland, Washington.

## Section 2 Description of the Proposed Action

The proposed action is to transport up to 5,120 m<sup>3</sup> (6,696 yd<sup>3</sup>) of contact-handled low-level mixed waste from Hanford Site to the ATG gasification and vitrification building in Richland, Washington, for treatment (see Table 2-1), and to return the treated waste to Hanford Site for disposal. The waste (characterized in Place 1994) would be staged to the ATG gasification and vitrification building over a 10-year period. The building is on a 45-acre ATG site adjacent to ATG's licensed low level waste processing facility at 2025 Battelle Boulevard, approximately 0.3 kilometers (0.2 miles) south of Horn Rapids Road (Figure 2-1). The ATG gasification and vitrification building is located adjacent to the DOE Hanford site boundary in an industrial area in the City of Richland. Impacts of ATG gasification and vitrification building operations are addressed in Section 5 of this document as it relates to the treatment of Hanford Site LLMW. Effects of construction and overall operation of the building is being evaluated under the Washington State Environmental Policy Act (SEPA). The ATG gasification and vitrification building siting and construction are not analyzed in this document. The SEPA environmental checklist for the ATG gasification and vitrification building is being prepared. Construction of this facility is not within the scope of this environmental assessment (EA). The action is being undertaken as a private action in anticipation of future work for a variety of contracts, including DOE. ATG would

proceed with the facility whether or not the Hanford Site LLMW is included. Treating the Hanford Site LLMW will require the use of no more than 25 percent of the capacity of the facility.

After the Hanford Site LLMW is treated, the residue from the treatment, a leach-resistant glass material, would be returned to Hanford Site and disposed of in a disposal facility. Treated waste would be returned to Hanford Site when a sufficient amount for a full shipment has accumulated.

## [Figure 2-1 ATG Gasification and Vitrification Building Site and Vicinity Features](#)

### **2.1 Waste Transport**

Untreated waste is, or will be, stored at Hanford Site's 200 West Area, approximately 33 kilometers (20 miles) northwest of the ATG gasification and vitrification building (Figure 2-2). The ATG gasification and vitrification building is located south of the existing ATG nonthermal treatment building (Figure 2-3).

The proposed ATG gasification and vitrification building and the nonthermal treatment building, along with covered waste storage buildings and other structures shown in Figure 2-3, comprise a mixed waste treatment facility. Both wastes to be gasified and vitrified in the ATG gasification and vitrification building and wastes to be stabilized in the nonthermal treatment building will be stored in covered waste storage buildings. The area where the covered waste storage buildings will be located is shown in Figure 2-3.

## [Figure 2-2 Waste Transport Route](#)

## [Figure 2-3 ATG Mixed Waste Facility Site Plan](#)

ATG would transport the waste to and from the facility by truck. Approximately 95 percent of the **32-kilometer** (20-mile) transport route would be on Hanford Site. ATG's waste transport operations are required to meet all safety requirements of the Department of Transportation (DOT) and the WSHWMA. Treated waste would be returned to 200 West Area for land disposal. The 200 West Area contains a RCRA compliant radioactive mixed waste land disposal facility consisting of two disposal trenches, each capable of accepting between 5,810 m<sup>3</sup> and 21,407 m<sup>3</sup> (7,600 yd<sup>3</sup> and 28,000 yd<sup>3</sup>) of waste depending upon the configuration of the waste received from ATG and other sources. The facility will be opened when the volume of accumulated waste justifies operation of the leachate collection system (WHC 1995).

All waste transport truck drivers would be required to be trained in proper waste handling, regulatory compliance, and spill emergency response procedures. ATG health and safety technicians would dispatch trucks, check safety equipment (lights, brakes, signals, tires), and ensure that vehicles are in compliance with applicable DOT regulations applicable (49 CFR 171, 172, 173, 177, 178). Health and safety technicians would also accompany trucks on all trips.

### **2.2 Waste Handling**

Handling covers packaging or repackaging, loading, receiving and inspecting, assaying, sorting, and tracking.

#### **2.2.1 Repackaging and Loading**

The operator would load waste containers from temporary storage at 200 West Area onto ATG trucks. Some waste may need to be repackaged at Hanford Site Central Waste Complex or T-Plant before being shipped to the ATG gasification and vitrification facility. ATG would be required to follow all DOE environmental, health, and safety requirements during the waste handling and loading operations. Waste containers would also be profiled and manifested according to all DOT, RCRA, and WSHWMA regulations governing transport of wastes.

#### **2.2.2 Inspecting and Assaying**

ATG waste acceptance would follow procedures specified in an approved radioactive materials license (State of Washington, WN-I0393-1) and RCRA final facility permit for the characterization of the waste's radioactive, chemical,

and physical properties. Waste manifests would assure that the waste does not exceed the limits permitted by ATG's permits and licenses. If the waste characterization shows higher levels of radioactive or hazardous constituents than permitted by the facility's permits and licenses, the waste would not be accepted but would be returned to the generator (i.e. Hanford Site). Facility inspectors would also confirm that the waste is suitable for treatment by gasification and vitrification. Each waste container would be labeled, bar-coded, and its properties logged into a computerized database. After treatment, waste containers would be reexamined and certified for transport and disposal.

### **2.2.3 Waste Constituents**

The incoming LLMW would contain hazardous constituents regulated both by RCRA and TSCA. RCRA wastes to be accepted by the ATG facility would include both listed and characteristic wastes. Some waste may qualify as TSCA waste due to the presence of PCBs.

### **2.2.4 Tracking**

Waste units would be tracked throughout the ATG shipping and treatment activities with the help of automated data systems. Workers handling, receiving, inspecting, and assaying the waste would log in the times, dates, and locations of each transaction and waste type, volume, and weight.

## **2.3 Pretreatment**

For some material, ATG would sort and size-reduce the waste material as needed.

## **2.4 ATG Gasification and Vitrification System and Operation**

The function of the ATG gasification and vitrification system is to: 1) destroy toxic and non-toxic organics; 2) reduce the waste volume; and, 3) vitrify the inert and radioactive residues from the destruction process. The system by-product is a fuel gas, referred to as synthesis gas or "syngas," that is treated and converted to a stabilized form, water and carbon dioxide before being discharged to the atmosphere. The ATG gasification and vitrification system components include: 1) a feed system; 2) a plasma torch, 3) a process chamber; 4) a three-stage syngas treatment and conversion system consisting of a filter, an acid gas scrubber, a syngas converter, a pre-filter bank, a high energy particulate (HEPA) filter bank, and an activated carbon filter bank; and 5) an emission monitoring system consisting of a continuous emissions monitor and a continuous activity monitor. A schematic diagram of the process is shown in Figure 2-4. System operations are described below. The equipment list and proposed layout of the ATG gasification and vitrification facility are shown in Figure 2-5.

### **2.4.1 System Description**

The process would accomplish two distinct operations, gasification and vitrification, simultaneously. Organics in the waste would be gasified in the absence of oxygen (reducing environment) to produce a fuel gas called syngas.

Inert wastes (metals and minerals) would be melted and incorporated into a leach-resistant vitrified product. Unlike a combustion process that produces heat, gasification and vitrification absorbs heat (endothermic) and thus requires an outside heat source. In the system to be employed by ATG, the outside source of heat would be produced by a plasma torch. The heat from the torch would convert the organic waste into its constituent elements such as carbon, hydrogen, and chlorine. Steam would then be introduced into the chamber, allowing the gasification (or steam reforming) reaction to take place. In some input wastes there would already be sufficient water within the matrix, and thus no added steam would be needed.

[Figure 2-4 Diagram of ATG Gasification and Vitrification System](#)

[Figure 2-5 ATG Gasification and Vitrification Building Equipment Layout](#)

The plasma torch would also provide the energy for vitrification. The heat would melt the inorganic material, and inorganic residues would be collected in the bottom of the process chamber and mixed with molten glass, which solidifies upon cooling. The vitrified product is a highly leach-resistant and durable glass/rock material. Glass formers and fluxes (to maintain a low glass viscosity) would be introduced into the process chamber to create the glass chemistry.

The syngas by-product discharged from the process chamber would be a mix of hydrogen, carbon monoxide, steam, acid gases, particulates, and low temperature vaporized metals. This mixture would be discharged from the process chamber at temperatures between 593 and 760C (1,100 and 1,400F). The syngas would be treated and cleaned, converted to water and carbon dioxide, and released.

A three-stage process, described in the following section, would filter out nearly all of the syngas impurities, convert the purified gas into water and carbon dioxide, and refilter the gas before discharge. A first stage filter would remove larger particulates. A second stage scrubber would remove acid gases (such as chlorine and fluorine), non-volatile or semi-volatile metals, and some particulates not removed by the first stage filter. In the third stage, the scrubber gas would be oxidized, converting the syngas to water and carbon dioxide. The water and carbon dioxide would then be filtered through a bank of pre-filters, HEPA filters, and activated carbon filters. After carbon filtration the gases would be discharged via the building stack with the building ventilation exhausts, and emission monitors would measure critical parameters stipulated in the facility permits.

In order to provide glass fluxing agents to aid in the vitrification process, certain chemicals would be added to the waste stream. These chemicals would vary according to the specific waste being treated. In general, the chemicals would be inert organics such as lime, soda ash, borax, and lithium carbonate (Barkley, Tom, 30 August 1996, personal communication).

As a means of treating LLMW, the ATG gasification and vitrification process has several advantages over incineration. First, gasification and vitrification produces a glass-like product that is virtually impervious to leaching. Second, occurring in the absence of oxygen, the ATG gasification and vitrification process requires no air and reduces by-product gas volume by 80 to 90 percent, allowing the use of smaller equipment with less waste in the system at any given time and thereby reducing the risk from a postulated accidental release scenario. The process chamber and by-product gas treatment system is smaller, safer, and simpler to maintain than an incinerator. Third, the absence of oxygen in the by-product gas nearly eliminates the possibility of reformation of toxic chlorinated organics such as dioxins and furans.

Treatment of wastes by an incineration process, by contrast, would occur in an oxygen-rich environment resulting in the combustion of the waste and the production of ash. Ash may require additional treatment to reduce leaching before it can be adequately disposed of. Also, the oxygen-rich environment makes it possible for toxic chlorinated organics to form in the incinerator by-product gas, thereby requiring additional gas filtration steps.

#### **2.4.2 Operations Description**

**Waste Acceptance.** As required, all of the waste shipped to the ATG gasification and vitrification facility would have been characterized by the Hanford Site contractor according to the applicable DOT, RCRA/TSCA and WAC treatment codes. At the ATG gasification and vitrification facility the waste character would be confirmed prior to the decision to accept the waste for treatment. Only waste meeting the requirements of ATG's radioactive license granted by Washington State Department of Health, and ATG's TSCA, RCRA, and other required permits would be accepted for treatment.

**Waste Feed Subsystem.** Upon acceptance solid waste would be sorted by compatible batches, loaded into mobile hoppers, taken to the feed area where the hoppers would be emptied into the solids feeders. Solids would be fed into the unit either by use of a tapered-auger to compress and form a plug, or by a ram feeder for solids that are not compressible. For auger feeding, the waste would be emptied into an airlock feeder unit above the auger. The feeder would convey the solids at a controlled rate into the ATG gasification and vitrification process chamber. Sludges and liquid wastes would be pumped into the process chamber through a pipe. The feed subsystem would be equipped to prevent gases from escaping the process chamber by a double lock-hopper, which would maintain a seal between the process chamber and the room environment during feed cycles.

**Plasma Torch.** A plasma torch on top of the process chamber would provide the low volume high energy heat source needed for ATG gasification and vitrification. The torch would transfer electrical energy to a carrier gas (nitrogen) to generate a continuous electric arc. The temperatures surrounding the arc would be in the range of 1,371 to 1,649C (2,500 to 3,000F), which is sufficient to produce the gasification reactions of steam with the toxic and non-toxic organic materials. The actual operating temperature within the range depends on the composition of the waste feed. The plasma torch also would provide the energy to vitrify inorganic wastes.

The torch for this thermal treatment system would require approximately 450 kilowatts of power. The torch system would be cooled by chilled water in a closed loop system. The torch would be retracted and inserted into the process chamber by an automated mechanism. During an upset condition, such as accidental interruption of cooling water, the torch would be automatically retracted to a safe position. The torch would contain a consumable tip that is subject to routine maintenance, and replacement after about 500 hours of use. A spare torch assembly would be provided for reliability, so that when one torch requires maintenance the other can be used.

**Process Chamber.** The ATG gasification and vitrification process chamber would be a refractory lined cube with internal dimensions of approximately 4-ft square. Four types of inputs would enter the chamber and two major outputs would be discharged. The inputs would be: 1) waste; 2) glass forming materials and fluxes; 3) steam; and, 4) nitrogen gas. Propane gas would also be an input but only for the initial warm-up period. The process outputs would be: 1) molten glass/rock and metals; and 2) syngas. The 23-centimeter (9-inch) thick chamber refractory would insulate the vessel and contain the glass. The vessel would operate in a totally reducing (in the absence of oxygen) environment at a slight vacuum. The front part of the chamber would serve to perform the initial gasification of organics and vitrify the inorganic material. The back section would complete the gasification reactions, provide turbulence for the steam reforming reactions, and provide additional residence time for the reactions.

**Vitrified Product Packaging.** Vitrified product from the ATG gasification and vitrification chamber would be drained through a special tap into a casting mold or a disposal container. The draining operation would be within a negative pressure enclosure that would exhaust to the converter unit. The molds or containers of vitrified waste would then be moved to a cooling and examination station. The Hanford Site waste feed would have an average bulk density of about 347 kg/m<sup>3</sup> (589 lbs/yd<sup>3</sup>). Approximately 44 percent of this waste would be organic material, 40 percent minerals, and the remainder metals. The vitrified Hanford Site waste product would have a bulk density of approximately 2,650 kg/m<sup>3</sup> (4,495 lbs/yd<sup>3</sup>). Based on these values, the volume of the waste feed is estimated to be reduced by a factor of approximately nine to one. This means that the incoming Hanford Site waste quantity of 5,120 m<sup>3</sup> (6,696 yd<sup>3</sup>) cubic meters to be treated by ATG over a ten-year period would be reduced to approximately 610 m<sup>3</sup> (793 yd<sup>3</sup>) of vitrified product. This estimate takes into account a volume of additives averaging 25 percent of the feed mass for the purpose of maintaining the glass chemistry. In addition to the vitrified product, secondary waste from the syngas processing must also be considered.

**First Stage Syngas Processing.** The syngas exiting the process chamber would contain particulates-including unreacted carbon, mineral particulates, and radioactive particulates-as well as acid gases and volatile metals. These materials would be mostly removed through the multi-stage treatment and conversion process. The first-stage of this processing and conversion process would filter out larger particulates, which would be returned to the gasification and vitrification chamber to increase the vitrified waste capture and the conversion of carbon to carbon monoxide. Dry sorbents may be injected prior to the filters to scrub acid gases. The salts and particulates formed in the dry scrubbing operation would subsequently be Removed and stabilized.

**Second-Stage Syngas Processing.** As the first-stage processing unit would not remove all radioactive and non-radioactive volatile metals and acid gases, the gas would next pass through a wet scrubber device with a sorbent, such as caustic solution, to neutralize the acid gases. The salt solution generated from this neutralization would then be precipitated, and the sludge removed and stabilized. The volume of stabilized waste from processing this Hanford Site waste is estimated to be approximately 520 m<sup>3</sup> (680 yd<sup>3</sup>). The supernatant liquid from the scrubber bottom would be recycled and reused in the scrubbing process. Sorbent injection and scrubber liquid discharge lines would be equipped with devices to prevent syngas backflow.

**Third-Stage Syngas Processing.** After undergoing second stage processing, the carbon monoxide and hydrogen in the syngas would be converted to carbon dioxide and water through oxidation, and then be filtered again by being passed through HEPA and carbon filter banks.

**Syngas Conversion.** Syngas would be converted to carbon dioxide and water vapor in an insulated chamber filled with a heat exchange media such as silica/alumina pebbles. The temperature of the media would initially be raised to approximately 649 to 927C (1,200 to 1,700F) by a propane powered process heater. Once the media in the front of the chamber reaches this operating temperature, a mixture of syngas and air would be admitted. The heat of the media would cause the syngas and air to react, generating heat in the back of the chamber. Using a cycling technique referred to as regenerative conversion, a four-way valve automatically cycles the incoming air/syngas point of entry from the front to the back end of the chamber, thereby using heat stored in the converter heat exchange media to maintain a continuous conversion process. If the syngas in the incoming gas mixture should drop below the required concentration, additional fuel from an exterior source (propane) would automatically be injected, ensuring that the heat exchange media temperature would be maintained within the required syngas operating range.

**HEPA/Activated Carbon Filtration.** The carbon dioxide and water vapor discharged from the converter would be cooled to approximately 121C (250°F) by a water quench device and released to the building ventilation exhaust duct plenum. This duct would mix the vapor with the building ventilation air and direct the total flow through the final filter banks. These banks would consist of sets of pre-filters, HEPA filters, and carbon filters. The pre-filter and HEPA filter banks would provide a 99.97 percent efficiency for removal of particulates greater than 0.3 micron in size. The carbon filter bank would capture fugitive organics that may have escaped the previous treatment steps. Spent HEPA and charcoal filters would be replaced approximately once a year, compacted, and sent for disposal.

**Emission Monitoring.** The exhaust from the HEPA/Charcoal filter banks would be discharged through the building stack. The stack would be equipped with continuous emission and continuous activity monitors to ensure compliance with emissions limits, including the radioactivity limits of the Clean Air Act (CAA), the Washington State Department of Ecology (Ecology), and the Washington State Department of Health (WSDOH).

### 2.4.3 Safety Features

The ATG gasification and vitrification system would include features to ensure that the process would safely shut down if a critical utility (i.e., electricity, service water, process/instrument air, steam or nitrogen) were to be interrupted or a key component fail. A description of these safety features is presented below.

**Automatic Safe Shutdown.** The ATG gasification and vitrification system would have an automatic safe shutdown feature. A computerized control system connected to a series of sensors would automatically shut the system down should an undesirable process condition or key component failure be detected. The following actions would occur: 1) all waste feeders would stop and connections to the process chamber isolated; 2) plasma torch power and gas flow would be cut-off; and, 3) the plasma torch would be lifted out of the process chamber, and the process chamber opening isolated by closing a valve. The safe shutdown process is accomplished using stored energy, therefore, safe shutdown would occur even with an electric power interruption.

**Post Shut-Down Syngas Handling.** Once a safe shutdown is initiated, feedstock would cease entering the chamber and power to the torch would be cut off. The chamber's refractory walls and the molten bath would contain sufficient thermal energy to gasify up to approximately 9 kilograms (20 pounds) of the waste remaining in the chamber, however. Process calculations show that after the shutdown gasification would continue for approximately 3 minutes. The system would continue to process the syngas produced as follows: 1) the syngas fan powered by an emergency power system would move the residual syngas through the treatment process; 2) the flow of syngas would ensure that the first-stage filter would perform its basic function; 3) the quench tank would revert to its back-up water supply to quench the gas, 4) the scrubber tank would have sufficient reserve capacity to supply the water and sorbent needed to scrub the residual syngas; 5) the converter heat exchange media would have sufficient thermal energy to convert the residual syngas into carbon dioxide and water; and 6) the building ventilation fan, empowered by an emergency power unit, would perform the normal HEPA/charcoal filtration and discharge of the converter effluent.

**Emergency Power Supply.** As indicated above, safe shut-down components such as the syngas fan, the scrubber pump,

and building exhaust fans, would be connected to an emergency power system. This system would consist of a diesel or natural gas powered generator and an uninterruptible unit that would supply power to critical system components should there be an accidental offsite power interruption.

**Protection Against Pressure Surges.** The system would also ensure safe shutdown in the event of a rapid or instantaneous pressure surge. Such a pressure surge could be caused by an inadvertent introduction of a high energy feedstock into the process chamber or a premature oxidation of syngas in the low temperature sections of the syngas treatment components, such as the scrubber. The latter event could occur by an air inleakage combined with the presence of an ignition source such as a spark- a double event scenario which is highly unlikely. To prevent such an event, both air inleakage prevention and spark arrest features would be included in the design. As an additional safety measure, rupture discs would be installed at the scrubber and quench tanks. In the event of an air/syngas reaction, the pressure surge would cause the rupture disk to open, releasing pressure to a separate duct connected to the inlet of the converter. Any relieved gas would be oxidized in the converter and filtered by the HEPA/charcoal filters before it would be released. The pressure surge will also activate the safe shutdown, as discussed above. Before restarting the system after any such shutdown, the rupture disc would be replaced.

**Syngas Leakage.** The process would operate at a negative pressure with respect to the room pressure. As an additional safety measure, sensors would be located outside the process lines to detect and alert the operators of any syngas leakage.

**Water Spillage.** The ATG gasification and vitrification system would be installed on a coated concrete floor with a 14 to 30-centimeter (6 to 12-inch) high perimeter curbing to provide a secondary containment system in accordance with RCRA standards. The curbed floor area would have a sufficient capacity to meet Uniform Building Code requirements for containing water from the automatic fire sprinkler system plus the capacity of storage tanks. The floor is constructed with expansion joints to prevent cracking and is coated with a chemical-resistant coating designed to prevent break through of the most reactive chemical stored for a minimum of three hours. Spills would be contained within the secondary containment floor and directed by the sloped surface toward a dry sump with a leak sensor and an alarm. In case of a spill, the plant operators would immediately implement corrective measures to stop the leaks and contain and cleanup the spilled substance.

## **2.5 Empty Container Cleaning**

Empty containers would be rinsed with high-pressure lances and hydrolyzing devices, as specified in WAC 173-303-160. The empty containers would be placed upside down over a hydrolyzer in an airtight cubicle. The activated hydrolyzer would remove surface contamination both on the inside and outside of the containers. Rinsing agents or solvents may be added to the rinse fluid as needed.

The cleaned containers would be removed and compacted for disposal or sent intact to Hanford for reuse. Contaminated liquids would be sent to a filtration unit. Filtered water would be reused and filter sludge sent to the ATG gasification and vitrification unit. Air withdrawn from the treatment cubicle would be passed through HEPA filters to remove airborne particulates, and the filters processed in the ATG gasification and vitrification unit.

## **2.6 Certification and Shipping**

Certification and shipping consists of receipt, assay, certification, and loading of treated waste. Packaged waste from the treatment process would be examined, tagged, logged, recorded, and sent for assay and certification. Containers would be examined using radioassay devices to measure alpha, beta, and gamma radioactivity and would be classified in accordance with transportation, storage, and disposal criteria. The containers would be weighed and measured to determine waste density. Each container would be labeled, and its contents logged into a computerized database. After inspection, containers would be moved to a temporary storage area to await shipment.

## **2.7 Worker Health and Safety**

The entire ATG processing and handling area would be kept under slight negative atmospheric pressure to prevent the

escape of radioactive particles. An induced draft fan system would withdraw air from the processing area at a constant rate. An intake filter would remove suspended particulates from incoming air. Air drawn from the confinement area would be passed through HEPA filters to remove particulates down to submicron size before atmospheric discharge.

The processing area and any other areas where radioactivity might be encountered would be monitored to protect workers, general public health and safety, and the environment. Radioactive exposures would be prevented to the extent possible and would be maintained below established safety limits. Area radiological monitors would be located at workstations and in areas where radioactive material could accumulate. Also, monitors would be placed at air discharge points to continuously record the quality of the released air.

## 2.8 Support Systems

The mechanical and utility systems would support the treatment operation. These systems include ventilation, building heat, emergency power generation, and water. The electrical and control systems would support the treatment and mechanical operations. These systems would include a motor control center, control panel and room, electrical transformers, building lighting, communication systems, and electrical distribution systems.

## 2.9 Transportation, Storage, and Disposal of Treated Waste

All treated waste, including secondary waste, would be transported from ATG's facility back to the Hanford Site 200 West Area. Upon arrival, waste containers would be either temporarily stored at the Central Waste Complex or placed in 200 Area mixed waste disposal trenches.

**Table 2-1**  
**Projected Accumulation of Hanford Site Low-level Mixed Waste**

Year	Waste Quantity (m <sup>3</sup> )	Waste Quantity (yd <sup>3</sup> )
1995	810*	1,053
1996	280	364
1997	325	423
1998	330	429
1999	310	403
2000	310	403
2001	300	390
2002	300	390
2003	310	403
2004	310	403
2005	310	403
2006	310	403
2007	305	397
2008	305	397
2009	<u>305</u>	<u>397</u>
Total	5,120	6,696

\*Accumulated as of 1995  
Source: RCRA Part B Application.

## Section 3 ALTERNATIVES TO THE PROPOSED

### **3.1 No Action Alternative**

Under the no action alternative LLMW would continue to accumulate at Hanford Site, pending future decisions. Also, life-cycle costs for the long-term storage of the untreated mixed waste are greater than life-cycle costs for near-term waste treatment and disposal. This alternative would, therefore, not support the purpose and need for the proposed action.

### **3.2 Alternatives Not Analyzed in Detail**

The following alternatives were considered in the process of identifying the preferred alternative (proposed action), but were infeasible and, therefore, not analyzed in detail in this document. The incinerator at the Umatilla Ordnance Depot, approximately 80 kilometers (50 miles) from Hanford Site, was not considered as a treatment option because the incinerator was not designed to treat radioactive waste. It was designed, instead, for the destruction of chemical weapons.

#### **3.2.1 Treatment at the Waste Experimental Reduction Facility, Idaho**

Under this alternative DOE would send the waste for treatment to the existing Waste Experimental Reduction Facility at Idaho National Engineering Laboratory (INEL), Idaho Falls, Idaho, approximately 800 kilometers (500 miles) from 200 West Area. The treated waste would be returned to the Hanford Site for eventual disposal. Risk of a transportation accident would be greater than for the preferred alternative. The higher risk would derive both from an increased accident probability due to a lack of access controls over much of the route and to an increased accident frequency probability due to longer travel times. It is assumed that the Waste Experimental Reduction Facility would operate with an efficiency equal to the ATG gasification and vitrification facility of the proposed action, and that waste handling procedures would be similar to the ATG facility.

Approximately 82 percent of the Hanford Site LLMW generated between 1993 and 1995 from on-site and off-site generators would not be treatable at INEL's Waste Experimental Reduction Facility. This is because the facility's waste acceptance criteria precludes numerous items from being incinerated, such as TSCA waste and waste with more than 0.1 nCi/g of alpha-emitting radionuclides. This alternative would only partially fulfill the purpose and need of the proposed action.

#### **3.2.2 Build a Thermal Treatment Facility at the Hanford Site 200 West Area**

Based on a study completed in 1993, a rotary kiln incinerator was proposed to be built on Hanford Site for the purpose of treating Hanford Site LLMW (Place 1993). Construction costs--including direct, escalation, and contingency--were estimated to be \$620 million for a stand-alone facility and \$20 million in annual operating costs. The proposed incinerator would have treated contact-handled transuranic mixed waste, remote-handled LLMW, remote-handled transuranic mixed waste, as well as contact-handled LLMW, in a process employing a plasma arc furnace.

The facility would have been built and operated at 200 West Area, adjacent to the present temporary LLMW storage site. As with the preferred alternative, the treated and stabilized waste would have been disposed of at 200 West Area. This alternative would have fulfilled the purpose and need of the proposed action. The cost was considered to be too high, however, and construction was not projected for completion until 2005 (Place 1993).

#### **3.2.3 Lockheed Environmental Systems and Technology Company Proposal**

This alternative would use a plasma arc melter, housed in Lockheed's existing Waste Treatment Facility near the center of INEL, to process LLMW from the Hanford Site. The facility is presently being built but would have to be modified and permitted (RCRA/TSCA) to accept Hanford Site LLMW. Similar to the preferred alternative, the final waste form produced would be glass/slag.

This facility is approximately 800 kilometers (500 miles) from 200 West Area. The operational impact of this treatment

is assumed to be similar to that of ATG's. Risk of a transportation accident would be greater than for the proposed action. The higher risk would derive both from an increased accident probability due to a lack of access controls over much of the route and to an increased accident frequency probability due to longer travel times.

### **3.2.4 Scientific Ecology Group Proposal**

This proposed alternative was to treat the Hanford Site LLMW at a steam detoxification unit being built for other treatment purposes in an existing scientific Ecology Group incineration building in Oak Ridge, Tennessee. The building is near the Clinch River and Grassy Creek, approximately 18 kilometers (11 miles) southwest of the center of Oak Ridge. Final waste form would be microencapsulated ash and solid residual. This facility is approximately 3,700 kilometers (2,300 miles) from 200 West Area. The operational impact of this treatment is assumed to be similar to that of ATG's. Risk of a transportation accident would be greater than for the proposed action, as would the cost of transporting the waste.

## **Section 4 Affected Environment**

This section describes the socioeconomic, physical, and biological environment of the ATG gasification and vitrification facility site, the 200 West Area at Hanford Site where wastes are in temporary storage and where the treated waste would be disposed of, and along the proposed 33-kilometers (20-miles) waste transport route. The identification of potential effects of the proposed action upon this environment is the purpose of this assessment.

The Hanford Site Environmental Report for Calendar Year 1994 (PNL 1995) and Hanford Site National Environmental Policy Act (NEPA) Characterization (Cushing 1995) are hereby incorporated by reference. These documents describe the affected environment for Hanford Site and are the principal sources of the selected information presented in this section. The affected environment at the ATG gasification and vitrification facility property is assumed to be similar to nearby areas at Hanford Site that are described, since it is adjacent to Hanford Site on the south and west. Information is supplemented where environmental conditions described in the referenced reports may not fully reflect conditions at the ATG property.

### **4.1 Location of the Proposed Action**

The ATG gasification and vitrification building would be located in the City of Richland on a 45-acre parcel of land south of Horn Rapids Road. The 200 West Area is located in the west central area of Hanford Site. The transport route would extend from the 200 West Area along Route 3 to Route 4 South to Stevens Drive (within the Hanford Site boundary), from Stevens Drive to Horn Rapids Road (outside of Hanford Site) to the ATG property (Figure 2-2).

### **4.2 Socioeconomic Environment**

On February 11, 1994, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations," which is intended to prevent disproportionate adverse environmental or economic impacts from federal policies or actions to minority and low-income populations. The following demographic information on ethnicity, race, and low-income communities in Benton and Franklin Counties is presented as a basis for an analysis of socioeconomic and environmental justice effects in Section 5.

At the time of the 1990 Census, the population of Benton County was estimated at 112,560 and the Franklin County population was 37,473 (see Table 4-1). Whites made up over 91.4 percent of the Benton County total and 71.8 percent of the Franklin County total. Asians and Pacific Islanders constituted about two percent of the population in both counties and Native Americans less than one percent. The African American population in Benton County was less than one percent, but about 3.5 percent in Franklin County. From 1990 to 1994 the white percentage of the population in Benton County declined by two percent (US Bureau of Census 1990; Office of Financial Management 1994). In Franklin County, the population classified as white decreased by 10 percent and the African American population decreased by less than one percent, while other races increased proportionately.

Both the Council on Environmental Quality and the US Environmental Protection Agency identify low-income populations using annual statistical income thresholds from the Bureau of the Census Current Population Reports, Series P-60 on Income and Poverty. The 1990 Small Area Income and Poverty Estimate for Benton County, published by the Bureau of Census, indicates that 11 percent of the population was below the poverty level, and the estimate for Franklin County was 22.7 percent. In 1990, the State of Washington population was 4,741,003, with approximately 517,933 or 10.9 percent of the total population below the poverty level (US Bureau of Census 1990).

### 4.3 Physical Environment

Meteorological data representative of the ATG gasification and vitrification building site are collected at local airports (WeatherDisc Associates 1990; 1990a; 1990b; and 1990c) and at various locations on the Hanford Site (Cushing 1995). Average daily temperature ranges vary from -3 to 5C (26 to 41F) in January and 15 to 33C (60 to 92F) in July. Annual precipitation averages about seven inches per year, with about half of that between November and February. Winter snowfall averages about 10 inches per year, accounting for about 40 percent of the winter precipitation. Dense fog typically occurs on 24 days per year, with most episodes during the fall and winter. Relative humidity averages about 75 percent during the winter and 35 percent during the summer.

Wind patterns in the Richland area are influenced by proximity to local topographic features, such as the Rattlesnake Hills and the Columbia River.

Winds at the Richland airport are predominantly from the south-southwest or the north-northwest. Wind speeds average six to seven mph during the winter and eight to 10 mph during the summer.

Poor dispersion conditions associated with low wind speeds and low level temperature inversions are common in the Richland area (Cushing 1995). Ground-based inversions lasting 12 hours or more occur frequently during fall, winter, and spring months. Ground-based inversions lasting over 24 hours sometimes occur during winter months. Mixing layer heights of less than 250 meters (820 feet) are common during both day and night hours in the winter and also are common at night during the summer.

The federal CAA authorizes the EPA to establish national ambient air quality standards to protect public health and welfare. Federal ambient air quality standards have been adopted for six "criteria pollutants": ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, inhalable particulate matter (PM<sub>10</sub>), and lead particles. The State of Washington also has established ambient air quality standards for these pollutants. The Washington ambient air quality standards are generally identical to the federal standards, except for more stringent state standards for sulfur dioxide. The State of Washington has adopted additional ambient air quality guidelines for various hazardous air pollutants not covered by federal ambient air quality standards.

Ambient air quality conditions are not routinely monitored in Benton or Franklin Counties, although special monitoring studies have been conducted at various times and locations. Benton and Franklin Counties are considered to be in compliance with federal ambient air quality standards. However, PM<sub>10</sub> monitoring in Kennewick during 1993 identified two instances where PM<sub>10</sub> concentrations exceeded the federal and state 24-hour standards.

The US Nuclear Regulatory Commission (NRC 1982) concluded that four earthquake sources should be considered for seismic design: the Rattlesnake-Wallula alignment, Gable mountain, a floating earthquake in the tectonic province, and a swarm area.

For the Rattlesnake-Wallula alignment, which passes along the southwest boundary of the Hanford Site, the Nuclear Regulatory Commission (NRC) estimated a maximum magnitude quake of 6.5, and for Gable Mountain, an east-west structure that passes through the northern portion of the Hanford Site, a maximum magnitude quake of 5.0. These estimates were based upon the inferred sense of slip, the fault length, and/or the fault area. The floating earthquake for the tectonic province was developed from the largest event located in the Columbia Plateau, the magnitude 5.75 Milton-Freewater earthquake. The maximum swarm earthquake for the Washington Public Power Supply System Project (WNP-2) seismic design was a magnitude 4.0 event, based on the maximum swarm earthquake in 1973 (NRC 1982).

The most recent probabilistic seismic hazard analysis calculated an annual probability of recurrence of a 0.2 g earthquake at  $5 \times 10^{-04}$  (Geomatrix 1994).

The principal river systems within the project water resources region of influence include the Columbia and the Yakima, which are described below. Smaller surface streams include Rattlesnake Springs, Snively Springs, Cold Creek (ephemeral), Dry Creek (ephemeral), and an intermittent stream about 0.8 kilometer (0.5 mile) to the west of the ATG gasification and vitrification building. There are no wild or scenic river segments within the region of influence. The ATG gasification and vitrification building is not located within 500 feet of any perennial surface water body.

Ground water in the project area is recharged by natural surface water bodies, by precipitation, and by artificial recharge, including constructed reservoirs, excess irrigation, canal seepage, deliberate augmentation, industrial discharges, and wastewater disposal. The hydrology of the 200 Areas is strongly influenced by the discharge of large quantities of wastewater to the ground over the last 50 years, which has resulted in elevated water levels across most of Hanford Site. Discharges of water to the ground have been reduced, resulting in decreases in the water table of up to 9 meters (29.5 feet) in the 200 Areas.

The ground water hydrology near and beneath the ATG gasification and vitrification building is distinct from that of the 200 West Area. Ground water in the southeastern portion of Hanford Site and in the vicinity of the ATG gasification and vitrification building is less affected by Hanford Site operations than by agricultural irrigation cycles and growing seasons in and around Richland (Newcomer et al. 1992). The aquifers near the ATG gasification and vitrification building are recharged both naturally and artificially. Artificial recharge is primarily by the north Richland recharge basins and by irrigated farming in the North Richland area. Ground water depth at the ATG gasification and vitrification building is greater than 3 meters (10 feet), based on well data (Ecology 1995). The ATG gasification and vitrification building is not over a "sole source aquifer," as defined in Section 1424 (e) of the Safe Drinking Water Act of 1974, and is not located in a ground water management area. No public or private domestic water supply wells are known to exist within 152.4 meters (500 feet) of or downgradient of the ATG gasification and vitrification building.

There are no natural surface water bodies near the ATG gasification and vitrification building nor is it within designated 100-year or 500-year floodplains. The 200 West Area is not within the area of probable maximum flood (DOE 1986). Portions of the 33-kilometers (20-mile) proposed waste transport route, however, are within the 100-year floodplain of both the Yakima and the Columbia Rivers (DOE 1986).

## **4.4 Ecology**

### **4.4.1 Terrestrial Biota**

**Vegetation.** Approximately six percent of the 1,450 km<sup>2</sup> (560 mi<sup>2</sup>) Hanford Site is developed, and the balance of the site is undeveloped. Hanford Site vegetation is characterized as a shrub-steppe ecosystem (Daubenmire 1970). Shrublands occupy the largest acreage at Hanford Site, primarily sagebrush-dominated communities. Grass communities are also common at Hanford Site, including cheatgrass, Sandberg's bluegrass, needle-and-thread grass, thickspike, bluebunch wheatgrass, bentgrass, meadow foxtail, lovegrasses, and reed canarygrass (Mazaika et al, in prep.). Approximately 23 tree species are found at Hanford Site, with black locust, Russian olive, cottonwood, mulberry, sycamore, and poplar being predominant species.

Hanford Site also includes riparian habitat, such as sloughs, backwaters, shorelines, islands, and palustrine areas associated with the Columbia River floodplain. Emergent riparian (wetland) habitat occurs in association with the Columbia River and includes riffles, gravel bars, oxbow ponds, backwater sloughs, and cobble shorelines. Hanford Site also includes a variety of unique habitats such as bluffs, dunes, and islands. For a complete list of species and a more complete description of habitat types, refer to the Hanford Site NEPA Site Characterization report (Cushing 1995).

Hanford Site also includes 655 km<sup>2</sup> (257 mi<sup>2</sup>) of land designated for research or as wildlife refuges, including the Arid Lands Ecology Reserve, US Fish and Wildlife Service Saddle Mountain National Wildlife Refuge, and the Washington State Department of Fish and Wildlife Wahluke Slope Wildlife Area (Cushing 1995).

The ATG gasification and vitrification building is located within an area of north Richland designated for heavy industrial uses. Some of the undeveloped land within the designated industrial area remains under cultivation. Vegetation on the ATG property includes shrubs and a variety of wild mustards and sagebrush plants sparsely scattered throughout the site. Site vegetation is dominated by nonnative weeds, including Russian thistle.

**Wildlife.** Common bird species in the vicinity of the ATG gasification and vitrification facility include the western meadowlark, white-crowned sparrow, gull, black-billed magpie, American crow, and European starling. Canada geese, red-tailed hawk, and American kestrel are common, and are likely to occasionally feed in nearby grain fields (ATG 1995a). Approximately 240 terrestrial vertebrate species have been observed at Hanford Site, including 40 mammal, 187 bird, 3 amphibian, and 9 reptile. Approximately 600 insect species also have been observed at Hanford Site (Cushing 1995).

The Tri-Cities area is within a major waterfowl flyway and wintering area. Waterfowl use is concentrated along the Columbia River, with limited waterfowl presence at the 200 West Area and in the immediate vicinity of the ATG gasification and vitrification building property.

#### **4.4.2 Aquatic Biota**

Hanford Site includes two types of natural aquatic habitats--the Columbia River and small spring-streams and seeps located mainly on the Arid Lands Ecology Reserve. These habitats include numerous species of phytoplankton, periphyton, macrophytes, zooplankton, benthic organisms, insects, and fish. Fish species common to the Columbia River include the Chinook salmon, sockeye salmon, coho salmon, and steelhead trout. Common waterfowl species include Canada goose, several species of ducks, and the coot. A complete species list for Hanford Site can be found in the Hanford NEPA Site Characterization report (Cushing 1995).

Larger Hanford Site wetlands are found along its Columbia River border. The width of the wetlands vary but may include extensive stands of willows, grasses, various aquatic macrophytes, and other plants (Cushing 1995). Other wetlands areas within the region of influence are within the Saddle Mountain National Wildlife Refuge, Wahluke Wildlife Area, and the Arid Lands Ecology Reserve (Cushing 1995).

Since there is no surface water in the immediate vicinity of the ATG gasification and vitrification building, there are no aquatic species. However, the ATG facility is about three kilometers (two miles) west of the Columbia River and is in its region of influence. The ATG site elevation is about ten meters (30 feet) above the average surface elevation of the river along the Hanford Site reach.

#### **4.4.3 Endangered and Threatened Species**

No plants or mammals on the federal endangered species list are known to exist at Hanford Site. Three bird species found at Hanford Site, however, are on the federal list of threatened and endangered species. Also, several species of plants and animals found there are under state consideration for formal listing. Table 4-2 lists the threatened and endangered species inhabiting or potentially inhabiting Hanford Site.

No threatened or endangered plant or animal species are known to exist or are suspected to be present on the ATG gasification and vitrification building property. The absence of native vegetation and the industrial nature of the area render it unlikely habitat for such species.

### **4.5 Cultural Resources**

Information regarding local cultural resources can be found in the Hanford Site NEPA Characterization (Cushing 1995). Two hundred and eighty-three prehistoric sites have been found on Hanford Site (Cushing 1995). Prehistoric archaeological sites common to Hanford Site include remains of numerous pit house villages, various types of open campsites, cemeteries, spirit quest monuments (rock cairns), hunting camps, game drive complexes, and quarries in mountains and rocky bluffs (Rice 1968a; 1968b; 1980).

**Table 4-1  
Population of Benton and Franklin Counties by Race and Ethnic Origin**

Race or Ethnicity	Benton County				Franklin County			
	1990 Population	% of 1990 Total	1994 Population	% of 1994 Total	1990 Population	% of 1990 Total	1994 Population	% of 1994 Total
White	102,832	91.4	113,569	89.4	26,917	71.8	26,668	62.2
African American	1,085	0.96	1,400	1.1	1,310	3.5	1,312	3.1
American Indian, Eskimo, or Aleut	861	0.76	992	0.78	263	0.7	318	0.7
Asian or Pacific Islander	2,246	2.0	3,113	2.45	869	2.3	1,367	3.2
Others	5,536	4.9	7,926	6.3	8,114	21.7	13,235	30.8
<b>TOTALS</b>	<b>112,560</b>	<b>100.02<sup>1</sup></b>	<b>127,000</b>	<b>100.03</b>	<b>37,473</b>	<b>100.0</b>	<b>42,900</b>	<b>100</b>
Hispanic Origin <sup>2</sup>	8,624	7.7	12,360	9.73	11,316	30.2	16,662	38.8

<sup>1</sup> Totals may not equal to 100% due to rounding.

<sup>2</sup> Hispanic Origin can be any race. It is not included in the percentage total.

SOURCES: US Bureau of Census 1990; Office of Financial Management 1994.

**Table 4-2  
Threatened and Endangered Species Inhabiting or Potentially Inhabiting Hanford Site**

Common Name	Scientific Name	Federal	State
<b>Insects</b>			
Oregon silverspot butterfly <sup>2</sup>	<i>Speyerra zerone</i>	T	T <sup>1</sup>
<b>Plants</b>			
Columbia milk-vetch	<i>Astragalus columbianus</i>		T
Columbia yellowcress	<i>Rorippa columbiae</i>		E <sup>1</sup>
Dwarf evening primrose	<i>Oenothera pygmaea</i>		T
Hoover's desert parsley	<i>Lomatium tuberosum</i>		T
Northern wormwood <sup>2</sup>	<i>Artemisia campestris borealis</i> <i>var. wormskioldii</i>		E
<b>Birds</b>			
Aleutian Canada goose <sup>3</sup>	<i>Branta canadensis leucopareia</i>	T	E
American white pelican	<i>Pelecanus erythrorhychos</i>		E
Bald eagle	<i>Haliaeetus leucocephalus</i>	T	T
Ferruginous hawk	<i>Buteo regalis</i>		T
Peregrine falcon <sup>3</sup>	<i>Falco peregrinus</i>	E	E
Sandhill crane <sup>3</sup>	<i>Grus canadensis</i>		E
<b>Mammals</b>			
Pygmy rabbit <sup>2</sup>	<i>Brachylagus idahoensis</i>		E

<sup>1</sup> T=Threatened; E=Endangered

<sup>2</sup> Likely not currently inhabiting Hanford Site

<sup>3</sup> Incidental occurrence

SOURCE: Cushing 1995.

## Section 5 Environmental Impacts of the Proposed Action

This section presents an analysis of potential environmental impacts of the proposed transport and treatment of 5,120 m<sup>3</sup> (6,696 yd<sup>3</sup>) of Hanford Site low-level mixed waste. Environmental concerns related to the proposed action include air emissions, storage and handling of hazardous chemicals and wastes, transportation of hazardous wastes and accident risks.

### 5.1 Facility Operation and Waste Transport

In this section, the environmental impacts of air emissions, hazardous chemicals and wastes, solid wastes, and transportation have been analyzed relative to the conditions described in Section 4, Affected Environment. Potential impacts associated with ATG gasification and vitrification building operations and waste transport also have been evaluated in the following documents, whose results are incorporated into this section:

- ISCST3 Air Dispersion Modeling Results for the ATG Gasification and Vitrification Facility (Sculley 1996)
- RADTRAN 4 Modeling Results for Transport of LLMW from the Hanford Site 200 West Area to the ATG Gasification and Vitrification Facility (Deshler 1996)
- Radiological Dose and Risk Assessment for ATG Gasification and Vitrification Building (Leung 1996)

#### 5.1.1 Air Pollutant Emissions

Plasma Energy Applied Technology, Inc. (PEAT) is the vendor for the ATG gasification and vitrification system proposed for the ATG mixed waste facility. PEAT has conducted a series of pilot studies to demonstrate the waste treatment capabilities of their system. Some of the pilot studies have included detailed air emissions analyses. Two of the waste streams tested in the pilot facility have general applicability to the proposed ATG gasification and vitrification system: medical facility waste (a mix of plastics, paper, food wastes, and some laboratory chemicals), and simulated dunnage wastes (a mix of wood, paper, plastic, and metal wastes).

The pilot facility emission test results were reported primarily as stack concentrations of individual chemicals. Those stack concentrations were converted into standard emission factors based on the waste feed rate and stack gas flow rates for the individual pilot tests. The medical waste tests used a feed rate of 2.3 kilograms (50 pounds) per hour. The simulated dunnage waste tests used a feed rate of 9 kilograms (20 pounds) per hour. In cases where the same chemicals were detected during both the medical waste and dunnage waste tests, the highest of the two emission rate values was used for estimating emissions from the ATG gasification and vitrification building.

The PEAT pilot facility was equipped with less extensive gas treatment equipment than is proposed for the ATG gasification and vitrification building. The PEAT pilot facility included an acid gas scrubber system and a flare system as primary emission controls. The proposed ATG gasification and vitrification system includes a ceramic candle filter, acid gas scrubber, syngas converter, HEPA filters, and carbon filters. In addition, the ATG system would cool the exhaust gas from the syngas converter before the final filtration stage of HEPA filters and carbon filters. Consequently, vaporized metals detected in the flare exhaust from the PEAT pilot facility would be condensed to particulate form and trapped in filters at the ATG facility.

Emission rate data from the PEAT pilot facility tests were adjusted to be representative of expected emissions from the proposed ATG facility. The HEPA and carbon filters are expected to provide an additional 99 percent removal of particulate matter and metals, while the carbon filters are expected to further reduce organic compound emissions by 50 percent.

### **5.1.2 Potential Ambient Air Pollutant Concentrations**

A conservative screening analysis of ambient air quality impacts from the proposed ATG gasification and vitrification building was developed using a gaussian dispersion model. The latest version of the industrial complex model was used for these analyses (ISCST3 Industrial Source Complex Short Term 3, EPA version 95250). The model was run for a 24-hour meteorological pattern representing a winter day with a persistent wind direction and limited pollutant dispersion characteristics.

Wind speeds were assumed to vary between 1 and 2 meters per second (2.2 to 4.4 mph). Moderate temperature inversion conditions were assumed to persist all day (stability classes E and F). Mixing height limits were set at 100 to 150 meters (328 to 482 feet). A realistic variation in precise wind directions was simulated by using a random number generator to produce a sequence of independent wind direction fluctuations of 10 degrees to either side of the assumed prevailing wind direction.

Table 5-1 summarizes anticipated facility emissions and the maximum expected pollutant concentrations downwind of the proposed ATG mixed waste facility. None of the modeled pollutant concentrations approach or exceed relevant state or federal air quality standards or ambient concentration guidelines. Details of the emissions and modeling analyses are documented in ISCST3 Air Dispersion Modeling Results for the ATG Gasification and Vitrification Facility (Sculley 1996).

### **5.1.3 Hazardous Chemicals**

The modeling results presented in Table 5-1 are directly proportional to the waste feed rate. The screening level dispersion modeling analysis assumed a daily average feed rate of 68 kilograms (150 pounds) per hour for the Hanford Site LLMW. More recent facility design changes now anticipate intermittent batch processing of the Hanford Site LLMW, with no waste processed on some days and a feed rate of 114 kilograms (250 pounds) per hour or more on days when Hanford Site LLMW is processed. Averaged over a typical 250 working days per year, the Hanford Site LLMW will be processed at an average rate of 35.3 kilograms (77.6 pounds) per hour.

Impacts associated with hazardous chemicals would not be expected if standard hazardous waste storage and handling procedures are followed.

Small quantities of acids, bases, oxidizers, toxins, flammable, reactives, heavy metals, and pesticides would be necessary for waste sample analyses and analytical equipment calibration in ATG's mixed waste facility laboratory. In addition to the ATG gasification and vitrification building, the mixed waste facility includes a non-thermal treatment building and two waste storage buildings. Laboratory personnel would be protected by conformance with regulatory requirements of 29 CFR 1910.1450. Laboratory hazardous chemical inventories would include compressed gases and flammable, explosive, toxic and/or corrosive liquids. As part of standard treatment, storage, and disposal facility RCRA requirements, a plan outlining specific workplace practices and procedures to ensure employee safety would be developed. Adherence to these requirements would minimize the potential impacts from the storage of hazardous chemicals, including acids and bases, two-part polymers, flammables, and compressed gases.

### **5.1.4 Solid and Hazardous Waste**

Compliance with the laws and regulations identified in Section 6 would minimize impacts of solid and hazardous waste disposal. After treatment in the ATG gasification and vitrification building, waste would be returned to Hanford Site for final disposition. The treatment processes may generate secondary waste as waste is treated. Any secondary waste generated at the ATG gasification and vitrification building would be packaged and certified prior to being returned to Hanford Site.

### **5.1.5 Transportation**

Predicted health effects from exposure to radiation is commonly expressed in numbers of latent cancer fatalities (LCF)

expected in a population. To predict the LCF from waste transport, factors provided in the 1990 Recommendations for the International Commission on Radiation Protection (ICRP 1990) were used, which are also consistent with factors used by the NRC in its rulemaking Standards for Protection Against Radiation (NRC 1991; 56 Federal Register 23363, May 21, 1991). These factors are applicable where the dose to an individual would be less than 20 rem and the dose rate would be less than 10 rem per hour. The dose to risk conversion factors are 500 LCF per million person-rem effective dose equivalent ( $5 \times 10^{-04}$  deaths per person-rem) for the general population and 400 LCF per million person-rem ( $4 \times 10^{-04}$  deaths per person-rem) for workers.

LLMW from the 200 West Area may contain up to 100 nCi/g of transuranic radionuclides, with container surface radiation doses up to 200 mrem/hr. This LLMW would be transported from the 200 West Area to the ATG gasification and vitrification building by truck (see Figure 2-2). The proposed route (11A) is largely (95%) within the Hanford Site boundaries and is subject to access control. Only authorized personnel are allowed to travel on this road. After treatment, the vitrified waste would be transported back to the 200 West Area for land disposal. Transportation health effects were estimated using the computer model RADTRAN 4 (version 4.0.18).

RADTRAN 4 was developed at Sandia National Laboratories to evaluate the risk of transporting radioactive material (Neuhauser and Kanipe 1992). Several input data files, representing various types of waste and transportation scenarios, are available for public use on the Sandia mainframe computer. The input data file representing the transfer of spent fuel to Hanford was modified based on the radiological characteristics (see Table 5-2) of the waste that would be treated at the proposed facility (Place 1994). The isotopes included in the input data files accounted for 99 percent or more of the activity of the current inventory of waste. The exclusion of isotopes present only in relatively small amounts would not change the output significantly. The waste characteristics described were for the  $890 \text{ m}^3$  ( $1,164 \text{ yd}^3$ ) of thermally treatable waste accumulated by 1994. Identical waste characteristics were assumed for the additional  $4,230 \text{ m}^3$  ( $5,533 \text{ yd}^3$ ) that is expected to be generated and treated by the year 2010.

In addition to modifying the isotope activity variables in the existing input data file, several parameters relating to shipment were altered, including:

- Fraction of travel in rural population zone changed to 1.0
- Fraction of rural travel on freeways changed to 0.9
- Kilometers traveled per trip (one-way) changed to 33
- Stop-time per trip changed to 0

Other general assumptions made in the input file were not changed. The worker population was assumed to consist of two people, the driver and an assistant. Because of the controlled access over most of the transport route, the majority of non-workers potentially exposed during incident-free transport would be those sharing the roadway with the truck. Using a traffic count of 470 vehicles per hour (one-way), the model would estimate that 317 people would be exposed during a single incident-free trip. The maximally exposed individual non-worker is assumed to live 10 meters (33 feet) from the roadway. From a default rural population density of 6 people/ $\text{km}^2$ , the model estimates that 8,100 people could be exposed to radioactive material released in an accident.

Other important variables in calculating transportation risk are the number and size of shipments. Five thousand one hundred twenty  $\text{m}^3$  of LLMW would be treated over a 10-year period. Assuming a waste density of  $347 \text{ kg/m}^3$  and a truck capacity of 18,100 kilograms (39,820 pounds), approximately 160 inbound (to the proposed facility) trips would be necessary over the 10-year period. Although the volume of the processed waste would be reduced by up to 80 percent, its density would increase to up to 2,650 kilograms per cubic meter (7,626 pounds per cubic yard) limiting the number of drums that could be transported to approximately 50 per shipment. Based on these calculations, approximately 150 outbound (away from the proposed facility) trips would be necessary over the 10-year period. Separate input data files were created for the inbound and outbound scenarios.

RADTRAN 4 can calculate the radiological dose and associated health risk from both incident-free travel and travel including accidents. Default values for the probability and severity of eight different accident categories were used for both input data files.

**Incident-free Transportation.** Predicted doses and risks are presented in Table 5-3. The inbound and outbound doses for both workers and non-workers are similar, and, as expected, the doses received by the non-workers passing the truck transports are lower than for the workers driving the trucks.

The RADTRAN 4 model predicts that a member of the public receiving the maximum exposure from 10 years of operation will receive less than 0.01 percent of the 100 mrem maximum allowable dose from a licensed nuclear facility during one year of operation. Exposure of either of the two workers in the worker population, the transport driver and an assistant, is predicted to be limited to 0.25 percent of the 5000 mrem annual limit for workers.

Predicted radiological exposures of the public and of workers posed by an accident occurring along the rural transport route are even smaller percentages of the regulatory limits. As the LCF for the worker and non-worker population is less than one, no observable health effects are expected to result from transport accidents.

**Transportation Accidents.** Each RADTRAN 4 model run assumes that accidents of eight different severities could occur during the transportation of the waste. Accident-severity categories were defined as various combinations of thermal (i.e., fire) and mechanical (i.e., impact, puncture, crush) environments and differed in the degree to which package shielding was damaged and contents were released. More severe accidents were assumed to result in releases of greater amounts of radioactive materials over a larger area and to occur with a much lower frequency than less severe accidents.

The 10-year cumulative population dose and health effects for non-workers from accidents occurring over the 10-year operating period are  $2.14 \times 10^{-07}$  person-rem ( $1.07 \times 10^{-10}$  LCF) for both inbound and outbound transport. The health impacts from an accident during transport are lower than those from incident-free transport because of the low probability of accident. The probability of an accident of any kind occurring during transport is  $2.10^{-08}$  per kilometer.

## 5.2 Human Health Impacts from Plant Operations

### 5.2.1 Hazardous Waste

Downwind concentrations of the compounds emitted from the PEAT test facility during gasification and vitrification were modeled using the EPA model ISCST3 (see Section 5.1.1.1). This modeling resulted in estimations of breathing zone air chemical concentrations. The analyses of the human health impacts of inhaling these predicted site-related chemical concentrations is presented in this section.

**Quantitative Analysis:** Chemical toxicities were analyzed using standard EPA human health risk assessment methodologies (US EPA, 1991a, 1991b). Human health risk assessment is a series of analyses comparing probable exposures to site-related chemicals with doses correlated with deleterious health effects. These analyses produce estimates of cancer risk or noncancer hazard. A noncancer hazard quotient (HQ) of greater than 0.25 and an excess cumulative cancer risk greater than  $1.0 \times 10^{-05}$  for an individual (one excess cancer per 100,000 exposed population) is used as a Standard of significance by EPA. These estimates are provided for those chemicals expected to be in ATG's gasification and vitrification building emissions and for which sufficient toxicological data is available.

HQs, or noncancer hazard quotients, are computed by comparing estimated daily intake levels with risk reference doses (RfD) available on US EPA's Integrated Risk Information System (IRIS) (US EPA 1995). RfDs are benchmark daily doses to which humans may be subjected without an appreciable risk of noncarcinogenic adverse effects during a lifetime (assumed to be 70 years). HQ values less than 0.25 indicate that the potential for adverse health impacts is negligible.

Estimates of incremental carcinogenic risk posed by assumed daily intake levels of contaminants of concern are calculated with cancer potency factors developed by the US EPA. A chemical's cancer potency factor provides an upper bound estimate on the cancer risk due to continuous chemical exposure throughout the course of a 70-year lifetime. In Table 5-4, cancer potency factors are expressed both as slope factors for inhalation and as RfD for oral intake. A cumulative excess cancer risk of  $1 \times 10^{-06}$  indicates that less than 1 additional cancer would be expected to be observed in one million people exposed to the chemical as compared to the number of cancers observed in one million people not exposed to the chemical.

Critical variables used in the risk estimates included the exposed receptors, exposure frequency (days/year exposed), chemical concentrations at certain distances from the stacks, and inhalation rates of the exposed receptors. For this study, both on-site workers and off-site residents were assumed to be exposed to site-related compounds. Based on available information (RCRA Part B Application), the analysis assumed that the facility would operate 250 days per year, which was used as the exposure frequency for both exposure scenarios. Based on EPA default parameters, workers were assumed to be breathing 20 m<sup>3</sup> of air per day (greater activity) and residents 15 m<sup>3</sup> of air per day (less activity).

To be conservative, the maximum modeled 24-hour average air concentrations using stable wind conditions were used as exposure point concentrations for the risk assessment of inhalation of ATG gasification and vitrification building emissions. The air modeling demonstrated that the peak air chemical concentrations were far below regulatory standards as shown in Tables 5-4 and 5-5. These values were used in the risk assessment. These maximum concentrations were also used for the worker scenario analysis.

Table 5-4 provides the analytical results, which show that modeled individual chemical concentrations corresponded to excess cumulative cancer risks of less than 1.0x10<sup>-06</sup> for both residential or worker scenarios. The highest excess cumulative cancer risk was found for worker exposure to acetaldehyde (1.34x10<sup>-07</sup>).

Calculated hazard quotients are not shown in Table 5-4 because calculations showed these values to be extremely low. For example, the highest individual hazard quotient calculated was for 4-methyl phenol and, as shown in the footnote to Table 5-4, is many times less than one. A hazard quotient equal to 0.25 is considered significant.

**Qualitative Analysis.** For a small subset of chemicals expected to be a component of the ATG gasification and vitrification facility emissions, quantitative analysis was not possible due to the lack of scientific evidence of their health effects. Measurements of these chemicals were compared to other health-based regulatory standards.

Regulations promulgated under the Washington Industrial Safety and Health Act (49.17 RCW) have established Permissible Exposure Limits (PELs) to regulate workplace exposure to air contaminants (WAC 296-62-07515). The Benton County Clean Air Authority regulates air emission sources within Benton County but largely incorporates by reference the Department of Ecology regulations (WAC 173-400 et seq.). Table 5-5 provides the results of this qualitative comparison. Again, the maximum chemical concentrations determined by air modeling were compared to the benchmark values. This is a conservative approach because actual on-site concentrations, to which workers may be exposed, would be much less than the values used for analysis. The results show that, for the chemicals examined, the maximum air chemical concentrations related to ATG emissions do not exceed PELs for worker exposure.

### 5.2.2 Radioactive Waste Characteristics

A total of 90 radionuclides have been identified in the Hanford Site LLMW. Analyses of the radionuclide inventory have distinguished between fission products (primarily beta-gamma emitters) and actinides (primarily alpha emitters). Ninety-nine percent of the fission product curie content is contributed by 10 radioactive constituents. The inventory of mobile radionuclides includes C-14, I-129, Se-79, Tc-99, and uranium isotopes. Total accumulated activity based on the list of fission products is 61.06 curies and total accumulated activity for the actinides is 144 curies (Leung 1996).

The radionuclides are present in the following waste matrices:

Dirt-Soil-Diatomaceous Earth	27%
Metal-Iron-Galvanized-Sheet	17%
Sludges	8%
Plastic-Polyurethane	8%
Absorbent-Kity Ltr-Vermiculite	8%
Oils	6%
Liquids	1%
Other	25%

### 5.2.3 Analysis Methodology

The following sections discuss the basic concepts and the methodology used in this environmental assessment report to calculate the impacts from normal operations and a credible worst-case accident scenario.

### 5.2.4 Radiation Limits

The effects on human beings of radiation emitted during the decay of a radioactive substance depends on the type of radiation and the total amount of radiation energy absorbed by the body. The total energy absorbed per unit quantity of tissue is referred to as absorbed dose. The absorbed dose, when multiplied by certain quality factors that take into account different sensitivities of various tissues, is referred to as effective dose equivalent, or simply dose. The unit of dose is the rem or mrem (1/1000 rem).

The maximum annual allowable radiation dose to the members of the public from NRC and State of Washington licensed nuclear facilities is 100 mrem (mrem) per year (Subpart D of 10 CFR 20, WAC 246-227-060). The National Emissions standards for Hazardous Air Pollutants (NESHAP) dose limit to an offsite individual from air emissions of radionuclides from the operation of NRC and Washington licensed facilities is 10 mrem per year (Subpart I of 40 CFR 61: WAC 173-400-075). Annual worker limit is 5,000 mrem per year (Subpart C of 10 CFR 20, WAC 246-221-010). NRC is expected to adopt an allowable radiation dose more consistent with the NESHAP limit in the near future. The 100 mrem per year limit on maximum allowable dose is consistent with DOE Order 5400.5 (DOE 1988) and the 5,000 mrem per year limit on worker exposure is consistent with DOE Order 5480.11 (DOE 1988). A limit of 25 rem for a one-time accidental dose from a major credible accident has been established by DOE in Chapter I of DOE Order 6430.1. This limit is consistent with the existing site criteria delineated in 10 CFR 100.

The average individual in the US receives a dose of about 360 mrem per year from all sources combined, including natural and medical sources of radiation. A person must receive an acute (short-term) dose of 600,000 mrem before the probability of near-term death becomes high.

In addition to limits on dose, assessments of radiological health effects are expressed in terms of LCF that may be observed after the exposure. Radiological health effects for individuals are expressed as the estimated increase in probability that an individual will develop a fatal cancer as a result of a received dose. That increase in probability is referred to in this document as risk. Radiological health effects for populations near the facility (within 80 kilometers, or 50 miles) are expressed as the increase in the LCF attributable to the received dose.

Risk from normal operations and accident scenario was calculated using the following formula:

$$\text{Risk} = \text{Frequency} \times \text{Dose (person-rem)} \times \text{Dose to Risk Conversion Factor (LCF/person-rem)}$$

Normal operations are assigned a frequency of 1; that is, they are always expected to occur. The frequency of exposure resulting from an accident is estimated for each accident scenario. The Dose to Risk Conversion Factor was also discussed earlier in the presentation of transportation impacts.

### 5.2.5 Dose Assessment For Airborne Releases

Airborne effluents would be the only releases to the environment from the operation of the ATG gasification and vitrification building. These are evaluated using the GENII computer code developed at the Pacific Northwest National Laboratory. The code implements the internal dosimetry models recommended by the International Commission on Radiological Protection in Publications 26 and 30. Committed effective dose equivalent from internal exposure is calculated in the code by applying weighting factors for the various body organs. The total effective dose equivalent is then the sum of the effective dose equivalent from external exposure and the committed effective dose equivalent from internal exposure.

GENII is used to evaluate doses resulting from two general scenarios: airborne release from normal operations, and a

worst-case credible accident scenario. The code uses the Gaussian plume model for air dispersion and accounts for the release height.

Radiation doses from airborne releases are calculated for the following receptors :

- **Population:** All members of the public who live within 80 kilometers or 50 miles of the ATG gasification and vitrification building.
- **Worker:** A facility worker at 100 meters from the release point.
- **Maximally Exposed Individual (MEI):** A hypothetical member of the general public living near the site boundary and receiving the maximum exposure as a result of releases from the normal operation scenario or the accident scenario.

Atmospheric releases are considered through the following pathways:

- External exposure from immersion in the plume.
- External exposure from plume.
- Internal exposure from inhalation of radionuclides in the airborne plume.
- Internal exposure from previously-deposited radioactive material resuspended in air due to wind actions (inhalation).
- Internal exposure from the ingestion of food crops and animal products. This pathway is not considered for workers).

For chronic releases, average meteorological data are used. Average meteorological conditions are a time weighted average composite of possible combinations of meteorological conditions. These data sets are generated by the APPRENTI module of the GENII code for specific applications of different analysis models. The Hanford Site 300 population and joint-frequency file within a 80 kilometer (50 mile) radius is used for the analysis. The Search option for maximally exposed individual in GENII was used for locating the distance where the maximum dose occurs. A 30-year food uptake is used for all scenarios.

### 5.2.6 Normal Operations Analyses

A series of GENII cases was performed for a 10-year period of normal operations for evaluating the dose for a worker and the maximally exposed individual member of the public. The Hanford Site 300 Area joint frequency meteorological file was used.

Table 5-6 presents the results of the dose and risk analysis for the population that lives within 80 kilometers (50 miles) of the ATG gasification and vitrification building. The GENII calculations predict that releases over a 10-year period of operations will result in a cumulative dose to the population of 0.0095 person-rem, or an approximate average individual dose of 0.000034 mrem based on a population of 281,600. The number of excess LCF expected in this population as a result of 10 years of normal operation is 0.000047, a number too low to be observed.

The calculated dose for workers at 100 meters is 0.00017 mrem after ten years. This dose is less than 0.000004 percent of the regulatory limit of 5,000 mrem per year for occupational exposure (10 CFR 20, Subpart C).

The above doses are those attributable to the ATG gasification and vitrification treatment of Hanford Site LLMW. This waste would account for one-third to one-sixth of the ATG gasification and vitrification building processing capability. Total doses from the facility with the possible addition of a second ATG gasification and vitrification unit, may be six times those presented above, still far below regulatory limits.

The annual doses to the maximally exposed off-site individual from routine emissions would be less than 0.02 percent of the 10 mrem/yr limit to members of the public for airborne emissions and less than 0.002 percent of the 100 mrem/yr total limit (maximum annual allowable to the members of the public). The hypothetical maximum occupational dose from routine ATG gasification and vitrification building emissions is an even smaller fraction of the 5,000 mrem/yr regulatory limit for workers. Several conservative assumptions were made in performing the dose assessment, and it is likely that actual doses would be substantially lower than estimated.

The calculated doses presented do not take credit for the effects of the ceramic filters. Adding the effects of filtering mechanisms would further reduce the dose and risk from radionuclide emissions.

Annual occupational doses from direct exposure to penetrating radiation resulting from operations may be inferred from the annual doses received from waste processing at the existing ATG low-level radioactive processing facility. That facility operates under a NRC agreement state Radioactive Material License stipulating the types and quantities of radioactive material that can be received and processed. The ATG gasification and vitrification building will operate under similar licensing requirements and process waste with similar radiological characteristics. Average annual doses from penetrating radiation measured by thermoluminescent dosimeters to ATG process operators is approximately 200 mrem. Assuming that one-quarter of the waste processed at the ATG gasification and vitrification building originates from Hanford Site, the annual worker dose from exposure to Hanford Sites LLMW would be 50 mrem. Ten years of operations would result in a cumulative dose of approximately 500 mrem. The facility is estimated to employ approximately 30 process operators. The collective dose to the workforce from 10 years of operations would be 15 person-rem with an LCF risk of  $6 \times 10^{-03}$ .

### 5.2.7 Accident Scenario Analyses

The worst case credible accident scenario chosen for this assessment is a fire that releases all of the contents of the process chamber. A fire is expected to occur with an annual frequency of  $1 \times 10^{-03}$ . The probability that such a fire would result in a release of radionuclides to the atmosphere from the process chamber is judged to be  $1 \times 10^{-01}$ . Thus the annual frequency that a fire event would lead to the airborne release of the radionuclides is conservatively estimated to be  $1 \times 10^{-04}$  (that is, the annual frequency times the probability that a fire would result in emission). Over a 10-year period of operation the probability that a fire event would result in radionuclide emission is conservatively estimated to be  $1 \times 10^{-03}$ .

At operating temperatures the process chamber, which has a total volume of  $1.8 \text{ m}^3$  ( $64 \text{ ft}^3$ ), contains about  $1.7 \text{ m}^3$  ( $60 \text{ ft}^3$ ) of gas above, and at most,  $0.1 \text{ m}^3$  ( $4 \text{ ft}^3$ ) of glassy melt. Only the radioactivity in the glassy melt is considered in the accident scenario analysis. The bulk of the radioactivity within the process chamber is contained in the glassy melt.

The worst-case scenario assumes that  $0.1 \text{ m}^3$  ( $4 \text{ ft}^3$ ) of glass melt are released into the building. Most radionuclides are assumed to be released as particulates. All of the tritium, carbon, and sulfur are assumed to be released as gases and 50 percent of the iodide is also assumed to be released as a gas.

For the scenario, a series of 16 cases corresponding to 16 sectors was run for the maximally exposed individual member of the public and the facility worker. The estimated yearly release to the environment as a result of the postulated worst case accident would be  $6.16 \times 10^{-04}$  curie of fission products and  $1.84 \times 10^{-04}$  curie of actinides. The total activity released would be  $8.0 \times 10^{-04}$  curie.

Doses and risks to the population within 80 kilometers (50 miles) of the ATG gasification and vitrification building are presented in Table 5-8. The cumulative effective dose equivalent for the entire population of 281,600 is calculated to be 0.05 person-rem (an average of  $1.7 \times 10^{-07}$  rem per individual). Accounting for both the low frequency of the worst-case accident and the 10 year period of operation, the number of excess LCF predicted in the local population is  $2.5 \times 10^{-08}$ .

The results for individual and worker doses are presented in Table 5-9. For the maximally exposed member of the public at 800 meters (2,624 feet), the cumulative dose, with food uptake continuing for a 30-year period, would be 2.5 mrem. For the maximally exposed individual worker at 100 meters (328 feet), this dose during the 10-year period of operation is estimated to be 1.8 mrem. Thus the dose received by both an individual member of the public and a worker would be less than 0.01 percent of the limit of 25,000 mrem established by the DOE for an accident. The risk of LCF for the maximally exposed individual is  $1.2 \times 10^{-09}$ .

The collective dose to the ATG workforce is estimated to be 0.180 person-rem, assuming a total workforce for mixed

waste treatment and low-level radioactive waste processing of 100. Since the event frequency is anticipated at 0.001, the risk of a LCF is  $7.2 \times 10^{-08}$ .

The controlling radionuclide for the accident scenario is Pu-238 and the controlling pathway is inhalation. The dose assessment conducted for both routine and accidental emissions of airborne radionuclides from the ATG gasification and vitrification building indicates that no workers or nearby members of the public will receive doses exceeding regulatory levels.

Radioactive emissions from the worst-case accident scenario result in doses to workers and the nearby public that are much lower than established limits.

### **5.3 Mixed Waste Storage**

Waste storage is limited to the physical capacity of containers and facilities as well as by regulatory permit capacities and time limits. RCRA Part B permitted (or RCRA Interim Status) storage facilities are limited by LDR of 40 CFR 268. Untreated mixed waste is not allowed to be land disposed. For mixed waste, storage is limited to one year (40 CFR 268.50[c]). RCRA allows for temporary extensions due to unforeseen problems, with proper approval.

The ATG gasification and vitrification building would annually treat approximately  $500 \text{ m}^3$  ( $650 \text{ yd}^3$ ) of Hanford Site LLMW. Wastes with the incinerator (INCIN) treatment code, such as PCB wastes, would be stored in the mixed waste storage building, along with other wastes. Except possibly for bulk soil contaminated with PCBs, most PCB wastes would be stored in the containerized waste storage area. The ATG mixed waste storage building would be managed in compliance with an approved spill prevention, control, and countermeasures (SPCC) plan, employing secondary containment, physical barriers between incompatible wastes, and routine inspections. Table 5-10 lists storage capacities, including numbers and types of containers.

#### **5.3.1 Hazardous Chemical Storage**

Hazardous chemical storage within the ATG gasification and vitrification building would be limited to the amounts required to support daily operations, which in the care of hazardous wastes is equivalent to one to three days of processing. The reagent storage area and chemical handling procedures are designed to allow safe and effective operational access to the hazardous chemicals and to reduce impacts resulting from any spills. Safety measures for acids and bases prevent vapor or liquid contact with skin, eyes, and mucous membranes. Physical barriers will separate oxidizers and flammables/combustibles. Other controls will include secondary containment, temperature controls, and ventilation. Storage of hazardous chemicals will be in accordance with Occupational Safety and Health Administration (OSHA) requirements and the SPCC plan.

### **5.4 Seismic Hazards**

The facility will be designed to meet or exceed uniform building code design standards for Seismic Zone 3. Such standards for wind forces are generally more stringent than Seismic Zone 3 requirements for the facility, since they require the structure to withstand up to 113 kilometers per hour (70 miles per hour) winds. Tanks and containers of liquids will be secured, to the extent feasible, to prevent overturning in a seismic event. Spill control measures are described in Section 5.3.

### **5.5 Water Resources**

The 200 West Area, the ATG gasification and vitrification building site and the transport route are not located within a flood-prone area.

The ATG gasification and vitrification building will be equipped with a secondary spill containment system, described in Section 2.4. This system will prevent spills from impacting surface or ground water.

The secondary containment system would have to fail in order for liquid waste to be released to the environment. In the unlikely event that such a failure occurred in conjunction with a hazardous materials spill, then a portion of the spill could be released to the ground surface. Normal hazardous material spill recovery procedures would be implemented to control and remediate the spilled material in that event.

## 5.6 Biological Resources

No threatened or endangered species are known to exist or suspected to be present at the ATG gasification and vitrification building property and no ground-disturbing activities are planned at the 200 West Area as part of this action. Therefore, no effects on such species are anticipated. During a wildlife survey conducted in 1989 at an area less than one mile from the proposed project location, no threatened or endangered species were encountered (DOE 1990). Activities related to the proposed action at the 200 West Area primarily involve loading and unloading of wastes, which should not adversely affect the relatively few threatened or endangered species found at Hanford Site. Neither wetlands or sensitive habitats would be affected by the proposed action.

Transport of waste to and from the 200 West Area would utilize existing roads. Risks to wildlife species from truck collisions would be minimal due to the relatively few transport trips expected. Therefore, no effects to wildlife or vegetation, including threatened and endangered species, are expected to occur from waste transport.

## 5.7 Cultural Resources

A cultural resources review was part of the siting process for the ATG gasification and vitrification building conducted by Ecology (Appendix E). This review found that the ATG gasification and vitrification building is not located within an archeological or historic site (Appendix E). If cultural resources are discovered during operation of the ATG gasification and vitrification building, activities which may disrupt these resources should be stopped and appropriate cultural resource agencies should be contacted.

## 5.8 Socioeconomic Impacts

No additional employees would be required at the Hanford Site 200 West Area. Approximately 30 to 50 employees would be added by ATG to operate the gasification and treatment building. With an estimated population of approximately 200,000 in the two-county area, the addition of this number of jobs would be expected to have a minor effect on the economy of the area.

## 5.9 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice on Minority and Low-income Populations, directs federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs and activities on minority and low-income populations. DOE is in the process of developing official guidance for implementation of the executive order. The following analysis was guided by the procedures set forth in the US EPA Draft Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses (US EPA 1996) and CEQ Draft Guidelines for Addressing Environmental Justice under the National Environmental Policy Act (CEQ 1996). CEQ and US EPA guidance for identifying disproportionately high and adverse effects on low-income and/or minority populations is evaluated in terms of environmental effects and health effects, as described below.

**Environmental Effects.** When identifying disproportionately high and adverse environmental impacts to minority and/or low-income populations, the following factors should be considered.

1. Whether there is or will be an impact on the natural or physical environment that significantly (as employed by NEPA) and adversely affects a minority or low-income population. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities or low-income communities when those impacts are interrelated to impacts on the natural or physical environment;
2. Whether environmental effects are significant (as employed by NEPA) and are or may be having an adverse

- impact on minority populations that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and
3. Whether the environmental effects occur or would occur in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

**Health Effects.** When identifying disproportionately high and adverse health impacts to minority and/or low-income populations, the following factors should be considered.

1. Whether the health effects, which may be measured in risks and rates, are significant (as employed by NEPA), or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death;
2. Whether the risk or rate of hazard exposure by a minority population or low-income population to an environmental hazard is significant (as employed by NEPA) and appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and
3. Whether health effects occur in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

The analysis in this EA indicates that implementation of the proposed action would not result in significant impacts to the environment or to human health. Impacts would be minimal to both the offsite population and potential workforce for normal operations and accident scenario conditions. The closest identified low-income communities in Benton and Franklin Counties are located at least eight kilometers from the ATG gasification and vitrification building. The maximally exposed public individual would be within 800 meters (2,624 feet) of the facility, and the effects are not above thresholds for human health protection. Impacts to populations from transport of the waste would be minimal since the transportation route to and from the 200 West Area has been used in the past for transport of radioactive wastes similar to that of the proposed action. It follows that there would not be disproportionately high or adverse impacts to minority or low-income populations.

## **5.10 Cumulative Impacts**

### **5.10.1 Radiation**

The previous discussion of radiation risk includes the cumulative analysis, and finds that the exposure and health risks both to the maximally exposed public individual and the maximally exposed worker are not significant.

### **5.10.2 Air Quality**

Cumulative air quality effects of processing Hanford Site LLMW at the proposed ATG facility would occur in several contexts. Other industrial facilities in the Richland area would also be releasing air pollutants, and emissions from the proposed ATG gasification and vitrification building would be added to those of neighboring industrial uses. In addition, the Hanford Site LLMW is not expected to be the sole source of wastes processed at the ATG gasification and vitrification building. Thus, from an emissions standpoint, the ATG gasification and vitrification building would be contributing incrementally to the cumulative total of air pollutants released in the area round the Hanford Site. There are no indications, however, that the cumulative emissions in the region would cause any violations of federal or state air quality standards. Nor are there any indications that the combination of chemical and radiological emissions would cause any appreciable change in cumulative cancer risk for the region.

### **5.10.3 Solid and Hazardous Waste**

With a design capacity of 700 metric tons (770 tons) per year per unit, the ATG gasification and vitrification building would have ample capacity to treat the forecast 5120 m<sup>3</sup>, or nearly 1800 metric tons (2000 tons) of the subject Hanford Site waste within a ten year period. The ATG gasification and vitrification process is designed to destroy hazardous organic compounds safely and reduce waste volume.

### 5.10.4 Storage

No cumulative impacts are expected from the storage of hazardous chemicals or waste. The hazardous chemicals that would be brought to the ATG gasification and vitrification building would be consumed during waste treatment operations.

4.68

1.25

**Table 5-1 Summary of Non-radiological Facility Emissions and Dispersion Modeling Results**

<b>Pollutant</b>	<b>Estimated Emission Factor, gm/ton<sup>1</sup></b>	<b>Emission Rate (gm/s) for Feed Rate of 150 lbs/hr</b>	<b>Maximum 24-Hour Average Breathing Zone Concentration (g/m<sup>3</sup>)</b>
Particulate Matter (PM <sub>10</sub> )	9.75x10 <sup>-05</sup>	4.42x10 <sup>-04</sup>	
Carbon Monoxide	1,450	3.02x10 <sup>-02</sup>	1.37x10 <sup>-01</sup>
Nitrogen Oxides	2,389	4.98x10 <sup>-02</sup>	2.26x10 <sup>-01</sup>
Sulfur Oxides	168	3.50x10 <sup>-03</sup>	1.59x10 <sup>-02</sup>
Sulfur Dioxide	107	2.22x10 <sup>-03</sup>	1.01x10 <sup>-02</sup>
Hydrochloric Acid	62.69	1.31x10 <sup>-03</sup>	5.92x10 <sup>-03</sup>
Hydrogen Fluoride	3.07	6.39x10 <sup>-05</sup>	2.90x10 <sup>-04</sup>
Formaldehyde	134	2.79x10 <sup>-03</sup>	1.27x10 <sup>-02</sup>
Acetaldehyde	672	1.40x10 <sup>-02</sup>	6.35x10 <sup>-02</sup>
Butyraldehyde	52	1.08x10 <sup>-03</sup>	4.88x10 <sup>-03</sup>
Diphenylene Methane (Fluorene)	0.031	6.42x10 <sup>-07</sup>	2.91x10 <sup>-06</sup>
Phenol	0.90	1.87x10 <sup>-05</sup>	8.48x10 <sup>-05</sup>
1,4-Dichlorobenzene (p-Dichlorobenzene)	0.012	2.57x10 <sup>-07</sup>	1.17x10 <sup>-06</sup>
2-Methylphenol (Cresol)	0.074	1.54x10 <sup>-06</sup>	6.99x10 <sup>-06</sup>
3/4-Methylphenol (Cresol)	0.063	1.30x10 <sup>-06</sup>	5.91x10 <sup>-06</sup>
Combined Methylphenol (Cresol) isomers	0.14	2.84x10 <sup>-06</sup>	1.29x10 <sup>-05</sup>
Acetophenone	0.032	6.60x10 <sup>-07</sup>	3.00x10 <sup>-06</sup>
Phenanthrene	0.05	1.08x10 <sup>-06</sup>	4.89x10 <sup>-06</sup>
Benzoic Acid	4.04	8.42x10 <sup>-05</sup>	3.82x10 <sup>-04</sup>
Naphthalene	0.41	8.59x10 <sup>-06</sup>	3.89x10 <sup>-05</sup>
2-Methylnaphthalene	0.14	2.84x10 <sup>-06</sup>	1.29x10 <sup>-05</sup>
Acenaphthylene	0.044	9.23x10 <sup>-07</sup>	4.18x10 <sup>-06</sup>
Dimethyl Phthalate	0.026	5.36x10 <sup>-07</sup>	2.43x10 <sup>-06</sup>
Diethyl Phthalate	0.15	-06	-05

		3.20x10	1.45x10
Di-n-Butyl Phthalate	0.36	7.58x10 <sup>-06</sup>	3.44x10 <sup>-05</sup>
Butylbenzyl Phthalate	2.60x10 <sup>-05</sup>	1.18x10 <sup>-04</sup>	
bis(2-Ethylhexyl) Phthalate	177	3.68x10 <sup>-03</sup>	1.67x10 <sup>-02</sup>
Dibenzofurans	0.040	8.31x10 <sup>-07</sup>	3.77x10 <sup>-06</sup>
2,3,7,8-Tetrachlorodibenzo-p-dioxin	8.36x10 <sup>-08</sup>	1.74x10 <sup>-12</sup>	7.90x10 <sup>-12</sup>
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.39x10 <sup>-07</sup>	4.98x10 <sup>-12</sup>	2.26x10 <sup>-11</sup>
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.39x10 <sup>-07</sup>	4.98x10 <sup>-12</sup>	2.26x10 <sup>-11</sup>
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.20x10 <sup>-07</sup>	2.49x10 <sup>-12</sup>	1.13x10 <sup>-11</sup>
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.20x10 <sup>-07</sup>	2.49x10 <sup>-12</sup>	1.13x10 <sup>-11</sup>
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3.47x10 <sup>-06</sup>	7.23x10 <sup>-11</sup>	3.28x10 <sup>-10</sup>
Octachlorodibenzo-p-dioxin	1.56x10 <sup>-05</sup>	3.24x10 <sup>-10</sup>	1.47x10 <sup>-09</sup>
2,3,7,8-Tetrachlorodibenzofuran	4.78x10 <sup>-07</sup>	9.97x10 <sup>-12</sup>	4.52x10 <sup>-11</sup>
1,2,3,7,8-Pentachlorodibenzofuran	3.59x10 <sup>-07</sup>	7.48x10 <sup>-12</sup>	3.39x10 <sup>-11</sup>
2,3,4,7,8-Pentachlorodibenzofuran	3.59x10 <sup>-07</sup>	7.48x10 <sup>-12</sup>	3.39x10 <sup>-11</sup>
1,2,3,4,7,8-Hexachlorodibenzofuran	1.56x10 <sup>-06</sup>	3.24x10 <sup>-11</sup>	1.47x10 <sup>-10</sup>
1,2,3,7,8,9-Hexachlorodibenzofuran	7.18x10 <sup>-07</sup>	1.50x10 <sup>-11</sup>	6.78x10 <sup>-11</sup>
2,3,4,6,7,8-Hexachlorodibenzofuran	2.51x10 <sup>-06</sup>	5.23x10 <sup>-11</sup>	2.37x10 <sup>-10</sup>
1,2,3,7,8,9-Hexachlorodibenzofuran	1.20x10 <sup>-07</sup>	2.49x10 <sup>-12</sup>	1.13x10 <sup>-11</sup>
1,2,3,4,6,7,8-Heptachlorodibenzofuran	7.78x10 <sup>-06</sup>	1.62x10 <sup>-10</sup>	7.35x10 <sup>-10</sup>
1,2,3,4,7,8,9-Heptachlorodibenzofuran	2.51x10 <sup>-06</sup>	5.23x10 <sup>-11</sup>	2.37x10 <sup>-10</sup>
Octochlorodibenzofuran	7.90x10 <sup>-05</sup>	1.64x10 <sup>-09</sup>	7.46x10 <sup>-09</sup>
Total Tetrachlorodibenzofuran	1.44x10 <sup>-07</sup>	3.00x10 <sup>-12</sup>	1.36x10 <sup>-11</sup>
Total Dibenzo-p-Dioxin Toxicity Equivalent	3.01x10 <sup>-07</sup>	6.28x10 <sup>-12</sup>	2.85x10 <sup>-11</sup>
Total Dibenzofuran Toxicity Equivalent	1.35x10 <sup>-06</sup>	2.81x10 <sup>-11</sup>	1.27x10 <sup>-10</sup>
Total Dioxin + Furan Toxicity Equivalent	1.65x10 <sup>-06</sup>	3.44x10 <sup>-11</sup>	1.56x10 <sup>-10</sup>
Aluminum (particulate)	0.129	2.68x10 <sup>-06</sup>	1.22x10 <sup>-05</sup>
Aluminum (vapor phase)	0.091	1.89x10 <sup>-06</sup>	8.55x10 <sup>-06</sup>
Aluminum (combined particulate and vapor)	0.22	4.57x10 <sup>-06</sup>	2.07x10 <sup>-05</sup>
Barium (particulate)	0.0033	6.92x10 <sup>-08</sup>	3.14x10 <sup>-07</sup>
Barium (vapor phase)	0.0078	1.62x10 <sup>-07</sup>	7.33x10 <sup>-07</sup>
Barium (combined particulate and	0.011	2.31x10 <sup>-07</sup>	1.05x10 <sup>-06</sup>

vapor)			
Cadmium	0.0037	7.67x10 <sup>-08</sup>	3.48x10 <sup>-07</sup>
Copper	0.0092	1.93x10 <sup>-07</sup>	8.73x10 <sup>-07</sup>
Iron (particulate)	0.104	2.17x10 <sup>-06</sup>	9.83x10 <sup>-06</sup>
Iron (vapor phase)	0.026	5.32x10 <sup>-07</sup>	2.41x10 <sup>-06</sup>
Lead	0.043	8.87x10 <sup>-07</sup>	4.02x10 <sup>-06</sup>
Magnesium (particulate)	0.015	3.11x10 <sup>-07</sup>	1.41x10 <sup>-06</sup>
Magnesium (vapor phase)	0.0056	1.16x10 <sup>-07</sup>	5.25x10 <sup>-07</sup>
Nickel	0.032	6.63x10 <sup>-07</sup>	3.00x10 <sup>-06</sup>
Zinc	0.050	1.04x10 <sup>-06</sup>	4.70x10 <sup>-06</sup>

<sup>1</sup> As discussed in Section 5.1.1, estimated emission factors were derived from pilot facility emission test results, pilot study waste feed rates, pilot study exhaust gas flow rates, and emission control factors to account for the effects of the HEPA and carbon filters proposed for the ATG gasification and vitrification building. Modeling analysis results are based on the ISCST3 dispersion model assuming 24 consecutive hours of low wind speeds, poor dispersion conditions (stability categories E and F) and persistent wind directions (randomized fluctuations within 10 degrees either side of the mean direction). Stack tip downwash and building wake effects were included in the model runs. Feed rates for the Hanford Site LLMW will vary significantly on a daily basis, ranging from no Hanford Site LLMW on some days to 250 or more pounds per hour on other days. Averaged over a 250-day work year, Hanford Site LLMW processing will average 77.6 pounds per hour.

Source: Sculley 1996.

**Table 5-2  
Radiological Characteristics of Hanford Site Low-level Mixed Waste**

<b>Fission Products</b>	<b>Activity in current stockpile (Ci)<sup>a</sup></b>	<b>Activity in Current Stockpile + Future Stockpile<sup>b</sup></b>	<b>Activity/Shipment (inbound)<sup>c</sup></b>	<b>Activity/Shipment (outbound)<sup>d</sup></b>
Cs-137	26.6	153.0247	0.9564	1.0202
Sr-90	24.24	139.4481	0.8716	0.9297
H-3	4.2	24.1618	0.1510	0.1611
Fe-55	2.78	15.9928	0.1000	0.1066
Mn-54	1.38	7.9389	0.0496	0.0529
Ce-144	0.4	2.3011	0.0144	0.0153
Co-60	0.27	1.5533	0.0097	0.0104
Eu-154	0.2	1.1506	0.0072	0.0077
Pm-147	0.18	1.0355	0.0065	0.0069

  

<b>Alpha-bearing radionuclides</b>	<b>Weight of Current Stockpile (g)<sup>e</sup></b>	<b>Activity in current stockpile (Ci)<sup>f</sup></b>	<b>Activity in Current Stockpile + Future Stockpile<sup>b</sup></b>	<b>Activity/Shipment (inbound)<sup>c</sup></b>	<b>Activity/Shipment (outbound)<sup>d</sup></b>
Pu-241	1.2	135.4741	779.356	4.87098	5.19571
Pu-238	0.13	2.1617	12.436	0.07772	0.08290

Am-241	0.6	1.9126	11.003	0.06877	0.07335
Pu-239	11.27	0.6998	4.026	0.02516	0.02684
Pu-240	0.7	0.1590	0.915	0.00572	0.00610
Np-237	11.27	0.0078	0.045	0.00028	0.00030

Mobile Isotopes	Activity in current stockpile (Ci) <sup>g</sup>	Activity in Current Stockpile + Future Stockpile <sup>b</sup>	Activity/Shipment (inbound) <sup>c</sup>	Activity/Shipment (outbound) <sup>d</sup>
C-14	0.082	0.4717	0.0029	0.0031
I-129	0.23	1.3231	0.0083	0.0088
Tc-99	0.015	0.0863	0.0005	0.0006

a From Table 12, Place (1994); includes isotopes responsible for 99 percent of the activity

b Current stockpile = 890 m<sup>3</sup>; current stockpile + future stockpile = 5120 m<sup>3</sup>

c Assuming 160 inbound shipments

d Assuming 150 outbound shipments

e From Table 14, Place (1994); includes isotopes responsible for 99.9 percent of the activity

f Calculated using specific activity for each isotope; calculated by Specific activity (Ci/g) = 3.578 x 10<sup>5</sup>/(half-life (years) x atomic mass)

g From Table 23, Place (1994)

**Table 5-3 Radiological Dose and LCF from Incident-free Transportation of LLMW to and from the ATG Gasification and Vitrification Building**

Inbound Waste	Workers	Non-workers
Average annual population dose (person-rem/yr)	0.025	0.0098
10-year cumulative population dose (person-rem)	0.25	0.098
10-year cumulative LCF	1.0x10 <sup>-04</sup>	4.9x10 <sup>-05</sup>
10-year maximally exposed individual (rem)	n/c*	9.3x10 <sup>-05</sup>
<b>Outbound Waste</b>		
Average annual population dose (person-rem/yr)	0.023	0.0092
10-year cumulative population dose (person-rem)	0.23	0.092
10-year cumulative LCF	9.4x10 <sup>-05</sup>	4.6x10 <sup>-05</sup>
10-year maximally exposed individual (rem)	n/c*	8.75x10 <sup>-05</sup>

Source: Tetra Tech 1996.

\*Not calculated by model.

**Table 5-4 Human Health Risk from Inhalation of ATG Gasification and Vitrification Building Air Emissions**

Chemical	Site Conc. Worker/Resident (g/m <sup>3</sup> )	Inhalation SF (g/kg- day) <sup>-1</sup>	Oral RfD (g/kg- day)	Resident RBSC- CA g/m <sup>3</sup>	Resident RBSC-NC g/m <sup>3</sup>	Worker RBSC- CA g/m <sup>3</sup>	CA Risk Resident	CA Risk Worker
2-Me phenol	6.99x10 <sup>-06</sup>		0.05		794.89			
4-Me phenol	5.90x10 <sup>-06</sup>		0.005		79.49			
Acenaphthalene	4.10x10 <sup>-06</sup>		0.03		476.93			
Acetaldehyde	6.40x10 <sup>-02</sup>	0.03		0.53		0.48	1.21x10 <sup>-07</sup>	1.34x10 <sup>-07</sup>
Acetophenone	3.00x10 <sup>-06</sup>		0.1		1589.78			
Benzoic acid	3.80x10 <sup>-04</sup>		4		63591.11			
Bis-(2-Ethylhexyl phthalate)	1.70x10 <sup>-02</sup>	0.014	0.02	1.14	317.96	1.02	1.50x10 <sup>-08</sup>	1.66x10 <sup>-08</sup>
Butyl Benzyl Phthalate	1.20x10 <sup>-04</sup>		0.2		3179.56			
Dibutyl Phthalate	3.40x10 <sup>-05</sup>		0.1		1589.78			
Dichlorobenzene	1.20x10 <sup>-06</sup>	0.11		0.14	0.00	0.13	8.30x10 <sup>-12</sup>	9.23x10 <sup>-12</sup>
Diethyl phthalate	1.50x10 <sup>-05</sup>		0.8		12718.22			
Dime Phthalate	2.40x10 <sup>-06</sup>		10		158,978			
Dioxins(Toxicity Equivalent)	1.60x10 <sup>-10</sup>	150,000		1.06E <sup>-07</sup>			1.51x10 <sup>-09</sup>	1.68x10 <sup>-09</sup>
Fluorene	2.90x10 <sup>-06</sup>		0.04		635.91			
Formaldehyde	1.30x10 <sup>-02</sup>	0.14	0.02	0.11	317.96	0.10	1.14x10 <sup>-07</sup>	1.27x10 <sup>-07</sup>
Napthalene	3.90x10 <sup>-05</sup>							
Nitrogen Oxides	2.30x10 <sup>-01</sup>							
Phenanthrene	4.90x10 <sup>-06</sup>		0.03		476.93			
Phenol	8.50x10 <sup>-05</sup>		0.6		9538.67			
Barium	1.00x10 <sup>-06</sup>		0.07		1112.84			
Cadmium	3.50x10 <sup>-07</sup>	37.85		4.20E <sup>-04</sup>			8.33x10 <sup>-10</sup>	9.26x10 <sup>-10</sup>
Copper	8.70x10 <sup>-07</sup>		0.04		588.22			
Nickel	3.00x10 <sup>-06</sup>	2.8		0.01		0.01	5.28x10 <sup>-10</sup>	5.87x10 <sup>-10</sup>
Zinc	4.70x10 <sup>-06</sup>		0.3		4769.3333			
Total Cancer Risk							2.53x10 <sup>-07</sup>	2.81x10 <sup>-07</sup>

Toxicity of dichlorobenzene based on benzene

CA= Cancer; RBSC=Risk Based Screening Concentration; Calculated using risk =  $1 \times 10^{-6}$ ; HQ=0.25; NC= Noncancer; RfD= Reference Dose; SF= Slope Factor

Note: Hazard Quotient calculations not shown due to extremely low numbers; i.e. largest HQ (4-me phenol)= $7.4 \times 10^{-08}$   
 Site concentrations are the maximum predicted concentrations downwind of the stacks. Site concentrations are based on modeling analyses assuming a waste feed rate of 150 pounds per hour. The expected annual average feed rate for the Hanford Site LLMW will be 77.6 pounds per hour over a 250-day work year.

**Table 5-5 Comparison Between ATG Airborne Site Chemical Concentrations and Regulatory Standards**

CHEMICAL	Site Conc. <sup>a</sup> mg/m <sup>3</sup>	PELs mg/m <sup>3</sup>	ASIL mg/m <sup>3</sup>
Aluminum Oxide <sup>b</sup>	0.000009	5000	17
Aluminum <sup>b</sup>	0.00001	5000	33
Carbon Monoxide	0.14	55000	NA
Hydrochloric Acid	0.006	7000	7
Hydrogen Fluoride	0.0003	2500	8.7
Iron Oxide	0.000006	10000	NA
Lead	0.000004	50	0.5
Magnesium Oxide	0.0000007	15000	33
Naphthalene	0.00004	50000	170

NA = Not Available

<sup>a</sup> Based on highest predicted concentration as a conservative estimate.

<sup>b</sup> Respirable particle concentration.

**Table 5-6 Population Radiological Exposures Resulting from 10 Years of Normal Processing of Hanford Site Waste**

	Cumulative Dose person- rem	Maximum Annual Dose person-rem	Number of Latent Cancer Fatalities	Controlling Nuclide	Controlling Pathway
Offsite population within 80 kilometers	0.0095	0.00093	0.000047	H-3	Ingestion

Source: Leung 1996.

Table 5-7 contains the results of the analyses, which shows that the maximally exposed individual member of the public would receive 0.0018 mrem from 10-years of facility operations, or an average 0.00018 mrem per year. This dose is less than 0.02 percent of the EPA regulatory limit of 10 mrem per year (Subpart I of 40 CFR 61) and 0.002 percent of the annual limit for total radiological exposure of 100 mrem per year (10 CFR 20 Subpart D). The controlling pathway for the public doses is ingestion of food products grown locally, and the controlling nuclide is H-3.

**Table 5-7 Radiological Exposures to the Public and Worker Resulting from Normal Processing of Hanford Site Waste**

	<b>Total Effective Dose Equivalent in mrem</b>	<b>Risk of Fatal Cancer</b>	<b>Controlling Nuclide</b>	<b>Controlling Pathway</b>	<b>Risk of Fatal Cancer</b>
MEI--Public at 800 meters	0.0018	$9.0 \times 10^{-10}$	H-3	Ingestion	$9.0 \times 10^{-10}$
MEI--Worker at 100 meters	0.00017	$6.0 \times 10^{-11}$	H-3	Inhalation	$6.0 \times 10^{-11}$

Notes:

1. Site 300 Joint frequency files are used, the site where the facility is located.
2. MEI Public (Maximally Exposed Individual) is calculated to be at 800 meters from release point.
3. Worker is calculated at a distance of 100 meters from the release point for all sectors. The sector with the highest dose is evaluated with all radionuclides.
4. The above dose computes total exposure from both beta and alpha-emitting radionuclides.
5. Operation assumed to continue for 10 years. Uptake by residents is assumed to continue for a period of 30 years after operation shutdown.
6. Fatal Cancer Risk = Frequency (equal to 1.0) x Dose in rem x  $5.0 \times 10^{-4}$  fatal cancer per rem (ICRP-60 conversion factor) for the public if dose is less than 20 rem. For worker, the factor is  $4.0 \times 10^{-4}$  fatal cancer per rem.

MEI Public—Assumptions

1. 30 years of food intake
2. Release ends after 10 years
3. Finite plume, ground and recreation external, inhalation uptake, terrestrial foods ingestion, animal product ingestion, and inadvertent soil ingestion all considered.

Worker—Assumptions

1. Intake, if any, ends after 10 years
2. Annual number of hours of exposure to plume and ground contamination is 2000
3. Same sector as the MEI public calculation
4. Exposure pathways considered are finite plume, ground external, and inhalation uptake

Source: Leung 1996.

**Table 5-8  
Population Radiological Exposures and Number of Latent Cancer Fatalities Resulting from a Worst-Case Credible Accident Scenario Occurring During a 10-Year Operational Period**

	<b>Cumulative Effective Dose Equivalent person-rem</b>	<b>Frequency of Exposure in 10-year Period</b>	<b>Number of Latent Cancer Fatalities</b>	<b>Controlling Nuclide</b>	<b>Controlling Pathway</b>
Offsite population within 80 kilometers	0.05	0.001	$2.5 \times 10^{-08}$	Pu-238	Inhalation

**Table 5-9 Radiological Exposures to Public and Worker from Accident Scenario Over a 10-year Period of Facility Operations**

	<b>Total Effective Dose Equivalent mrem</b>	<b>Frequency of Event in 10-year Period</b>	<b>Risk of Latent Cancer Fatality</b>	<b>Controlling Nuclide</b>	<b>Controlling Pathway</b>
MEI--Public at 800	2.5	0.001	$1.2 \times 10^{-09}$	Pu-238	Inhalation

Worker at 100 meters                      1.8                      0.001                       $7.2 \times 10^{-10}$                       Pu-238                      Inhalation

Note:

1. Accident under evaluation is a fire that occurs during the processing of the inventory.  $1 \text{ m}^3$  ( $4 \text{ ft}^3$ ) of material is released into the inventory (half of the volume of the process chamber). All filters are assumed disabled.
2. Total of curie released is  $7.0 \times 10^{-03}$  curie.
3. The release fractions used are from the Elders, "Guide of Radiological Accident Consequences for Siting & Design of DOE Non reactor Nuclear Facilities" (LA-10294-MS).
4. Frequency of a fire in the facility is estimated to be  $1 \times 10^{-02}$  o  $1 \times 10^{-03}$  per year. Probability that fire results in the above event assumed to be 0.1. Frequency of Event in a 10-year period =  $1 \times 10^{-02} \times 1 \times 10^{-01} \times 10 \text{ years} = 1 \times 10^{-02}$
5. Uptake of radionuclides for the MEI-Public is assumed to continue for 30 years
6. Fatal Cancer Risk =Frequency x Dose in Rem x  $5.0 \times 10^{-04}$  fatal cancer per rem for MEI-Public and  $4.0 \times 10^{-04}$  for Worker.

Source: Leung 1996.

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**Table 5-10 Total Storage Capacities of Mixed Waste Storage Building**

Building Location	Area Building Location	Storage Type	Number of Containers	Container Type	Number of Containers	Total Containers Stored	Container Volume (ft <sup>3</sup> )	Total Volume Stored (ft <sup>3</sup> )
Pre-engineered building	1 Bulk Raw Waste Storage Area	Sea Van Storage	2	Sea Van	Stored on Floor	2	2,560.00	5,120
		18-yd <sup>3</sup> Roll-off Box Storage	4	Roll-Off Box	Stored on Floor	4	486.00	1,944
		B-25 Box Storage	4	B-25 Box	Stored on Floor	4	100.00	400
	2 Stabilized Waste Storage	Stabilized Waste Storage	2	B-25 Box	4	8	100.00	800
		Stabilized Waste Storage	48	55-gal Drum	3	144	7.30	1,051
		Stabilized Waste Storage	24	55-gal Drum	6	144	7.30	1,051
		Stabilized Waste Storage	96	55-gal Drum	9	864	7.30	6,307
Modular Waste Storage	3 Containerized Raw Wastes Storage	Stabilized Waste Storage	18	64 ft <sup>3</sup> Box	4	72	64.00	4,608
		Stabilized Waste Storage	9	64 ft <sup>3</sup> Box	1	9	64.00	576
Modular Waste Storage	3 Containerized Raw Wastes Storage	Raw Waste Storage	48	55-gal Drum	2	96	7.30	701
		Raw Waste Storage	12	85-gal Drum	4	48	11.20	538

	Raw Waste Storage	96	55-gal Drum	3	288	7.30	2,102
	Raw Waste Storage	6	85-gal Drum	2	12	11.20	134
4	Containerized Reactive, Corrosive, ignitable waste storage	32	55-gal Drum	1	32		234
	Corrosive Waste Storage	32	55-gal Drum	1	32	7.30	234
	Flammable/Ignitable Waste Storage	32	55-gal Drum	1	32	7.30	234

Source: ATG 1996b.

## Section 6 Permits and Regulatory Requirements

This section describes permits and regulations applicable to hazardous waste transport and ATG gasification and vitrification facility operation. The proposed action is subject to federal, state, and local permits and regulations governing the storage, treatment, handling, and transport of LLMW.

### 6.1 Facility Operation

Table 6-1 lists the major permits and approvals required for ATG gasification and vitrification facility operation, and related permitting or approving agencies. The ATG gasification and vitrification facility also must comply with WSHWMA, Hanford Site Solid Waste Acceptance Criteria, NRC, and other federal, state, and local regulations.

#### 6.1.1 Resource Conservation and Recovery Act (PL 94-580)

The RCRA required the EPA to establish regulations governing the handling of hazardous wastes. These regulations are set forth in EPA Administered Permit Programs: The Hazardous Waste Permit Program (40 CFR 270) and they set standards for generators and transporters of hazardous wastes, including owners and operators of storage, treatment, and disposal facilities. The general permit requirements for all TSDF are described in Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR 264). RCRA regulations also require owners and operators of a TSDF to obtain an operating permit for the ATG gasification and vitrification facility from the appropriate state regulatory agency, which is Ecology.

The ATG gasification and vitrification building is expected to be permitted as a miscellaneous thermal treatment unit under Washington Administrative Code 173-303-680, Miscellaneous Units.

The Part B permit application for the ATG gasification and vitrification facility will contain detailed information on the facility description and site specific information, such as facility inspection schedules (40 CFR 270). The application will outline and detail the general requirements necessary to demonstrate compliance with 40 CFR 264 standards, including emission controls.

The permit application will contain chemical and physical characteristics of the waste to be treated, the waste analysis procedures, waste acceptance criteria, security procedures, engineering design criteria and supporting drawings, waste handling procedures, and other information required by EPA and Ecology to verify compliance. The application also will include data from the demonstration test operations, optimized operating parameters of the ATG gasification and vitrification process including operating temperatures, waste feed rates and mass balance studies, training methodology, and location of pollution prevention equipment. The approved Part B permit would be subject to changes, updates, and

regulatory agency-approved modifications (see 40 CFR 270.42).

### **6.1.2 Toxic Substances Control Act (PL 94-469)**

In addition to Ecology's approval of the ATG gasification and vitrification process, a TSCA Part B permit from the EPA would be required. The RCRA Part B permit will be modified to include TSCA requirements. The result is expected to be a RCRA/TSCA permit. Ecology and EPA Region X would decide which would be the controlling agency.

### **6.1.3 Treatment of PCBs by Alternative Methods**

The gasification and vitrification process is an alternative method to an EPA designated best demonstrated and available technology (BDAT) for PCBs, and will be permitted as an alternative method. The RCRA Part B permit will include tests to demonstrate that treatment with gasification and vitrification is equivalent to treatment with a BDAT technology.

### **6.1.4 Technology Equivalency Approvals**

Since gasification and vitrification is a nonincinerator process, approvals from Ecology will be needed for treating RCRA wastes designated with incineration and combustion treatment codes. RCRA Part B permit application will include equivalency test plans for complying with requirements for treatment wastes with INCIN codes.

### **6.1.5 Radiological Permit**

An amendment to ATG's current radioactive waste license to include the gasification and vitrification facility operations will be required from the Washington State Department of Health.

### **6.1.6 Air Permits**

The federal Clean Air Act (PL 91-604) and State of Washington regulations require many types of industrial facilities to obtain air quality permits prior to construction or operation. State and federal requirements generally are addressed through integrated permit regulations established by state or local air pollution control agencies. Air quality permits for facilities in Benton, Franklin, or Walla Walla Counties are processed by the Benton, Franklin, Walla Walla Air Pollution Control Authority. Federal aspects of such permits include prevention of significant deterioration requirements for attainment areas, new source review requirements for nonattainment areas, and NESHAP requirements. Federal Title V operating permit requirements also might apply if the proposed facilities cause emissions from the overall ATG site to exceed threshold quantities for either criteria pollutants or hazardous air pollutants. Compliance with state hazardous air pollutant ambient concentration limits also will be addressed as part of the air quality permit process.

## **6.2 Transportation**

The loading and transport of hazardous waste will be governed by the applicable regulations, orders, and guidance of agencies such as DOE, Ecology, DOT, NRC, and EPA. These regulations, orders, and guidance cover shipping, packaging, vehicle safety, routing of shipments, and protection of workers. Regulations specific to hazardous waste transport include the following:

### ***State of Washington***

WAC 173-303 - State of Washington Administrative Code, "Dangerous Waste Regulations," as amended. Administered through Ecology.

### ***Department of Transportation***

49 CFR 171 - General Information, Regulations, and Definitions

49 CFR 172 - Hazardous Materials Table and Hazardous Materials Communications Regulations

49 CFR 173 - Shippers-General Requirements for Shipments and Packaging

49 CFR 177 - Carriage by Public Highway

49 CFR 178 - Shipping Container Specifications

**Other**

10 CFR 71 - Packing and Transportation of Radiological Material

40 CFR 260 - Hazardous Waste Management System: General

40 CFR 261 - Identification and Listing of Hazardous Waste

40 CFR 262 - Standards applicable to Generators of Hazardous Waste

49 CFR 107 - Hazardous Materials Program Procedures

49 CFR 263 - Standards applicable to Transporters of Hazardous Waste

49 USC 1801 - Hazardous Materials Transportation Act

**6.3 Worker Safety**

The OSHA, RCRA, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), require RCRA TSDf to take steps to prevent injury and illness, to limit worker exposure to hazardous chemicals, to develop emergency planning, and to provide the community with information. ATG will be required to annually report on these required activities, including the reporting of hazardous chemical quantities.

ATG would utilize a hazard communication program (29 CFR 1910.1200), train waste operation and emergency response personnel (29 CFR 1910.120 HAZWOPER), educate employees, and prevent, control, and minimize impacts resulting from hazardous chemical releases according to a SPCC plan (40 CFR 264.52). For the ATG gasification and vitrification building ATG would be required to maintain up-to-date copies of material safety data sheets (MSDS) and a master list of all hazardous chemicals associated with operations. The SPCC plan contained within the RCRA Part B permit application would include information on personal protective equipment (e.g., respirators, suits, gloves), engineering controls, and management procedures to minimize hazards to personnel and the environment. Laboratory personnel would be protected by conformance with regulatory requirements of 29 CFR 1910.1450.

**Table 6-1 Major Permits and Approvals Required for ATG Gasification and Vitrification Facility Operation**

<b>Permit</b>	<b>Permitting Agency</b>
RCRA Part B	Washington State Department of Ecology
Treatment of PCBs by Alternative Methods (TSCA)	US Environmental Protection Agency
Notification of PCB Activity (TSCA)	US Environmental Protection Agency
Radiological Air Permit (NESHAP)	Washington State Department of Health
Radiological Permit Update	Washington State Department of Health

Source: RCRA Part B Application.

## Section 7 Agencies Consulted

Agencies contacted for information during preparation of this EA include the Washington State Department of Ecology, City of Richland Planning Department, the Benton County Planning Department, and the Benton County Clean Air Authority.

The Oregon Department of Energy, Washington State Department of Ecology, Wanapum People, Yakama Indian Nation, Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation were notified of the intent to prepare this EA (see Appendix D). Copies of the draft EA will be distributed to these entities and others for a 30-day review period. All comments received during the review period will be considered in preparing the final EA.

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## **8.2 Personal Communications**

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### Summary

The US Department of Energy (DOE) needs to treat contact-handled low-level mixed waste (LLMW), containing polychlorinated biphenyls (PCBs) and other organics, to meet existing regulatory standards for eventual disposal. Part of the Hanford Site LLMW to be treated is being stored at Hanford Site's 200 West Area, and the rest will accumulate and be added to the stockpile between now and the year 2010. Treatment of the waste would reduce its volume by approximately 90 percent.

Treatment followed by land disposal would reduce long-term surveillance and maintenance burdens at Hanford Site and would be in compliance with interagency agreements. Allied Technology Group, Inc. (ATG), a commercial company, would transport the waste to its gasification and vitrification facility for treatment and return the treated waste to Hanford Site for disposal.

The proposed action and the no action alternative are analyzed in detail. Additional alternatives are discussed but not analyzed in detail because, for reasons identified, have been determined to be infeasible. These alternatives include the construction of a treatment facility at Hanford Site's 200 West Area; treatment of the waste at either an existing facility or at a proposed facility at the Idaho National Engineering Laboratory, Idaho Falls, Idaho; and treatment at a proposed facility at Oak Ridge, Tennessee. All action alternatives include the assumption that the treated waste would be returned to Hanford Site for disposal, as under the proposed action.

Under the no-action alternative the waste would continue to be accumulated and stored at Hanford Site. The need to treat the waste so that it may be safely disposed of would not be met. A treatment facility that previously had been considered for Hanford Site would have reduced transport distances to near zero, but that proposal was rejected by DOE as being too costly. Transport of the waste to Idaho or Tennessee for treatment would increase the risk of public and worker exposure because of the increased transport distances.

The potential for individual and cumulative environmental impacts from the proposed action has been analyzed and no substantial adverse environmental effects have been identified. Analyses of postulated accident scenarios have concluded that accident risks associated with the proposed action would be small.

Quantitative evaluations were performed of dose and risk to the public and workers from radioactive materials or hazardous chemical releases during incident-free transport and normal operations. Evaluations were also performed of the dose and risk for accident scenarios for transport and treatment operations. These evaluations involved the use of modeling to predict environmental impacts.

Modeling of radiological exposures predicted that a member of the public receiving the maximum exposure during 10 years of incident-free transport would receive less than 0.01 percent of the maximum allowable dose from a licensed nuclear facility during one year of operation. Annual worker exposure is predicted to be less than 0.25 percent of the annual limit for workers. No observable health effects are predicted to result from incident-free transport. Predicted public and worker radiological exposures from an accident occurring along the rural transport route are small fractions of the regulatory limits. No observable health effects are expected to result from transport accidents. The predicted exposures for both incident-free and transportation accidents are based on the results of the transportation model RADTRAN 4.

Excess cumulative cancer risk for the maximally exposed individual member of the public and for workers from exposure to nonradiological chemical constituents in the building stack emissions are predicted to be less than one in a million. None of the modeled pollutant concentrations approach or exceed relevant state or federal air quality standards or ambient concentration guidelines. These conclusions are based on results from the air dispersion model ISCST3, maintained by the US EPA.

Ten years of normal processing is predicted to expose an individual member of the public to less than 0.02 percent of the annual regulatory radiological limit for air exposures (100 millirem) and less than 0.002 percent of the annual limit for total radiological exposure. Worker exposure is predicted to be less than 0.000004 percent of the annual regulatory limit for workers (5,000 millirem). As for transportation, no health effects that would be observable in the local population are expected to result from 10 years of normal processing. As for chemical exposures, the excess cumulative cancer risk was modeled for both residential and worker scenarios and was found to be less than one excess cancer per one million exposed population. This is less than the standard of significance, which is one excess cancer per 100,000 exposed population. These results are based on the results of the air dispersion model GENII developed at the Pacific Northwest National Laboratory.

Predicted exposures resulting from the accidental release of the entire contents of the main process chamber into the gasification and vitrification building, the worst-case credible accident scenario, are less than 0.01 percent of the limit established by the US Department of Energy for major credible accidents. As for transportation, no observable health effects are expected to result from a worst-case credible accident.