AIR QUALITY PERMITTING
TECHNICAL MEMORANDUM

Permit to Construct No. 023-00001

BNFL, INC. / DEPARTMENT OF ENERGY

ADVANCED MIXED WASTE TREATMENT FACILITY

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Project No. P-020504

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Permit Status:

FINAL

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ACRONYMS, UNITS, AND CHEMICAL NOMENCLATURE LIST

AAC	Acceptable Ambient Concentration
AACC	Acceptable Ambient Concentration for Carcinogens
acfm	actual cubic feet per minute
AIRS	Aerometric Information Retrieval System
AFT	AIRS Facility System
αLLMW	alpha low-level mixed waste
AM-241	Americum 241
AMWTF	Advanced Mixed Waste Treatment Facility
AMWTP	Advanced Mixed Waste Treatment Project
AP-42	Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources
BNFL	BNFL, Inc.
C-14	carbon 14
CAP-88	Clean Air Act Assessment Package - 1988
CFR	Code of Federal Regulations
CO	carbon monoxide
day/yr	days per year
DEQ	Idaho Department of Environmental Quality
DOE	U.S. Department of Energy
DWHE	drummed waste-handling enclosure
DWPG	drummed waste-processing glovebox
EDE	effective dose equivalent
EPA	Environmental Protection Agency
gr/dscf	grains per dry standard cubic feet
H-3	Tritium
HEPA	high-efficiency particulate air
hr/day	hours per day
HVAC	heating, ventilation, and air conditioning
IDAPA	a numbering designation for all administrative rules in Idaho promulgated in accordance with the Idaho Administrative Procedures Act
INEEL	Idaho National Engineering and Environmental Laboratory
lb/hr	pound per hour
m^3	cubic meter(s)
MMBtu/hr	million British thermal units per hour
mrem/yr	millirems per year
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards For Hazardous Air Pollutants
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NSPS	New Source Performance Standards
OP	operating permit
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
Pu-238	Plutonium 238
Pu-241	Plutonium 241
PSD	Prevention of Significant Deterioration
PTC	permit to construct
PTE	potential to emit
PW	process weight
SO_2	sulfur dioxide
SO_x	sulfur oxides
TAP	toxic air pollutant
TRU	Transuranic
TSA	Transuranic Storage Area
T/yr	tons per year
VOC	volatile organic compound
WC	waste category

PURPOSE

The purpose for this memorandum is to satisfy the requirements of IDAPA 58.01.01.200, *Rules for the Control of Air Pollution in Idaho,* and to document the factual basis for issuing this permit to construct (PTC).

PROJECT DESCRIPTION

A modified PTC application was submitted by BNFL, Inc. (BNFL) for the Advanced Mixed Waste Treatment Facility (AMWTF) located at the Idaho National Engineering and Environmental Laboratory (INEEL). This application represents the second revision to a PTC application for the AMWTF submitted by BNFL in April 1998. Within the second revision of the original PTC application, proposed modifications to the AMWTF design include:

- The deletion of the incineration, evaporation, macro-encapsulation, and micro-encapsulation processes;
- A shift from thermally processing a significant number of sludge-type (non-debris) waste containers to non-thermally treating primarily debris-type wastes; and
- An increase in box line throughput.

The original ventilation system proposed was modified to include removal of carbon adsorption units and some particulate filtration units. Emissions estimates were revised to reflect the proposed modifications.

SUMMARY OF EVENTS

April 16, 1998:	BNFL submitted a PTC application for the AMWTF.
May 22, 1998:	The Idaho Department of Environmental Quality (DEQ) declared the PTC application complete.
July 13, 1998:	BNFL withdrew the PTC application based on removal of the vitrifier system.
October 13, 1998:	BNFL submitted a revised PTC application for the AMWTF (PTC Revision 1).
November 4, 1998:	BNFL submitted additional information in support of the revised PTC application.
November 16, 1998:	DEQ declared the revised PTC application complete.
April 15, 1999 - June 28, 1999:	DEQ held a public comment period for the proposed PTC application (PTC Revision 1).
May 25, 1999:	DEQ held a public hearing for the proposed PTC application (PTC Revision 1).
September 10, 1999:	DEQ issued PTC No. 023-00001 for the AMWTF to the U.S. Department of Energy (DOE) and BNFL. DEQ performed the technical analysis based on the revised PTC application.
April 7, 2000:	DEQ received a written request from DOE to remove the incinerator and evaporator units from the PTC.
July 19, 2000:	DEQ issued PTC No. 023-00001 for the AMWTF to the DOE and BNFL. The incinerator, evaporator units, and micro-encapsulation system were not included in this PTC.

August 30, 2000:	The BNFL submitted a Notice of Initiation of Construction in accordance with PTC No. 023-00001 for the AMWTF.
August 15, 2001:	The BNFL submitted a second revision to the PTC application for the AMWTF. (PTC Revision 2)
March 1, 2002 - April 1, 2002:	DEQ held an opportunity to request a public comment period for the PTC application. (PTC Revision 2)
April 19, 2002	DEQ issued PTC No. 023-00001 for the AMWTF to DOE and BNFL.
May 9, 2002	BNFL submitted a request for changes to PTC No. 023-00001 issued for the AMWTF on April 19, 2002.

DISCUSSION

1. Process Description

This section provides a brief description of the processes that occur within the AMWTF. For a detailed description, please refer to the PTC application.

The Advanced Mixed Waste Treatment Project (AMWTP) is designed to process approximately 65,000 cubic meters (m^3) of alpha low-level mixed waste (αLLMW), transuranic (TRU) contact-handled mixed waste, and radioactive-only waste from the TRU Storage Area (TSA); plus an additional 20,000 m^3 of waste during the first 13 years of operation. The ultimate goal is to process the waste stored at the INEEL Radioactive Waste Management TSA to produce final waste forms certified for disposal at the Waste Isolation Pilot Plant in New Mexico, or other waste management units. The AMWTF is part of the AMWTP.

Construction of the AMWTF began in August 2000 with completion scheduled for August 2002. The AMWTF is expected to treat approximately 46,600 m^3 of the 65,000 m^3 of waste processed by the AMWTP. The operational lifetime of the AMWTP may be extended if an option to treat an additional 100,000 m^3 of DOE waste is exercised.

The AMWTF is designed, built, and operated by BNFL under a privatized, non-commercial contract with the DOE. The AMWTF has the capability to treat specified INEEL waste streams, with the flexibility to treat other applicable INEEL and DOE waste streams generated at INEEL or at other locations.

The process section of the AMWTF is divided into three ventilation confinement zones to minimize the potential for waste constituents to be released to the environment via the air pathway. Air within the AMWTF generally flows from the outside through the clean areas into Zone 1, then into Zone 2, and finally into Zone 3. Exhaust from the Zone 3 ventilation confinement zone is drawn, via extract fans, through high-efficiency particulate air (HEPA) filters, then discharged via the main stack. Under normal operating conditions, uncontained waste is located only in Zone 3 areas, while Zone 1 and 2 areas remain radiologically clean and accessible to workers. Subchange rooms with airlock doors allow personnel and supplies to pass from one ventilation zone to another without disrupting Zone 3 airflow. (Airlock doors prevent more than one set of doors from being opened at any time. If more than one set of airlock doors is open at one time, an alarm is activated.)

The material transfer system is used to remotely convey waste containers, clean containers, and transfer containers filled with waste around the AMWTF in a safe and efficient manner. This overall system consists of the:

- Waste box receiving and processing system,
- Low-level waste box import/export,
- Waste drum receiving and staging system,
- Central conveyor system,
- Waste drum assay system,
- Waste drum fill system,
- Empty drum receiving and staging system, and
- Puck drum import and export system.

Pretreatment within the AMWTF occurs primarily in box lines. The AMWTF currently contains two box lines located on the central south side of the second floor. A series of first floor waste-transfer conveyors and elevators feeds containers up to the second floor box line-sorting areas. The containers are filled with waste, lowered to the box line/drum conveyor areas, lidded, and transferred to downstream treatment areas. Boxes pass from Zone 1, to Zone 2, and Zone 3 box line areas through a series of variable geometry doors. Containers are lidded until they enter the box open and sort cells within Zone 3. All boxes that enter the AMWTF are opened and processed in one of the two box lines.

Waste containers and waste in the box lines are handled remotely within concrete cells. Waste samples are collected in the box lines for laboratory analysis when additional waste characterization is required prior to downstream treatment. Following sorting in one of the box lines, the waste (in containers) is typically transferred to the central conveyor system, pending assay, or to an assay cell, where it is radio-assayed. After radio-assay, containers are typically transferred to the central conveyor system or directly to a downstream treatment area.

The special case waste area includes a glovebox system consisting of a transfer glovebox, treatment glovebox, sampling glovebox, container-in-container glovebox, and bag-out transfer ports. The special case waste glovebox system interfaces with the material transfer system on the first floor via an airlock door and elevator.

The drum repack system consists of a drum waste-handling enclosure (DWHE) and the drummed waste packaging glovebox (DWPG). Containers are received into the DWHE through an airlock door and elevator that interfaces with the material transfer system on the first floor. The DWHE consists of a drum-opening station with a ventilation hood, sorting cart(s), drum lift/tipping equipment, various tools/equipment, an empty drum-crushing machine, and an area for staging waste drums. The DWPG portion of the drum repack system is used for repackaging waste into containers. Typically, special case waste items are bagged out of the DWPG and hand carried to the special case waste glovebox system.

The supercompaction treatment area consists of the infeed glovebox, the supercompactor glovebox, and the postcompaction glovebox. Containers that are destined for supercompaction are conveyed to the infeed glovebox, where they are prepped (i.e., punctured) for supercompaction. From the infeed glovebox, containers enter the supercompactor, where they are compacted with a hydraulic press. Once supercompacted, the pucks are transferred to the postcompaction glovebox.

The post-compaction glovebox contains a puck staging area and a puck drum loading area. Once fully loaded, the puck drums are lidded and fed out of the postcompaction glovebox via conveyors to the clean drum staging area. From there, the containers are transferred out of the AMWTF.

Three stacks convey AMWTF exhaust to the atmosphere: the main stack (a rectangular support frame), a boiler stack, and a potable hot water heater stack/flue. Table 1 lists the extract flues, along with the area(s) each flue serves. Exhausts from treatment processes and ventilation zones are separately conveyed to the atmosphere in three individual circular flues of varying sizes within the main stack.

The water boiler stack and the heater stack extend from the utility room. The three heating, ventilation, and air conditioning (HVAC) hot water boiler exhaust flues are clustered in a triangle; a steel frame provides structural support. The heater stack conveys exhaust from the potable hot water heater only.

Table 1. AMWTF EXTRACT FLUES AND AREAS SERVED

Extract Flue (Stack)	Stack Height (feet)	Design Flow Rate (acfm[a])	Design Discharge Velocity (feet per minute)	Exit Temperature (°F)[b]	Maximum Exit Diameter (inches)	Areas and/or Systems Served
Zone 1/ Zone 2 Extract (Main)	90	67,045	4,000	72	56	Areas designated Zone 1 or 2 (no emission sources)
Zone 3 Extract (Main)	90	30,010	4,000	72	37	Areas designated Zone 3, including emission sources: Box lines DWHE[c]
Glovebox Extract (Main)	90	635	4,000	72	5.5	Areas designated Zone 3 gloveboxes, including emission sources: Supercompactor gloveboxes DWPG[d] Special case waste gloveboxes
HVAC[e] Hot water boilers (parameters for each of 3 total) (Boiler)	51	4,880	1,848	350	22	Exhaust from propane-fueled HVAC hot water boilers (two operating, one standby)
Potable hot water heater (Heater)	34	1,025	959	425	14	Exhaust from propane-fueled potable hot water heater

[a] actual cubic feet per minute
[b] Exit temperatures specified for main stack flues are nominal. Exit temperatures vary with seasonal weather changes and operation of heat recovery system
[c] drum waste handling enclosure
[d] drum waste processing glovebox
[e] heating, ventilation, and air conditioning

2. Emission Estimates

Air pollutant emissions have been estimated based on normal year-round operations of the AMWTF. For purposes of air quality permitting, emissions have been calculated on a potential to emit (PTE) basis for criteria air pollutants, radionuclides, and other toxic air pollutants (TAPs). The PTE for all of these pollutants is based on bounding limitations imposed by the PTC, which include throughput limits, control device requirements, and facility operations of 24 hours per day and 8,760 hours per consecutive 12-month period. This section is a summary of all calculations, assumptions, and control device efficiencies used in determining the PTE.

2.1 General Assumptions

Particulate matter - In general, processes that disturb the waste, such as drilling, dumping, sorting, sizing, grinding, shredding, and handling, were assumed to generate particulate matter (PM) emissions. Combustion processes (i.e., operation of the boilers and heater) also contribute to PM emissions. All PM emissions were assumed to be particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}).

Volatile organic compounds - Volatile organic compounds (VOCs) were accounted for in areas where waste containers are not lidded, or where waste containing organic constituents is disturbed by sizing, drilling, or other disruptive activities. Operation of the boilers and the heater also contributes to VOC emissions. Semivolatile pollutants included in the waste inventory are treated as VOCs.

2.2 Source Emissions Summary

Process Emissions - Emissions calculations for facility processes were based on emission factors from applicable sections of the Environmental Protection Agency (EPA) publication AP-42, *Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources* (hereafter referred to as AP-42). If a good process match was not identified in AP-42, a conservative emission factor was derived from process knowledge and best engineering judgment.

Process emissions are generated at the facility during the DWHE and DWPG processes, and by operating the box lines, the supercompactor gloveboxes, and the special case waste glovebox system.

Exhausts from the DWHE and box lines are treated by three stages of HEPA filters prior to being emitted into the atmosphere through the Zone 3 flue of the main stack. Exhaust from the DWPG, supercompactor gloveboxes, and special case waste glovebox processes are treated by three stages of HEPA filters prior to being emitted into the atmosphere through the glovebox extract flue of the main stack. The first stage of filter banks contain a minimum of two parallel HEPA filters and serve local ducts. The second and third stages contain three parallel HEPA filters.

Removal efficiencies for emission control equipment were applied to each source to determine the abated emission rates. The HEPA filters in the AMWTF are rated at a minimum removal efficiency of 99.97% for 0.15 to 0.3 micron particles with an increasing efficiency for larger and smaller particles. A removal efficiency for HEPA filters of 99.9% was used in nonradioactive PM emissions calculations.

Particulate matter emissions are generated during facility process operations. There were no comparable AP-42 emission factors for these processes; therefore, the permittee estimated emissions by applying a safety factor to the PM emission factor for concrete batching operations listed in AP-42 Table 11.12-2. The PM emission factor used for process emissions was 20 pounds per ton of material processed.

Emissions estimates of PM from the DWHE/DWPG, box line, supercompactor gloveboxes, and special case waste glovebox processes were presented by the permittee in Table E-2 of the PTC application. These calculations were reviewed by DEQ staff and found consistent with DEQ methods. Table E-2 of the PTC application is presented in Appendix A of this technical memorandum. A summary of PM emissions is presented in Table 2 below.

For process VOC emissions, the AP-42 emission factor for solvent operations was applied. However, the "solvents" were contained in a liquid (e.g., lathe cutting oil) that was then stabilized with an absorbent, such as calcium silicate. The emission factors were applied to the liquid fraction of the waste. According to the permittee, process experience has shown that debris waste, which often consists of pieces of material with high surface areas exposed to surrounding air, retains a negligible amount of the original concentration of organic constituent.

Emissions estimates of VOCs from the DWHE/DWPG, box line, supercompactor gloveboxes, and special case waste glovebox processes were presented by the permittee in Table E-3 of the PTC application, and additional information was submitted on May 9, 2002. These calculations were reviewed by DEQ staff and found to be consistent with DEQ methods. Table E-3 from the additional information is presented in Appendix A of this technical memorandum. A summary of process VOC emissions is presented in Table 2 below.

From total VOC and PM emissions from process sources, individual TAP emissions were determined by multiplying the worst-case concentration percentage of each constituent in the applicable waste type (non-debris or debris) by the total VOCs or PM emitted for that process/area. The TAPs were separated into those that are likely to be emitted as VOCs and those likely to be emitted as PM.

Individual waste streams to be treated in the AMWTF have been grouped into seven debris waste categories (WC) and three non-debris WCs. The debris WCs have been grouped according to their primary matrix constituents into metal debris, inorganic debris, graphite, ceramic/brick debris, organic debris, paper/rags/plastic/rubber, and heterogeneous debris. The non-debris WCs include inorganic homogeneous solids, organic homogeneous solids, and soil. The estimated concentrations of pollutants in each waste stream are based on previous analysis performed at INEEL. A summary of concentrations is presented in Appendix B. For each WC, the highest value for the estimated concentration of a particular pollutant in any of the waste streams in that WC is assigned to that pollutant for the WC. Where no estimated concentration is available, the maximum expected concentration is used. When no estimated or maximum expected concentration is available, a concentration of 1% is assigned.

Emissions estimates of TAPs from the DWHE/DWPG, box line, supercompactor gloveboxes, and special case waste glovebox processes were presented by the permittee in Table 4-3 of the PTC application. These calculations were reviewed by DEQ staff and found consistent with DEQ methods. Table 4-3 of the PTC application is presented in Appendix A of this technical memorandum. Emissions of TAPs are further discussed in Sections 3 and 6 of this memorandum.

Boilers and Heater - Emissions from the three HVAC hot water boilers and the potable hot water heater were calculated using emission factors obtained from AP-42, Table 1.5-1. Each HVAC boiler has a rated capacity of 12.55 million British thermal units per hour (MMBtu/hr), and the potable hot water heater has a rated capacity of 2.0 MMBtu/hr.

Emissions estimates from the boilers and hot water heater were presented by the permittee in Table 4-4 of the PTC application. These calculations were reviewed by DEQ staff and found consistent with DEQ methods. Table 4-4 of the PTC application is presented in Appendix A of this technical memorandum. A summary of emissions from the boilers and heaters is presented in Table 2 below.

Table 2. CRITERIA POLLUTANT EMISSIONS ESTIMATES

Advanced Mixed Waste Treatment Facility Emissions Limits - Hourly (lb/hr)[a] and Annual (T/yr)[b]										
	PM_{10}[c]		SO_2[d]		NO_X[e]		VOC[f]		CO[g]	
Source Description	**lb/hr**	**T/yr**	**lb/hr**	**T/yr**	**lb/hr**	**T/yr**	**lb/hr**	**T/yr**	**lb/hr**	**T/yr**
DWHE/DWPG	5.3E-09	2.3E-08	0	0	0	0	4.9E-04	2.1E-03	0	0
Box Lines	1.9E-08	8.3E-08	0	0	0	0	1.7E-03	7.4E-03	0	0
Super-compactor Gloveboxes	1.8E-08	7.9E-08	0	0	0	0	1.7E-03	7.4E-03	0	0
Special Case Wastes Glovebox	4.9E-12	2.1E-11	0	0	0	0	2.2E-04	9.5E-04	0	0
Boilers	1.7E-01	9.7E-02	4.2E-01	2.4E-01	5.3	3.1	1.4E-01	8.1E-02	8.9E-01	5.2E-01
Hot Water Heater	8.8E-03	1.9E-02	3.3E-02	7.3E-02	3.1E-01	6.8E-01	1.1E-02	2.4E-02	4.2E-02	9.2E-02
TOTAL	**1.8E-01**	**1.2E-01**	**4.5E-01**	**3.1E-01**	**5.6**	**3.7**	**1.6E-01**	**1.2E-01**	**9.3E-01**	**6.1E-01**

[a] lb/hr = pounds per hour
[b] T/yr = tons per year
[c] PM_{10} = particulate matter with mean diameter less than 10 micrometers
[d] SO_2 = sulfur dioxide
[e] NO_x = nitrogen oxides
[f] VOC = volatile organic compound
[g] CO = carbon monoxide

Radionuclide Emissions: - Construction approval for the AMWTF was previously granted to BNFL in October 1998 by EPA Region 10 based upon a facility design that included processes that have since been eliminated. The eliminated processes included incineration, evaporation, macro-encapsulation, micro-encapsulation, and an analytical laboratory. The physical and operational changes to the AMWTF do not constitute a modification under Title 40 of the Code of Federal Regulations (40 CFR) 61.15(a) because the physical changes do not result in an increase in the emission rate of an hazardous pollutant to which a standard applies. A revised National Emission Standard for Hazardous Air Pollutant (NESHAP) radionuclide analysis performed by BNFL was included in the PTC application; however, BNFL does not intend to submit the revised NESHAP analysis to EPA Region 10.

As previously discussed, the AMWTF will treat 65,000 m^3 of αLLMW and TRU, plus an additional 20,000 m^3 of DOE waste (assumed to be similar in content to the 65,000 m^3). Assumptions made in calculating radionuclide emissions included:

- The 20,000 m^3 of yet unidentified DOE waste to be treated will be similar (in radionuclide content, waste-type composition, and treatment required) to the 65,000 m^3 of waste currently at the TSA,
- The AMWTF will process 85,000 m^3 over a 13-year period, and operate 24 hr/day, 365 days/yr, and
- The radionuclide inventory is evenly distributed throughout the waste.

Appendix B of the PTC application contains the mass and volume balance process flow sheets that show the TSA waste quantities to be treated by the individual technologies at the AMWTF. Throughputs based on 85,000 m³ of waste for the areas that could contribute to the radioactive emissions at the AMWTF are presented in Appendix C of this memorandum. A combination of process knowledge, regulatory direction, and experience with the technologies used at the AMWTF was used to identify the areas that may contribute to airborne radionuclide emissions. Waste in intact, unopened containers does not contribute to radionuclide emissions in accordance with 40 CFR 61, Appendix D 2(a). Therefore, waste handling activities in Zone 1 and Zone 2 were not included in the NESHAP analysis.

An inventory of the radionuclides in TSA-stored waste based on previous analysis was used as the basis for inventory calculations. The radiological makeup of each box or drum of TSA waste is uncertain. Therefore, the analysis of radionuclide emissions assumes the radionuclides are evenly distributed throughout the waste. An inventory of radionuclides in the 65,000 m³ of TSA waste including a correction to account for the additional 20,000 m³ to be treated at the AMWTF is presented in Appendix C of this memorandum. The flues serving the Zone 3 areas and gloveboxes that exhaust through the main stack contribute to radioactive air emissions.

During processing, some fraction (release fraction) of the radionuclides in the waste is released to the ventilation system. A release fraction of 0.001 for liquids and particulate solids was used in accordance with 40 CFR 61, Appendix D 2(a)(ii). A release fraction of 1.0 was used for tritium (H-3) and carbon-14 (C-14) due to the gaseous physical state of these radionuclides. This is a conservative assumption, as most of the waste is solid and could be assigned a release fraction of 10^{-6} in accordance with 40 CFR 61, Appendix D.

The radionuclides released into the ventilation system are treated by HEPA filters. Values established in 40 CFR 61, Appendix D, Table 1 are used to determine a filtration factor for the HEPA filters for each of the two flues that contribute to radionuclide emissions. The filtration factors used for the analysis do not take credit for equipment not listed in 40 CFR 61, or for the actual efficiency of those that are listed. In practice, the filtration factor is significantly higher when the actual equipment and efficiencies are taken into account. Zone 3 flue and glovebox flue exhausts pass through three HEPA filters each, prior to being released into the atmosphere. A filtration factor of 0.01 is used for each HEPA filter in accordance with 40 CFR 61, Appendix D, Table 1. Therefore, the overall filtration factor is 1.0E-06.

The combined effect of the release fraction and filtration factor yield an overall fraction of 1.0E-09 of radionuclides processed at the AMWTF being released into the atmosphere, with the exception of H-3 and C-14. The overall fractions for these two radionuclides are 1.0E-06.

Modeling was performed using the Clean Air Act Assessment Package (CAP-88) computer code, an EPA-approved program designed for assessment of dose and risk from radionuclide emissions to air. The radionuclide emissions used for the CAP88-PC analysis are presented in Appendix C of this memorandum, as are the radionuclide inventory and annual throughputs. To arrive at the estimates in the table, the throughput for an area was multiplied by the activity concentration for a radionuclide, applying the appropriate factor(s) to account for filtration and release into the ventilation system. This was done for both flues to arrive at an unabated and abated value for the primary radionuclides identified as present in TSA waste.

The average yearly throughput - plus conservative radionuclide concentrations, release fractions, and filtration efficiencies - represent a worst-case, bounding scenario. It is conservatively assumed that radionuclides are conserved between subsequent processes. For example, the analysis assumed that a large portion of the radionuclides entering the box lines was present at the original concentrations in the subsequent supercompaction process.

3. Modeling Impact Assessment

On August 14, 2001, BNFL submitted a PTC application for the AMWTF. The ISCST3 model, an approved regulatory model, was used by BNFL to assess the ambient air quality impacts. The operating scenario modeled was for process equipment at the facility operating at full capacity as worst case. Full capacity included two of the three boilers operating for 8,760 hours per year (hr/yr). All sulfur oxide (SO_x) and nitrogen oxide (NO_x) emissions were modeled assuming that all SO_x was emitted as sulfur dioxide (SO_2) and all NO_x was emitted as nitrogen dioxide (NO_2). These are worst-case assumptions. The ambient impacts from operation of the AMWTF are given in Table 3 below. The ambient impacts are below the National Ambient Air Quality Standards (NAAQS) listed in IDAPA 58.01.01.577.

Table 3. AMBIENT IMPACTS OF CRITERIA POLLUTANTS

	SO_2[1]			PM_{10}[2]		CO[3]		NO_2[4]	Lead
	3-hour (µg/m³)[5]	24-hour (µg/m³)	Annual (µg/m³)	24-hour (µg/m³)	Annual (µg/m³)	1-hour (µg/m³)	8-hour (µg/m³)	Annual (µg/m³)	Quarterly (µg/m³)
A	40.4	12.9	1.5	4.9	0.6	202	46.6	18.5	1.2E-07
B	375	120	18.3	86	32.7	11,450	5,130	40	0.15
C	415.4	132.9	19.8	90.9	33.3	11,652	5,176.6	58.5	0.15
D	1,300	375	80	150	50	40,000	10,000	100	1.5

A Modeled Ambient Concentration
B Background Concentration
C Modeled Ambient Concentration plus Background Concentration
D National Ambient Air Quality Standards (NAAQS) for SO_2, PM_{10}, NO_2, and CO
1 SO_x = sulfur dioxide
2 PM_{10} = particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
3 CO = carbon monoxide
4 NO_2 = nitrogen dioxide
5 µg/m³ = micrograms per cubic meter

Process TAP emissions were evaluated and determined to be below state standards.

A comparison of estimated TAP emissions and screening levels listed in IDAPA 58.01.01.585 and .586 is presented in Appendix D. One compound, 1,1,2,2-tetrachlorethane, exceeded the screening level listed in IDAPA 58.01.01.585. The permittee modeled ambient impacts from all TAPs listed in Appendix D using refined modeling. The ambient impacts were below the respective acceptable ambient concentrations (AACs) listed in IDAPA 58.01.01.585 and acceptable ambient concentrations for carcinogens (AACCs) listed in IDAPA 58.01.01.586. A discussion of the modeling results used to establish the ambient impacts of the sources at the AMWTF is included in Appendix D.

Radionuclide impacts were modeled using the CAP-88 modeling program. The maximum individual dose at the southern INEEL boundary was calculated using the model. This receptor location represents the hypothetical, worst-case maximally exposed individual for the AMWTF and bounds any dose that would be received by an actual receptor. Based on the potential abated radionuclide releases, the effective dose equivalence (EDE) for that location is 8.4E-04 millirem per year (mrem/yr). Summaries of the throughputs, radionuclide inventory, annual potential abated and unabated emissions estimates, and potential annual unabated doses at the southern boundary as calculated by CAP-88 are presented in Appendix C.

4. Facility Classification

The AMWTF is considered a support facility to the INEEL. INEEL is an existing major facility as defined in IDAPA 58.01.01.006.55 and 16.01.01.008.14. There is not a significant net emissions increase of any regulated air pollutant from the AMWTF as defined in 58.01.01.006.92.

5. Area Classification

The AMWTF is located in Air Quality Control Region 61 and Zone 12. The AMWTF is located within the boundaries of the INEEL and Butte County in the southwest portion of the Idaho Falls regional district. Butte County is designated as unclassifiable for all criteria air pollutants.

6. Regulatory Review

IDAPA 58.01.01.006.55.i Major Facility

A major facility is defined as any facility that emits, or has the potential to emit (PTE), 100 tons per year (T/yr) or more of any regulated air pollutant. The INEEL has the PTE more than 100 T/yr of regulated air pollutants. Therefore, the INEEL is a major facility.

IDAPA 58.01.01.006.56 Major Modification

IDAPA 58.01.01.006.56 defines a major modification as a change to a major facility that would either result in significant net emission increases (as specified in IDAPA 58.01.01.006.92) of any regulated air pollutant. The results of the emissions calculations indicate that the AMWTF is not defined as a major modification. The results of the significant threshold analysis are shown in Table 6. Compounds from the significant emissions list specified in IDAPA 58.01.01.006.92 that are expected to be present in the wastes processed at the AMWTF or generated by AMWTF operations include asbestos, beryllium, CO, lead, mercury, NO_X, VOCs, PM, PM_{10}, radionuclides, and SO_2.

Two PTC applications were submitted by BNFL for facilities at the Radioactive Waste Management Complex (AMWTF and Transuranic Storage Area). It was determined appropriate by DEQ to consider annual emissions from both facilities when comparing emissions estimates to the significant emission thresholds. Emissions from both of these facilities are shown on Table 6. As shown in Table 6, the potential emissions from both facilities are below the significant thresholds.

Table 6. SIGNIFICANT EMISSION THRESHOLD ANALYSIS

Pollutant	AMWTF Emissions (T/yr)[a]	Transuranic Storage Area Emissions (T/yr)	Total Emissions From Both Facilities (T/yr)	Significant Emission Threshold (T/yr)
Asbestos	8.3E-08	3.2E-08	1.2E-07	7.0E-03
Beryllium	1.8E-09	7.1E-10	2.5E-09	4.0E-04
CO	6.1E-01	3.30E+00	7.2E+00	1.0E+02
Lead	4.6E-08	1.8E-08	6.4E-08	6.0E-01
Mercury	1.9E-04	4.7E-07	6.6E-04	1.0E-01
NO_x	3.7E+00	2.2E+01	2.6E+01	4.0E+01
VOCs	1.2E-01	1.1E+00	1.2E+00	4.0E+01
PM	1.2E-01	1.1E+00	1.2E+00	2.5E+01
PM_{10}	1.2E-01	1.1E+00	1.2E+00	1.5E+01
Radionuclides	8.4E-04 mrem/yr[b]	1.3E-02 mrem/yr	1.4E-02	0.1 mrem/yr
SO_2	3.1E-01	3.2E+00	3.5E+00	4.0E+01

[a] tons per year
[b] millirems per year

<u>IDAPA 58.01.01.006.58</u> <u>Modification</u>

IDAPA 58.01.01.06.58 defines a modification as any change in the method of operation at a stationary source that increases the amount of any regulated air pollutant. An exception is listed in subsection A for increases in the production rate, if such increases do not exceed the operating design capacity of the affected stationary source, and if a more restrictive production rate is not specified in a permit. The PTC application indicated a change in the method of operation including the deletion of the incineration, evaporation, macroencapsulation, and microencapsulation processes, a shift form thermally processing a significant number of sludge-type waste containers to nonthermally treatment, and an increase in the box line throughput. These changes in methods of operation result in an increase in the emissions of some pollutants from the AMWTF. Therefore, the changes are defined as a modification.

<u>IDAPA 58.01.01.201</u> <u>Permit to Construct Required</u>

A PTC is required to commence modification of any stationary source.

<u>IDAPA 58.01.01.202</u> <u>Application Procedures</u>

The permittee has complied with this *Rule* by providing necessary and requested information regarding facility operations, emissions, and controls.

<u>IDAPA 58.01.01.203</u> <u>Permit Requirements for New and Modified Stationary Sources</u>

The permittee shall comply with all applicable local, state, and federal emission standards. The permittee has demonstrated to the satisfaction of the DEQ that the facility will comply with applicable local, state, and federal emission standards, and the facility will not cause or significantly contribute to a violation of any ambient air quality standard.

IDAPA 58.01.01.210 Demonstration of Preconstruction Compliance with Toxic Standards

Toxic air pollutant emissions estimates were included within the PTC application, and are presented in Appendix D of this memorandum. The PTE emission rates were compared against the screening level emission rates for each specific TAP as listed in 58.01.01.585 and .586. When the estimated emission rate of a TAP exceeded the screening level, the ambient impact was derived using the refined model ISCST3.

The pollutants' maximum ambient impact value was used to determine compliance with the acceptable ambient concentrations listed in IDAPA 58.01.01.585 or the acceptable ambient concentrations for carcinogens listed in IDAPA 58.01.01.586. The permittee demonstrated compliance for TAPs emitted from the AMWTF.

The potential emissions of 1,1,2,2-tetrachloroethane exceeded the screening level listed in IDAPA 58.01.01.586 of 1.1E-05 pounds per hour (lb/hr). The modeled ambient impact was 4.44E-04 micrograms per cubic meter, which is below the AACC listed in IDAPA 58.01.01.586. A summary of TAP emissions is presented in Appendix D.

IDAPA 58.01.01.212 Obligation To Comply

The permittee is responsible to comply with all applicable local, state, and federal statutes, rules, and regulations.

IDAPA 58.01.01.301 Requirement to Obtain a Tier I Operating Permit

No owner or operator may operate any Tier I source without an effective Tier I operating permit (OP). The AMWTF is located within INEEL, a major facility. The INEEL has submitted an application to obtain a Tier I OP. Therefore, the permittee must modify either the Tier I OP application, or the Tier I OP if it is issued prior to the issuance of this PTC.

IDAPA 58.01.01.577 Ambient Air Quality Standards for Specific Air Pollutants

Emissions of criteria pollutants listed in IDAPA 58.01.01.577 were shown to comply with the respective Ambient Air Quality Standards. See Section 3 and Table 3 of this memorandum.

IDAPA 58.01.01.585/586 Toxic Air Pollutants

Emissions of TAPs listed in IDAPA 58.01.01.585 and 586 were shown to comply with applicable AACs and AACCs.

IDAPA 58.01.01.590 New Source Performance Standards

IDAPA 58.01.01.590 states that the owner or operator of any stationary source shall comply with 40 CFR 60 as applicable to the stationary source. Each of the three propane-fired boilers maximum rated heat capacity is 12.555 MMBtu/hr; therefore, the boilers are subject to 40 CFR 60 Subpart Dc, *Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units*. The maximum rated heat input capacity of the potable water heater is 2.0 MMBtu/hr; therefore, it is not subject to New Source Performance Standard requirements.

IDAPA 58.01.01.625 Visible Emissions

The facility will not discharge any pollutant to the atmosphere from any stack or vent for a period or periods aggregating more than three minutes in any 60-minute period that is greater than 20% opacity as determined by the EPA Test Method 9.

IDAPA 58.01.01.650 Rules For Control of Fugitive Dust

The facility is required to take all reasonable precautions to prevent the generation of fugitive dust.

IDAPA 58.01.01.676 and .677 Fuel-burning Equipment - Particulate Matter

A person shall not discharge into the atmosphere from any fuel-burning equipment with a maximum rated input of less than 10 MMBtu/hr, or from fuel-burning equipment with a maximum rated input capacity of 10 MMBtu/hr or more and commencing operation on or after October 1, 1979, PM from liquid fuel combustion in excess of 0.050 grains per dry standard cubic foot (gr/dscf) corrected to 3% oxygen. The emission standards in IDAPA 58.01.01.676 and .677 apply to the propane-fired boilers and potable hot water heater at the facility. A combustion evaluation is presented in Appendix E of this memorandum. The estimated emissions from the boilers and potable water heater are 0.0045 gr/dscf corrected to 3% oxygen; therefore, these equipment pieces comply with the standard.

IDAPA 58.01.01.701 Particulate Matter - New Equipment Process Weight Limitations

The permittee shall not emit to the atmosphere from any process point of emissions PM in excess of:

- $0.045(PW)^{0.60}$ lb/hr, if process weight (PW) is less than 9,250 lb/hr, or
- $1.10(PW)^{0.25}$ lb/hr, if PW is greater than or equal to 9,250 lb/hr.

The facility is subject to the PW limit of IDPA 58.01.01.701 for its DWHE, DWPG, box lines, supercompactor glovebox, and special case waste glovebox processes. The evaluation of the PW limit for these processes is presented in Appendix F of this memorandum. The evaluation is based on the maximum throughputs limits presented in the PTC. Based on these throughput limits and the operation of the HEPA filters, the facility complies with the PW limits established by the equations in IDAPA 58.01.01.701.

40 CFR 60.40c Subpart Dc Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

The three boilers at the AMWTF are subject to NSPS 40 CFR 60.40c. The emissions requirements of Subpart Dc are summarized below. Monitoring, recordkeeping, and reporting requirements are presented in the Tier II OP.

- 60.40c(a): Subpart Dc apply to steam generating units that have a heat input capacity of greater than or equal to 10 MMBtu/hr but less than 100 MMBtu/hr. The maximum steam generating capacity of each boiler is approximately 12.555 MMBtu/hr; therefore, Subpart Dc is applicable.

- 60.42c(d): To comply with the SO_2 standard, BNFL will not burn oil with a sulfur content greater than 0.5% by weight. Compliance with the fuel oil sulfur limit is based on a 30-day rolling average as provided in 60.42c(g).

- 60.43c(c): The opacity standard in this section applies to units that combust oil and have a heat input capacity of 30 MMBtu/hr or greater. The boilers at the AMWTF have a heat input capacity of 12.555 MMBtu/hr; therefore, the opacity standard does not apply to these boilers.

40 CFR 61 — National Emission Standards for Hazardous Air Pollutants (NESHAP) and Maximum Achievable Control Technology (MACT)

The NESHAP section 40 CFR 61, Subpart H is applicable to AMWTF. Below is a general summary of the provisions of 40 CFR 61, Subpart H as they apply to the AMWTF.

The permittee shall not emit radionuclides into the ambient air in excess of concentrations that would cause any member of the public to receive in any year an EDE of 10 mrem/yr in accordance with 40 CFR 61.92.

The NESHAP analysis determined that monitoring of both the Zone 3 and glovebox flues that contribute to the AMWTF's radioactive air emissions is required in accordance with 40 CFR 61.93(b)(4) since the calculated unabated doses (2.9E+02 mrem/yr for the glovebox flue and 2.7E+02 mrem/yr for the Zone 3 flue) at the INEEL boundary each exceed 0.1 mrem/yr.

Appendix C of this memorandum presents summaries of potential (i.e., unabated) doses for the glovebox and Zone 3 flues, respectively. For each flue, the radionuclides contributing to greater than 10% of the total are americium-241 (Am-241) at 49%, plutonium-238 (Pu-238) at 28%, and plutonium-239 (Pu-239) at 18%; therefore, these three radionuclides must be measured in accordance with 40 CFR 61.93(b). Sampling port locations for the ventilation ducts are accessed from the penthouse. The ducts are designed to accommodate isokinetic radionuclide sampling in accordance with 40 CFR 61.93.

Measurements and data correspondence relating to sampling or monitoring systems, performance testing measurements, equipment calibration checks, and maintenance performed on the systems or equipment are kept in accordance with the AMWTF quality assurance program. Radionuclide emissions are reported annually in the INEEL NESHAP radionuclide reports in accordance with 40 CFR 61.94. Records documenting radionuclide emission input parameters, calculations, analytical methods, and the procedure used to determine the EDE are maintained at the facility for five years in accordance with 40 CFR 61.95.

7. Permit Requirements

The purpose of the PTC is to ensure that regular facility operation does not result in pollutant emissions that exceed applicable regulatory limits.

7.1 Emission Limits

The facility is subject to 40 CFR 61, Subpart H , which states that radionuclides shall be monitored continuously from the sampling site. The monitoring methodology must follow the guidance presented in ANSI/HPS N13.1, 1999, *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities.*

An emission limit for NO_X emissions per consecutive 12-month period from the three boilers is established in the PTC. The limit was requested by BNFL to ensure combined NO_X emissions from the AMWTF and the Transuranic Storage Area do not exceed the significant threshold limit stated in IDAPA 58.01.01.006.92.a.

The permit does not establish any other criteria pollutant emission limits from the waste processing, the three boilers, or the one hot water heater at the AMWTF. This equipment could potentially operate 8,760 hours per year (hr/yr) at maximum capacity and not cause a violation of NAAQS, nor would the emissions exceed the significant emissions rates listed in IDAPA 58.01.01.006.92.a. In addition, when in operation, emissions from propane combustion in the boilers and heater should be relatively constant with little fluctuation.

7.2 Operating Requirements

The emissions estimates for the facility were based on a waste throughput of 85,000 m^3, therefore, the permit limits the waste throughput of the AMWTF to 85,000 m^3.

The permit establishes throughput limits for the DWHE, DWPG, box lines, supercompactor gloveboxes, and special case waste glovebox systems. As discussed in Section 7.1 of this technical memorandum, these processes have associated does impact limits for radionuclides. The radionuclide emissions estimates were based on process throughputs. Therefore, operating requirements for these five processes were established to ensure compliance with the emissions limits.

In addition, limiting the process throughputs ensures compliance with the AACs and AACCs for TAP emissions from waste processing. Emissions of TAP were evaluated based on the PTE based on the throughput limits for the five processes at the AMWTF and the waste characterization presented in the permit application. Based on this information, TAP emissions were in compliance with the AACs and AACCs. Therefore, it is assumed that compliance with the process waste throughput limits demonstrates compliance with the TAP ambient standards established in IDAPA 58.01.01.585 and .586.

As discussed in Section 7.1 of this memorandum, an emission limit for NO_x emissions per any consecutive 12-month period from the three boilers and water heater at the AMWTF was established. Emissions of NO_x directly correlate to the amount of fuel burned in the boilers based on EPA emission factors. Therefore, fuel consumption limits were established for the boilers. Boiler emissions are assumed to be non-fluctuating when operated at maximum capacity; therefore, compliance with the fuel throughput limits is assumed to demonstrate compliance with the NO_x emission limits per any consecutive 12-month period.

Emissions estimates of radionuclides were based on operating HEPA filters in conjunction with the Zone 3 and glovebox ventilation systems. Therefore, the PTC requires HEPA filter installation, calibration, maintenance, and operation. In addition, the facility is required to follow a maintenance program to ensure that all ventilation equipment is functioning as required. The maintenance program is detailed in Appendix B of the PTC.

8. AIRS Information

AIRS/AFS[a] FACILITY-WIDE CLASSIFICATION[b] DATA ENTRY FORM

AIR PROGRAM / POLLUTANT	SIP[c]	PSD[d]	NSPS[e] (Part 60)	NESHAP[f] (Part 61)	MACT[g] (Part 63)	TITLE V	AREA CLASSIFICATION A – Attainment U – Unclassifiable N – Nonattainment
SO_2[h]	B						U
NO_x[i]	B						U
CO[j]	B						U
PM_{10}[k]	B						U
PT (Particulate)[l]	B						
VOC[m]	B						U
THAP (Total HAPs)[n]	B						
			APPLICABLE SUBPART				
				H			

[a] Aerometric Information Retrieval System (AIRS) Facility Subsystem (AFS)

[b] AIRS/AFS Classification Codes:

- A = Actual or potential emissions of a pollutant are above the applicable major source threshold. For NESHAP only, class "A" is applied to each pollutant which is below the 10 T/yr threshold, but which contributes to a plant total in excess of 25 T/yr of all NESHAP pollutants.
- SM = Potential emissions fall below applicable major source thresholds **if and only if** the source complies with federally enforceable regulations or limitations.
- B = Actual and potential emissions below all applicable major source thresholds.
- C = Class is unknown.
- ND = Major source thresholds are not defined (e.g., radionuclides).

[c] State Implementation Plan
[d] Prevention of Significant Deterioration
[e] New Source Performance Standards
[f] National Emission Standards for Hazardous Air Pollutants
[g] Maximum Achievable Control Technology
[h] sulfur dioxide
[i] nitrogen oxides
[j] carbon monoxide
[k] particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
[l] particulate matter
[m] volatile organic compounds
[n] hazardous air pollutants

FEES

The AMWTF is located within INEEL, a major facility as defined in IDAPA 58.01.01.008.55; therefore, the facility is subject to registration fees.

RECOMMENDATION

Based on review of the application materials and applicable state and federal rules and regulations, DEQ staff recommends that DOE, INEEL, BNFL Inc. AMWTF be issued a PTC to allow the facility to process 85,000 m^3 of radioactive waste. An opportunity to request public comment period was held between March 1, 2002 and April 1, 2002. Requests for a comment period and a public hearing have not been received by DEQ. This project does not involve PSD requirements.

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APPENDIX A

ADVANCED MIXED WASTE TREATMENT FACILITY

IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

EMISSIONS CALCULATIONS

Table E-2. Total PM from Process Sources

Process Area		Process Rate	Waste Type	Waste Density	Waste Throughput	Emission Factor	HEPA Filter #1	HEPA Filter #2	HEPA Filter #3	Total PM Emitted
	Notes		a		b		c	c	c	d
	e	dm/dy		lb/dm	ton/hr	PM emitted	PM RE	PM RE	PM RE	lb/hr
DWHE/DWPG	f,g	43	D	294	0.26	1%	99.9%	99.9%	99.9%	5.3E-09
Box Lines	f,g,h	152	D	294	0.93	1%	99.9%	99.9%	99.9%	1.9E-08
Supercompactor Gloveboxes	f,g	150	D	294	0.92	1%	99.9%	99.9%	99.9%	1.8E-08
SCW Glovebox System	g,i	0.025	ND	471	0.00025	1%	99.9%	99.9%	99.9%	4.9E-12
Total PM										4.2E-08

a. Waste types: ND=Non-debris (OHS, IHS, S); D=Debris (CBD, G, HD, ID, MD, OD, PRPR).

b. For processes with process rates given in drums per day, Waste Throughput (ton/hr) = Process Rate (dm/dy) x Waste Density (lb/dm) / (2000 lb/ton x 24 hr/day).

c. The HEPA filters in the AMWTF are rated at a minimum RE of 99.97% for 0.15 to 0.3 micron particles with increasing efficiency for larger and smaller particles. This calculation assumes a conservative overall RE of 99.9% per HEPA filter.

d. Total PM Emitted (lb/hr) = Waste Throughput (ton/hr) x Emission Factor (lb/ton) x [1 - (PM RE1 (%) / 100)] x [1 - (PM RE2 (%) / 100)] x [1 - (PM RE3 (%) / 100)].

e. Unit appreviations: dm=drum; dy=day; lb=pound; hr=hour; RE=removal efficiency

f. The waste density is the maximum average debris density (from CBD).

g. Worst-case PM emissions are assumed to be generated by this process at a very conservative assumption of 1%. The PM emission factor of 1% (20 lb/ton) is 200 times greater than the emission factor for concrete batching (0.1 lb emitted/ton processed), which is a much dustier operation than waste sorting/sizing, supercompaction, or open container handling. Emission factors for concrete batching can be found in AP-42, Table 11.12-2.

h. The process rate of 10 boxes/day is equivalent to 152 55-gal drums/day (4x4x7 ft).

i. The worst-case PM emissions in the SCW Glovebox system is assumed from one (5 liters, maximum) container per day of organic sludge. The waste density is the maximum average non-debris density (from OHS).

Table E-3. Total VOCs from Process Sources (new table with 3.64 drums per day for SCW Glovebox).

Process Area		Process Rate	Waste Type	Waste Density	Waste Throughput	Liquid Throughput	Emission Factor	"VOC" Emissions
	Notes		a		b	c	d	e
	f	dm/dy		lb/dm	ton/hr	ton/hr	lb/ton	lb/hr
DWHE/DWPG	g	43	D	294	0.26	0.00068	0.72	4.92E-04
Box Lines	g,h	152	D	294	0.93	0.0024	0.72	1.74E-03
Supercompactor Gloveboxes	g	150	D	294	0.92	0.0024	0.72	1.72E-03
SCW Glovebox System	i	0.025	ND	471	0.00025	0.00025	0.72	1.76E-04
SCW Glovebox System	j	3.64	D	294	0.02	0.0001	0.72	4.17E-05
Total VOCs								4.17E-03

a. Waste types: ND=Non-debris (OHS, IHS, S); D=Debris (CBD, G, HD, ID, MD, OD, PRPR).
b. For processes with process rates given in drums per day, Waste Throughput (ton/hr) = Process Rate (dm/dy) x Waste Density (lb/dm) / (2000 lb/ton x 24 hr/day).
c. The quantity of liquid in the waste stream (except for SCW - see footnote i) is assumed to be up to 1% in up to 26% of the containers; therefore, Liquid Throughput = 0.01 x 0.26 x Waste Throughput.

d. Emission factors are from AP-42, Table 4.7-1, Emission Factors for Solvent Reclaiming. Processes handling (disturbing) waste use 0.72 lb VOCs emitted per ton of solvent (liquid). Areas where waste is not disturbed use 0.02 lb/ton (factor for a solvent storage tank vent). Also, liquid is not all VOCs (mostly aqueous or oil).
e. "VOC" Emissions (lb/hr) = Liquid Throughput (ton/hr) x Emission Factor (lb/ton). "VOCs" = Industrial lubricant (oil) contaminated with VOCs or aqueous solutions.
f. Unit appreviations: dm=drum; dy=day; lb=pound; hr=hour.
g. The waste density is the maximum average debris density (from CBD).
h. The process rate of 10 boxes/day is equivalent to 152 55-gal drums/day (4x4x7 ft).
i. The worst-case VOC emissions in the SCW Glovebox system is assumed from one (5-liters, maximum) container per day of organic sludge that is assumed to be in liquid form. The waste density is the maximum average non-debris density (from OHS).
j. The throughput for the SCW glovebox is 200 gallons per day or 3.64 drums per day. All assuptions as made for the other debris lines apply.

Table 4-3. Summary of Process Emissions Exiting the Main Stack

Pollutant	*Notes*	*Worst-Case Non-Debris*	*Worst-Case Debris*	*DWHE/ DWPG*	*Box Lines*	*Super-compactor Glovebox*	*SCW Glovebox System*	*Total Emissions*	
				a	*a*	*a*	*b*		
		wt%	*wt%*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*ton/yr*
"VOCs"	*c*			*4.9E-04*	*1.7E-03*	*1.7E-03*	*1.8E-04*	*4.1E-03*	*1.8E-02*
Volatiles									
Acetone		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Benzene		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Butanol, n- (n-butyl alcohol)		*0.001*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-09*	*3.9E-05*	*1.7E-04*
Butanone, 2- (methyl ethyl ketone)		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Carbon tetrachloride		*5*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*8.8E-06*	*4.8E-05*	*2.1E-04*
Chlorobenzene		*1*	*0*	*0.0E+00*	*0.0E+00*	*0.0E+00*	*1.8E-06*	*1.8E-06*	*7.7E-06*
Chloroform		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Dichloroethane, 1,2-		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Dichloroethylene	*d*	*0*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*0.0E+00*	*3.9E-05*	*1.7E-04*
Dichloroethylene, cis-1,2-	*d*	*0*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*0.0E+00*	*3.9E-05*	*1.7E-04*
1,1-Dichloroethylene		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Ethoxyethanol, 2-		*1*	*0*	*0.0E+00*	*0.0E+00*	*0.0E+00*	*1.8E-06*	*1.8E-06*	*7.7E-06*
Ethyl benzene		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Ethyl ether	*d*	*0*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*0.0E+00*	*3.9E-05*	*1.7E-04*
Isopropanol (isopropyl alcohol)		*0*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*0.0E+00*	*3.9E-05*	*1.7E-04*
Methane	*d*	*0*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*0.0E+00*	*3.9E-05*	*1.7E-04*
Methanol		*0.003*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*5.3E-09*	*4.0E-05*	*1.7E-04*
Methylene chloride		*0.07*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.2E-07*	*4.0E-05*	*1.7E-04*
Tetrachloroethane, 1,1,2,2-		*0*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*0.0E+00*	*3.9E-05*	*1.7E-04*
Tetrachloroethylene		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Toluene		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Trichloroethane, 1,1,1-	*d*	*15*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*2.6E-05*	*6.6E-05*	*2.9E-04*
Trichloroethane, 1,1,2-		*1*	*0*	*0.0E+00*	*0.0E+00*	*0.0E+00*	*1.8E-06*	*1.8E-06*	*7.7E-06*
Trichloroethylene		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Trichloro-1,2,2-trifluoroethane, 1,1,2-	*d*	*5*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*8.8E-06*	*4.8E-05*	*2.1E-04*
Xylene		*0.005*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*8.8E-09*	*4.0E-05*	*1.7E-04*
Semivolatiles									
Cyclohexane		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
Mercury		*2.5*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*4.4E-06*	*4.4E-05*	*1.9E-04*
Nitrobenzene		*1*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*1.8E-06*	*4.1E-05*	*1.8E-04*
1,2,4-Trimethylbenzene		*0*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*0.0E+00*	*3.9E-05*	*1.7E-04*
1,3,5-Trimethylbenzene		*0*	*1*	*4.9E-06*	*1.7E-05*	*1.7E-05*	*0.0E+00*	*3.9E-05*	*1.7E-04*
Total PM	*e*	*NA*	*NA*	*5.3E-09*	*1.9E-08*	*1.8E-08*	*4.9E-12*	*4.2E-08*	*1.8E-07*
Metals									
Arsenic		*1*	*1*	*5.3E-11*	*1.9E-10*	*1.8E-10*	*4.9E-14*	*4.2E-10*	*1.8E-09*
Barium		*1*	*1*	*5.3E-11*	*1.9E-10*	*1.8E-10*	*4.9E-14*	*4.2E-10*	*1.8E-09*
Beryllium		*1*	*1*	*5.3E-11*	*1.9E-10*	*1.8E-10*	*4.9E-14*	*4.2E-10*	*1.8E-09*
Cadmium		*1*	*1*	*5.3E-11*	*1.9E-10*	*1.8E-10*	*4.9E-14*	*4.2E-10*	*1.8E-09*
Chromium		*1*	*1*	*5.3E-11*	*1.9E-10*	*1.8E-10*	*4.9E-14*	*4.2E-10*	*1.8E-09*
Lead	*f*	*1*	*25*	*1.3E-09*	*4.6E-09*	*4.6E-09*	*4.9E-14*	*1.1E-08*	*4.6E-08*
Nickel		*1*	*0*	*0.0E+00*	*0.0E+00*	*0.0E+00*	*4.9E-14*	*4.9E-14*	*2.1E-13*
Selenium		*1*	*1*	*5.3E-11*	*1.9E-10*	*1.8E-10*	*4.9E-14*	*4.2E-10*	*1.8E-09*
Silver		*1*	*1*	*5.3E-11*	*1.9E-10*	*1.8E-10*	*4.9E-14*	*4.2E-10*	*1.8E-09*
Other Pollutants									
Asbestos		*0*	*45*	*2.4E-09*	*8.4E-09*	*8.3E-09*	*0.0E+00*	*1.9E-08*	*8.3E-08*
Cyanide		*1*	*0*	*0.0E+00*	*0.0E+00*	*0.0E+00*	*4.9E-14*	*4.9E-14*	*2.1E-13*
PCBs		*15*	*1*	*5.3E-11*	*1.9E-10*	*1.8E-10*	*7.4E-13*	*4.2E-10*	*1.9E-09*

a. Emission Rate (lb/hr) = Worst-Case Debris Concentration (wt%/100) x "VOC" Emissions (lb/hr) or Total PM (lb/hr).
b. Emission Rate (lb/hr) = Worst-Case Non-Debris Concentration (wt%/100) x "VOC" Emissions (lb/hr) or Total PM (lb/hr).
c. See Table E-3 in Appendix E for calculations of total VOCs.
d. Pollutant not regulated by IDAPA 58.01.01, "Rules for the Control of Air Pollution in Idaho."
e. See Table E-2 in Appendix E for calculations of total PM.
f. The worst-case debris concentration for lead is adjusted from the maximum expected concentration of 56% to a very conservative 25%. The lead in the debris waste is primarily in the form of lead shielding bricks, which are not size-reduced; therefore, little PM is generated during handling.

Table 4-4. Summary of Emissions from Boilers and Heater

Pollutant	*Emission Factor for Propane Boilers*			*HVAC Hot Water Boilers*	*Potable Hot Water Heater*	*Total Maximum Hourly Emissions*	*HVAC Hot Water Boilers*	*Potable Hot Water Heater*	*Total Annual Emissions*
	lb/1,000 gal			*lb/hr*	*lb/hr*	*lb/hr*	*ton/yr*	*ton/yr*	*ton/yr*
	Commercial[a]	*Industrial*[a]	*Notes*	*b*	*c*		*b*	*c*	
Maximum Usage (gal/hr for emissions in lb/hr, gal/yr for emissions in ton/yr)			*d,e*	*277.4*	*22.1*	*299.5*	*322,084*	*96,798*	*418,882*
Carbon monoxide	*1.9*	*3.2*		*8.9E-01*	*4.2E-02*	*9.3E-01*	*5.2E-01*	*9.2E-02*	*6.1E-01*
Nitrogen oxides	*14*	*19*		*5.3E+00*	*3.1E-01*	*5.6E+00*	*3.1E+00*	*6.8E-01*	*3.7E+00*
Sulfur dioxide	*1.5*	*1.5*	*f*	*4.2E-01*	*3.3E-02*	*4.5E-01*	*2.4E-01*	*7.3E-02*	*3.1E-01*
PM/PM-10	*0.4*	*0.6*		*1.7E-01*	*8.8E-03*	*1.8E-01*	*9.7E-02*	*1.9E-02*	*1.2E-01*
Ozone (VOCs)	*0.5*	*0.5*		*1.4E-01*	*1.1E-02*	*1.5E-01*	*8.1E-02*	*2.4E-02*	*1.0E-01*

a. Emission factors are from AP-42, Table 1.5-1, Emission Factors for LPG Combustion for commercial boilers (heat input capacities generally between 0.3 and 10 million BTU/hr) and industrial boilers (heat input capacities generally between 10 and 100 million BTU/hr).

b. Three HVAC hot water boilers (2 operating, 1 redundant) each have a rated input capacity of 12,555,000 BTU/hr.

c. The potable hot water heater has a rated input capacity of 2,000,000 BTU/hr.

d. The maximum hourly usage is calculated by dividing the rated input capacity by 90,513 BTU/gal [heating value of commercial propane @ 2,488 BTU/ft^3 x 36.38 ft^3 of propane vapor (@ 60°F) per 1 gal liquid propane].

e. The annual propane usage is based on normal operation for one yr. The yearly usage for the HVAC boilers = [16,740,000 BTU/hr (HVAC design heating load) x 7,033 degree-days/yr x 24 hr/day x 0.65 (heating effect correction factor)] / [84°F (diff. temp.) x 0.75 (efficiency correction factor) x 90,513 BTU/gal]. The yearly usage for the hot water heater is based on 50% of maximum usage, or (22.1 gal/hr x 0.5) x 24 hr/day x 365 days/yr.

f. The emission factor for sulfur dioxide is 0.10 x S (S=15 gr/100 ft^3).

APPENDIX B

ADVANCED MIXED WASTE TREATMENT FACILITY

IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

WASTE CHARACTERIZATIONS

Table 4-1. Worst Case Pollutant Concentrations in AMWTF WCs

Pollutant	IHS	OHS	S	Worst-Case Non-Debris	CBD	G	HD	ID	MD	OD	PRPR	Worst-Case Debris
	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
Volatiles												
Acetone	0.01	1	-	1	-	-	1	1	1	-	1	1
Benzene	1	-	-	1	-	1	1	1	1	-	1	1
Butanol, n- (n-butyl alcohol)	0.001	0.001	0.001	0.001	-	-	1	-	-	-	-	1
Butanone, 2- (methyl ethyl ketone)	*1*	-	-	*1*	-	-	*1*	-	-	*1*	*1*	*1*
Carbon tetrachloride	0.075	5	0.07	5	-	1	1	1	0.001	1	1	1
Chlorobenzene	1	-	-	1	-	-	-	-	-	-	-	0
Chloroform	1	1	-	1	-	1	1	1	1	-	1	1
Dichloroethane, *1,2-*	1	-	-	1	-	-	-	-	-	-	1	1
Dichloroethylene[a]	-	-	-	0	-	-	-	-	1	-	-	1
Dichloroethylene, *cis-1,2-*[a]	-	-	-	0	-	-	-	-	-	-	1	1
Dichloroethylene, *1,1-*	1	1	-	1	-	-	1	1	1	1	1	1
Ethoxyethanol, 2-	1	-	-	1	-	-	-	-	-	-	-	0
Ethyl benzene	1	-	-	1	-	-	1	-	1	-	1	1
Ethyl ether[a]	-	-	-	0	-	-	1	-	-	-	-	1
Isopropanol *(isopropyl alcohol)*	-	-	-	0	-	-	-	-	-	1	-	1
Methane[a]	-	-	-	0	-	-	-	-	1	-	1	1
Methanol	0.003	0.001	0.001	0.003	-	1	1	-	1	-	1	1
Methylene chloride	0.07	0.005	0.005	0.07	1	1	1	1	0.02	0.1	1	1
Tetrachloroethane, *1,1,2,2-*	-	-	-	0	-	-	-	-	-	-	1	1
Tetrachloroethylene	1	1	1	1	-	1	1	1	-	-	1	1
Toluene	1	1		1	1	1	1	1	1	1	1	1
Trichloroethane, *1,1,1-*[a]	0.2	15	0.02	15	1	1	1	1	0.008	1	1	1
Trichloroethane, *1,1,2-*	1	-	-	1	-	-	-	-	-	-	-	0
Trichloroethylene	0.01	1	1	1	0.1		1	1	1	1	1	1
Trichloro-1,2,2-trifluoroethane, *1,1,2-*[a]	0.01	5	0.01	5	-	1	1	1	1	0.15	1	1
Xylene	*0.005*	*0.001*	*0.001*	*0.005*	*1*	-	*1*	*1*	*1*	*1*	*1*	*1*
Semivolatiles												
Cyclohexane	*1*	-	-	*1*	-	-	-	-	*1*	-	*1*	*1*
Mercury	*2.5*	*1*	*0.03*	*2.5*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Nitrobenzene	*1*	*1*	*1*	*1*	-	-	*1*	-	-	-	-	*1*
Trimethylbenzene, *1,2,4-*	-	-	-	0	-	-	-	-	-	-	1	1
Trimethylbenzene, *1,3,5-*	-	-	-	0	-	-	-	-	-	-	1	1
Metals												
Arsenic	1	1	-	1	1	-	1	1	1		1	1
Barium	1	1	-	1	1	-	1	1	1	1	1	1
Beryllium	1	1	-	1	-	-	-	-	1	-	-	1
Cadmium	0.001	0.001	1	1	1	-	1	1	1	-	1	1
Chromium	1	1	1	1	1	-	1	1	1	-	1	1
Lead	0.001	0.001	1	1	1	-	10	5	5	25	56	56
Nickel	1	1	-	1	-	-	-	-	-	-	-	0
Selenium	1	1	1	1	1	-	1	1	1	-	1	1
Silver	1	1	1	1	1	-	1	1	1	-	1	1
Other Pollutants												
Asbestos	-	-	-	0	-	-	-	45	-	-	-	45
Cyanide	1	-	-	1	-	-	-	-	-	-	-	0
Polychlorinated biphenyls (PCBs)	-	15	-	15	-	-	1	-	-	-	-	1

a. Pollutant not regulated by IDAPA 58.01.01, "Rules for the Control of Air Pollution in Idaho."

APPENDIX C

ADVANCED MIXED WASTE TREATMENT FACILITY

IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

RADIONUCLIDE EMISSIONS CALCULATIONS

Table 1. Throughput in Areas Contributing to AMWTF Radiological Emissions

		THROUGHPUT	
Area	Flow Sheet Node[a]	kilorgrams (total)	kilograms per year
1. ZONE 3 EXTRACT:			
Drummed waste handling enclosure[b]	2D	2,050,860	157,758
Box lines	2B	11,463,054	881,773
Total:		13,513,914	1,039,532
2. GLOVEBOX EXTRACT:			
SCW gloveboxes	13B, 13D, 15D	142,902	*10,992*
Supercompactor gloveboxes	7, 10, 14D, 16D	14,753,982	1,134,922
Drummed waste packaging glovebox[b]	NA[b]	170,905	13,147
Total:		15,067,789	1,159,061

[a] The flow sheet node refers to the mass and volume balances presented in Appendix B of the permit to construct application.

[b] The throughput of the drummed waste packaging glovebox is two drums per day from the drummed waste handling enclosure (which has a normal throughput of 1 drum/hr); therefore, the throughput of the drummed waste packaging glovebox is 2/24 of the drummed waste handling enclosure throughput.

Table 2. Radionuclide Inventory for TSA Waste and as Scaled for the AMWTF

Radionuclide[a]	Best Estimate Activity[b] (Ci)	Scaled Best Estimate[c] (Ci)	Activity Concentration in Waste[d] (Ci/kg)
Am-241	1.22E+05	1.60E+05	4.54E-03
Pu-238	1.16E+05	1.52E+05	4.32E-03
Pu-239	6.87E+04	8.98E+04	2.56E-03
Pu-240	1.59E+04	2.08E+04	5.92E-04
Pu-242	1.04E+00	1.36E+00	3.87E-08
Pu-241	1.61E+05	2.11E+05	6.00E-03
Ba-137m	2.25E+03	2.94E+03	8.38E-05
Cs-137	2.26E+03	2.96E+03	8.42E-05
Sr-90	2.02E+03	2.64E+03	7.52E-05
Y-90	2.02E+03	2.64E+03	7.52E-05
U-233	1.02E+03	1.33E+03	3.80E-05
Cm-244	5.39E+02	7.05E+02	2.01E-05
H-3	1.68E+02	2.20E+02	6.26E-06
Cs-134	1.11E+02	1.45E+02	4.13E-06
Co-60	1.00E+02	1.31E+02	3.72E-06
Bi-212	2.66E+01	3.48E+01	9.91E-07
C-14	2.38E+00	3.11E+00	8.87E-08
Ce-144	2.71E+01	3.54E+01	1.01E-06
Fe-55	1.13E+00	1.48E+00	4.21E-08
Kr-85	6.86E+00	8.97E+00	2.56E-07
Ni-63	3.57E+00	4.67E+00	1.33E-07
Pb-212	2.66E+01	3.48E+01	9.91E-07
Pm-147	2.73E+01	3.57E+01	1.02E-06
Po-212	1.70E+01	2.22E+01	6.33E-07
Po-216	2.66E+01	3.48E+01	9.91E-07
Pr-144	2.72E+01	3.56E+01	1.01E-06
Ra-224	2.66E+01	3.48E+01	9.91E-07
Sb-125	1.65E+00	2.16E+00	6.15E-08
Th-228	2.66E+01	3.48E+01	9.91E-07
Th-232	7.31E+00	9.56E+00	2.72E-07
Tl-208	9.54E+00	1.25E+01	3.55E-07
U-232	2.60E+01	3.40E+01	9.68E-07
U-234	5.78E+00	7.56E+00	2.15E-07
Total	4.94E+05	6.47E+05	1.84E-02

[a] Radionuclides from Table 11 INEL-95/0412. Radon (Rn-220) not included per 40 CFR 61, Subpart H.
[b] Best estimate activities in Curies (Ci) from Table 11 INEL-95/0412; the activity for tritium (H-3) has been adjusted to account for decay.
[c] Scaling factor is 85,000 m^3 / 65,000 m^3.
[d] Based on total mass of 35,107,163 kg.

Table 3. Annual Abated and Unabated Emissions Estimates for the AMWTF

	Zone 3 (Box Lines, DWHE)		Glovebox (SC, SCW, DWPG)		TOTAL	
Nuclide	Unabated Ci/yr (RF = 0.001)	Abated Ci/yr (FF = 1.0E-6)	Unabated Ci/yr (RF = 0.001)	Abated Ci/yr (FF = 1.0E-6)	Unabated Ci/yr	Abated Ci/yr
Am-241	4.72E+00	4.72E-06	5.27E+00	5.27E-06	9.99E+00	9.99E-06
Pu-238	4.49E+00	4.49E-06	5.01E+00	5.01E-06	9.50E+00	9.50E-06
Pu-239	2.66E+00	2.66E-06	2.97E+00	2.97E-06	5.63E+00	5.63E-06
Pu-240	6.16E-01	6.16E-07	6.86E-01	6.86E-07	1.30E+00	1.30E-06
Pu-242	4.03E-05	4.03E-11	4.49E-05	4.49E-11	8.52E-05	8.52E-11
Pu-241	6.23E+00	6.23E-06	6.95E+00	6.95E-06	1.32E+01	1.32E-05
Ba-137m	8.71E-02	8.71E-08	9.71E-02	9.71E-08	1.84E-01	1.84E-07
Cs-137	8.75E-02	8.75E-08	9.76E-02	9.76E-08	1.85E-01	1.85E-07
Sr-90	7.82E-02	7.82E-08	8.72E-02	8.72E-08	1.65E-01	1.65E-07
Y-90	7.82E-02	7.82E-08	8.72E-02	8.72E-08	1.65E-01	1.65E-07
U-233	3.95E-02	3.95E-08	4.40E-02	4.40E-08	8.35E-02	8.35E-08
Cm-244	2.09E-02	2.09E-08	2.33E-02	2.33E-08	4.41E-02	4.41E-08
H-3	6.51E+00	6.51E+00	7.25E+00	7.25E+00	1.38E+01	1.38E+01
Cs-134	4.30E-03	4.30E-09	4.79E-03	4.79E-09	9.09E-03	9.09E-09
Co-60	3.87E-03	3.87E-09	4.32E-03	4.32E-09	8.19E-03	8.19E-09
Bi-212	1.03E-03	1.03E-09	1.15E-03	1.15E-09	2.18E-03	2.18E-09
C-14	9.22E-02	9.22E-02	1.03E-01	1.03E-01	1.95E-01	1.95E-01
Ce-144	1.05E-03	1.05E-09	1.17E-03	1.17E-09	2.22E-03	2.22E-09
Fe-55	4.38E-05	4.38E-11	4.88E-05	4.88E-11	9.25E-05	9.25E-11
Kr-85	2.66E-04	2.66E-10	2.96E-04	2.96E-10	5.62E-04	5.62E-10
Ni-63	1.38E-04	1.38E-10	1.54E-04	1.54E-10	2.92E-04	2.92E-10
Pb-212	1.03E-03	1.03E-09	1.15E-03	1.15E-09	2.18E-03	2.18E-09
Pm-147	1.06E-03	1.06E-09	1.18E-03	1.18E-09	2.24E-03	2.24E-09
Po-212	6.58E-04	6.58E-10	7.34E-04	7.34E-10	1.39E-03	1.39E-09
Po-216	1.03E-03	1.03E-09	1.15E-03	1.15E-09	2.18E-03	2.18E-09
Pr-144	1.05E-03	1.05E-09	1.17E-03	1.17E-09	2.23E-03	2.23E-09
Ra-224	1.03E-03	1.03E-09	1.15E-03	1.15E-09	2.18E-03	2.18E-09
Sb-125	6.39E-05	6.39E-11	7.12E-05	7.12E-11	1.35E-04	1.35E-10
Th-228	1.03E-03	1.03E-09	1.15E-03	1.15E-09	2.18E-03	2.18E-09
Th-232	2.83E-04	2.83E-10	3.16E-04	3.16E-10	5.99E-04	5.99E-10
Tl-208	3.69E-04	3.69E-10	4.12E-04	4.12E-10	7.81E-04	7.81E-10
U-232	1.01E-03	1.01E-09	1.12E-03	1.12E-09	2.13E-03	2.13E-09
U-234	2.24E-04	2.24E-10	2.50E-04	2.50E-10	4.73E-04	4.73E-10
TOTAL	25.73	6.60	28.7	7.35	54.48	14

[a] Annual Zone 3 throughput is 1,039,532 kg/yr. Includes release fraction of 0.001 per 40 CFR Part 61, Appendix D.
[b] No credit for release fractions or removal efficiencies taken for tritium (H-3) or carbon-14 (C-14).
[c] Annual Glovebox throughput is 1,159,061 kg/yr. Includes release fraction of 0.001 per 40 CFR Part 61, Appendix D.

Table 4. Summary of Potential Doses from the Glovebox Flue at the INEEL Southern Boundary

Radionuclide	Unabated Dose (mrem/yr)	Radionuclide	Unabated Dose (mrem/yr)	Radionuclide	Unabated Dose (mrem/yr)
Am-241	1.43E+02	Cs-137	3.91E-03	Pm-147	2.62E-06
Pu-238	8.10E+01	H-3	2.12E-04	Po-212	0.00E+00
Pu-239	5.17E+01	Sr-90	1.23E-02	Po-216	0.00E+00
Pu-240	1.19E+01	Y-90	4.05E-05	Pr-144	1.83E-09
Pu-241	1.89E+00	Bi-212	1.22E-06	Ra-224	1.96E-04
Pu-242	7.44E-04	C-14	1.42E-04	Sb-125	2.28E-06
U-233	2.94E-01	Ce-144	2.80E-05	Th-228	1.40E-02
Ba-137m	2.51E-02	Fe-55	2.02E-08	Th-232	5.49E-03
Cm-244	3.32E-01	Kr-85	3.07E-11	U-232	2.66E-02
Co-60	1.33E-03	Ni-63	6.92E-08	U-234	1.65E-03
Cs-134	6.30E-04	Pb-212	8.89E-06		
				Total	2.9E+02

[a] The doses from individual isotopes were calculated by adjusting the isotopic breakdown given for the highest dose (for the distance modeled) by the ratio of the dose at the southern boundary to the highest dose.

Table 5. Summary of Potential Doses from the Zone 3 Flue at the INEEL Southern Boundary

Radionuclide	Unabated Dose (mrem/yr)	Radionuclide	Unabated Dose (mrem/yr)	Radionuclide	Unabated Dose (mrem/yr)
Am-241	1.33E+02	Cs-137	3.61E-03	Pm-147	2.43E-06
Pu-238	7.54E+01	H-3	2.01E-04	Po-212	0.00E+00
Pu-239	4.81E+01	Sr-90	1.13E-02	Po-216	0.00E+00
Pu-240	1.11E+01	Y-90	3.77E-05	Pr-144	1.68E-09
Pu-241	1.76E+00	Bi-212	1.12E-06	Ra-224	1.82E-04
Pu-242	6.94E-04	C-14	1.33E-04	Sb-125	2.12E-06
U-233	2.74E-01	Ce-144	2.60E-05	Th-228	1.30E-02
Ba-137m	2.32E-02	Fe-55	1.88E-08	Th-232	5.11E-03
Cm-244	3.10E-01	Kr-85	2.91E-11	Tl-208	7.74E-10
Co-60	1.23E-03	Ni-63	6.41E-08	U-232	2.49E-02
Cs-134	5.83E-04	Pb-212	8.27E-06	U-234	1.53E-03
				Total	2.7E+02

[a] The doses from individual isotopes were calculated by adjusting the isotopic breakdown given for the highest dose (for the distance modeled) by the ratio of the dose at the southern boundary to the highest dose.

APPENDIX D

ADVANCED MIXED WASTE TREATMENT FACILITY

IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

TOXIC AIR POLLUTANT EMISSIONS AND MODELING MEMORANDUM

SUMMARY OF TOXIC AIR POLLUTANT EMISSIONS

TABLE 1. NON-CARCINOGENS

Pollutant	Max. Hourly Emissions (lb/hr)	Screening Level (lb/hr)	Modeling? (Y/N)	Emissions (tons/yr)
Acetone	4.10E-05	1.2E+02	N	1.8E-04
Barium	4.20E-10	3.3E-02	N	1.8E-09
n-Butyl alcohol	3.90E-05	1.0E+01	N	1.7E-04
Chlorobenzene	1.80E-06	2.3E+01	N	7.9E-06
Chromium	4.20E-10	3.3E-02	N	1.8E-09
Cyanide	4.90E-14	3.33E-01	N	2.1E-13
Cyclohexane	4.10E-05	7.0E+01	N	1.8E-04
1,2-dichloroethylene	3.90E-05	5.27E+01	N	1.7E-04
2-Ethoxyethanol	1.80E-06	1.3E+00	N	7.9E-06
Ethylbenzene	4.10E-05	2.9E+01	N	1.8E-04
Isopropyl alcohol	3.90E-05	6.5E+01	N	1.7E-04
Methanol	4.00E-05	1.73E+01	N	1.8E-04
Mercury	4.40E-05	3.E-03	N	1.9E-04
Methyl ethyl ketone	4.10E-05	3.93E-01	N	1.8E-04
Nitrobenzene	4.10E-05	3.33E-01	N	1.8E-04
Selenium	4.20E-10	1.3E-02	N	1.8E-09
Silver	4.20E-10	7.E-03	N	1.8E-09
Toluene	4.10E-05	2.5E+01	N	1.8E-04
Trichloroethylene	4.10E-05	1.8E+01	N	1.8E-04
1,2,4-trimethylbenzene	3.90E-05	8.2E+00	N	1.7E-04
1,3,5-trimethylbenzene	3.90E-05	8.2E+00	N	1.7E-04
Xylene	4.00E-05	2.9E+01	N	1.8E-04

TABLE 2. CARCINOGENS

Pollutant	Max. Hourly Emissions (lb/hr)	Screening Level (lb/hr)	Modeling? (Y/N)	Emissions (tons/yr)
Arsenic	4.20E-10	1.5E-06	N	1.8E-09
Asbestos	1.90E-08	NA	N	8.3E-08
Benzene	4.10E-05	8.0E-04	N	1.8E-04
Beryllium	4.20E-10	2.8E-05	N	1.8E-09
Cadmium	4.20E-10	3.7E-06	N	1.8E-09
Carbon tetrachloride	4.80E-05	4.4E-04	N	2.1E-04
Chloroform	4.10E-05	2.8E-04	N	1.8E-04
Chromium VI	4.20E-10	5.6E-07	N	1.8E-09
1,1-dichloroethane	4.10E-05	2.5E-04	N	1.8E-04
1,1-dichloroethylene	4.10E-05	1.3E-04	N	1.8E-04
Methylene chloride	4.00E-05	1.6E-03	N	1.8E-04
Nickel	4.90E-14	2.7E-05	N	2.1E-13
PCBs	4.20E-10	6.6E-05	N	1.8E-09
1,1,2,2-tetrachloroethane	3.90E-05	1.1E-05	Y	1.7E-04
Tetrachloroethylene	4.10E-05	1.3E-02	N	1.8E-04
1,1,2-trichloroethane	1.80E-06	4.2E-04	N	7.9E-06
Trichloroethylene	4.10E-05	5.1E-04	N	1.8E-04

MEMORANDUM

TO: Michael Stambulis, State Office of Technical Services

FROM: Mary Anderson, MA Modeling Coordinator, Air Quality Division

SUBJECT: Modeling Review for the Permit to Construct Application for the Advanced Mixed Waste Treatment Facility (AMWTF)

DATE: April 4, 2002

1. SUMMARY:

A modified permit to construct (PTC) application was submitted by BNFL, Inc. (BNFL) for the Advanced Mixed Waste Treatment Facility (AMWTF) located at the Idaho National Engineering and Environmental Laboratory (INEEL). This application represents the second revision to a PTC application for the AMWTF submitted by BNFL in April 1998. Within the second revision of the original PTC application, proposed modifications to the AMWTF design include the deletion of the incineration, evaporation, macroencapsulation, and microencapsulation processes, a shift from thermally processing a significant number of sludge-type (non-debris) waste containers to nonthermally treating primarily debris-type wastes, and an increase in box line throughput. The ventilation system originally proposed was subsequently modified including removal of carbon adsorption units and some particulate filtration units. However, the emission estimates of some pollutants have increased slightly as a result of the current AMWTF design. To account for this, Science Applications International Corporation (SAIC), modeled the total criteria pollutants emitted from the AMWTF and the total toxic air pollutants (TAPs) emitted from the main stack. Although there were inconsistencies between the modeling analysis presented by SAIC and state and federal guidance, the results demonstrated compliance with all applicable standards. Because the ambient impacts are so small, the inconsistencies in modeling methodology would not impact the results enough as to cause or significantly contribute to a violation of any ambient air quality standard. Also, the ambient impacts from this project, in conjunction with the Transuranic Storage Area – Retrieval Enclosure (TSA RE) project, demonstrate compliance with the regulatory limits. Therefore, the modeling analysis presented in the application, and revised by DEQ, demonstrated compliance with all applicable standards.

SAIC also re-evaluated the radionuclide emissions. The National Emission Standards for Hazardous Air Pollutants (NESHAPs) analysis was revised to reflect the current AMWTF design. The revision does not result in an increase in the rate of radionuclide emissions. Therefore, DEQ modeling staff did not review the NESHAPs analysis.

2. DISCUSSION:

2.1 Applicable Air Quality Impact Limits

The facility is located in Butte County, which is designated as unclassifiable for all criteria pollutants. Therefore, total ambient impacts, including background, for the criteria pollutants must be below the National Ambient Air Quality Standards (NAAQS) listed in Table 1.

Table 1. Applicable regulatory limits.

Pollutant	Averaging Period	Significant Contribution Level[a] (μg/m³)[b]	Regulatory Limit[c] (μg/m³)
Criteria Pollutants			
Nitrogen dioxide	Annual	1	100
Sulfur dioxide	Annual	1	80
	24-hour	5	365
	3-hour	25	1300
PM_{10}[d]	Annual	1	50
	24-hour	5	150
Carbon monoxide	8-hour	500	10,000
	1-hour	2000	40,000
Lead	Quarterly		1.5
Toxic Air Pollutants			
Non-Carcinogens			
Acetone	24-hour		8.90E+04
Barium	24-hour		2.50E+01
Butanol, n- (n-butyl alcohol)	24-hour		7.50E+03
Butanone, 2- (methyl ethyl ketone)	24-hour		2.95E+04
Chlorobenzene	24-hour		1.75E+04
Chromium	24-hour		2.50E+01
Cyanide	24-hour		2.50E+02
Cyclohexane	24-hour		5.25E+04
Ethoxyethanol, 2-	24-hour		9.50E+02
Ethyl benzene	24-hour		2.18E+04
Isoproponal (isopropyl alcohol)	24-hour		4.90E+04
Mercury	24-hour		2.50E+00
Methanol	24-hour		1.30E+04
Nitrobenzene	24-hour		2.50E+02
Selenium	24-hour		1.00E+01
Silver	24-hour		5.00E+00
Toluene	24-hour		1.88E+04
Trichloroethylene	24-hour		1.35E+04
Trimethylbenzene, 1,2,4-	24-hour		6.15E+03
Trimethylbenzene, 1,3,5-	24-hour		6.15E+03
Xylene	24-hour		2.18E+04
Carcinogens			
Arsenic	Annual		2.3E-04
Asbestos	Annual		4.0E-06
Benzene	Annual		1.2E-01
Beryllium	Annual		4.2E-03
Cadmium	Annual		5.6E-04
Carbon Tetrachloride	Annual		6.7E-02
Chloroform	Annual		4.3E-02
Chromium	Annual		8.3E-05
Dichloroethane, 1,2-	Annual		3.8E-02
Dichloroethylene, 1,1-	Annual		2.0E-02
Methylene chloride	Annual		2.4E-01
Nickel	Annual		4.2E-03
PCBs (Aroclor)	Annual		1.0E-02
Tetrchloroethane, 1,1,2,2-	Annual		1.7E-02
Tetrachloroethylene	Annual		2.1E+00
Trichloroethane, 1,1,2-	Annual		6.2E-02
Trichloroethylene	Annual		7.7E-01

a. IDAPA 58.01.01.006.93
b. Micrograms per cubic meters
c. For the criteria pollutants IDAPA 58.01.01.577; 58.01.01.585 for non-carcinogens; and 58.01.01.586 for carcinogens.
d. Particulate matter with an aerodynamic diameter less than or equal to 10 micrometers.

2.2 Current Air Quality

No ambient air quality data is available for the INEEL area. The statewide background concentrations have been determined to be reasonable for the INEEL area. Table 2 presents the data for the current air quality in the area of the AMWTF.

Table 2. Current air quality in the INEEL area.

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)[a]
Nitrogen dioxide	Annual	40
Sulfur dioxide	3-hour	374
	24-hour	120
	Annual	18.3
PM_{10}[b]	24-hour	86
	Annual	32.7
Carbon monoxide	1-hour	11,450
	8-hour	5,130
Lead	Quarterly	0.15

a. Micrograms per cubic meters
b. Particulate matter with an aerodynamic diameter less than or equal to 10 micrometers.

2.3 Modeling Impact Assessment

SAIC performed the air dispersion modeling analysis by calculating dispersion coefficients. Dispersion coefficients have units of $\mu g/m^3$ per lb/hr. Each source is modeled separately with a unit emission rate (1 lb/hr). The resulting concentration obtained from the ISCST3 model is then multiplied by the appropriate emission rate to obtain the actual ambient concentration. The resulting ambient concentrations for each of the sources are then added.

The normal guidance for a PTC application would require the facility to model the proposed increase in emissions and compare the resulting ambient impact to the significant contribution levels (SCLs). If the estimated ambient concentrations exceed the SCLs, then a full impact analysis would be required. However, SAIC modeled the total criteria pollutant and TAP emissions from the AMWTF for this analysis instead of only those emissions that are increasing with the proposed modification. TAPs are only vented through the stacks at the main building. In essence, SAIC performed a full impact analysis without necessarily being required to.

2.3.1 Emission and Source Data

According to the application, two stacks were actually effective stacks (i.e., multiple stacks modeled as one stack). The effective main stack represents the combined three flues of the main building. SAIC estimated the effective stack parameters incorrectly. According to *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised* (EPA 1992), the correct method is to calculate a merged stack parameter which accounts for the relative influence of stack height, plume rise, and emissions rate on concentrations. This merged stack parameter is calculated according to Equation 1. The stack that has the lowest value of M is used as the "representative " stack. The stack modeled has the source parameters of the representative stack and the sum of all the emissions. Table 3 presents that individual stack parameter used in Equation 1 as well as the results of the merged stack analysis. Following this methodology, the Glovebox Extract stack is the representative stack. Therefore, the model was rerun using these stack parameters.

The application indicates that the boiler stack is also an effective stack representing the combined water boiler exhaust flues. However, in Appendix C of the application, only one boiler stack is identified. Based on this, it is inferred that all boiler stacks have the same source parameters. Therefore, all boiler emissions were modeled using the boiler stack parameters. Table 4 presents the stack parameters used in the model. Tables 5 and 6 present the criteria pollutant and TAPs emission data.

Equation 1

$$M = \frac{h_s V T_s}{Q}$$

where

M = merged stack parameter

and

h_s = stack height (meter)
V = stack gas volumetric flow rate (cubic meter per second)
T_s = stack gas exit temperature (K)
Q = pollutant emission rate (grams/second)

Table 3. Calculation of merged stack parameters.

Parameter	Zone 1/Zone 2 Extract	Zone 3 Extract	Glovebox Extract
Height (m)	26.82	26.82	27.43
volumetric flow rate (m^3/s)	31.64	14.16	0.3
Temperature (K)	295.37	295.37	295.37
Emission Rate (g/s)	0.126	0.126	0.126
Merged Stack Parameter	1989436	890341.7	19291.88
Minimum value	**19291.88**		
Representative stack	**Glovebox Extract**		

Table 4. Stack parameters

Parameter	Effective Main Stack	Effective Boiler Stack	Heater Stack
Height (feet)	90	50.7	34
Diameter (inches)	5.5	22	14
Exit velocity (ft/min)[a]	4,000	1,848	959
Temperature (°F)[b]	72	350	425

a. Feet per minute
b. Degrees Fahrenheit

Table 5. *Criteria* Pollutant Emissions (pounds per hour)

Source Description	PM_{10}[a]	Sulfur Dioxide	Nitrogen Dioxide	Carbon Monoxide	Lead
Boilers	1.70E-01	4.20E-01	5.3E+00	8.90E-01	N/A[b]
Hot Water Heater	8.80E-03	3.30E-02	3.1E-01	4.20E-02	N/A
Main Stack	4.20E-08	N/A	N/A	N/A	1.10E-08

a. Particulate matter with an aerodynamic diameter less than or equal to 10 micrometers.
b. Not applicable

Table 6. *Toxic air pollutants emission rates from the main stack.*

Pollutant	Averaging Period	Maximum Emission Rate[a] (lb/hr)[b]
Non-Carcinogens		
Acetone	24-hour	4.3E-05
Barium	24-hour	4.22E-10
Butanol, n- (n-butyl alcohol)	24-hour	3.95E-05
Butanone, 2- (methyl ethyl ketone)	24-hour	4.13E-05
Chlorobenzene	24-hour	1.76E-06
Chromium	24-hour	4.22E-10
Cyanide	24-hour	4.90E-14
Cyclohexane	24-hour	4.13E-05
Ethoxyethanol, 2-	24-hour	1.76E-06
Ethyl benzene	24-hour	4.13E-05
Isoproponal (isopropyl alcohol)	24-hour	3.95E-05
Mercury	24-hour	4.39E-05
Methanol	24-hour	3.95E-05
Nitrobenzene	24-hour	4.13E-05
Selenium	24-hour	4.22E-10
Silver	24-hour	4.22E-10
Toluene	24-hour	4.13E-05
Trichloroethylene	24-hour	4.13E-05
Trimethylbenzene, 1,2,4-	24-hour	3.95E-05
Trimethylbenzene, 1,3,5-	24-hour	3.95E-05
Xylene	24-hour	3.95E-05
Carcinogens		
Arsenic	Annual	4.22E-10
Asbestos	Annual	1.90E-08
Benzene	Annual	4.13E-05
Beryllium	Annual	4.22E-10
Cadmium	Annual	4.22E-10
Carbon Tetrachloride	Annual	4.83E-05
Chloroform	Annual	4.13E-05
Chromium	Annual	4.22E-10
Dichloroethane, 1,2-	Annual	4.13E-05
Dichloroethylene, 1,1-	Annual	4.13E-05
Methylene chloride	Annual	3.96E-05
Nickel	Annual	4.90E-14
PCBs (Aroclor)	Annual	4.23E-10
Tetrchloroethane, 1,1,2,2-	Annual	3.95E-05
Tetrachloroethylene	Annual	4.13E-05
Trichloroethane, 1,1,2-	Annual	1.76E-06
Trichloroethylene	Annual	4.13E-05

a. Emission rates taken from Table 4-7 of the application. These emission rates represent the total TAP emissions exhausted from the main stack.

b. Pounds per hour

2.3.2 Model Description and Justification

SAIC chose ISCST3 as the appropriate model for this application. SAIC based their decision on previous permitting actions for the INEEL. DEQ staff agree that ISCST3 is the appropriate model for this application. SAIC applied ISCST3 using the recommended defaults for rural conditions, as specified in the *Guideline on Air Quality Models* (40 CFR 51, Appendix W). SAIC also chose the option of wet plume depletion. DEQ staff agree that these assumptions are appropriate.

2.3.3 Receptor Network

Five different receptor grids were used. Each receptor grid was included in a separate ISCST3 input file. Table 7 presents the receptor grids used by SAIC. However, DEQ determined that the pollutant and averaging times addressed by the various receptor grids are not consistent with current guidance. According to the application, it has been interpreted in past permitting actions that ambient air includes all locations beyond the INNEL boundary. This is based on the fact that facility access is controlled by security guards. However, in the application, on-site receptors were used to estimate concentrations for pollutants with short averaging periods (i.e., 24 hours or less). Based on this inconsistency, DEQ determined that all receptors presented would be used in this analysis. In future permits, the facility will be required to address the issue of ambient air and the location of receptors in more detail. Based on this information, the appropriate receptor grids to be used for certain pollutants and averaging periods are as follows:

- Boundary – all pollutants, all averaging periods
- Highways – all criteria pollutants for all averaging periods; non-carcinogens with 24-hour averaging period
- Of-site – all pollutants, all averaging periods
- On-site – all pollutants, all averaging periods
- Special – all pollutants all averaging periods

Table 7. Description of receptor grids presented in application.

ISCST3 file name	Number of receptors	Pollutant/ Averaging Period	Description
Boundary	286	All pollutants/all averaging periods	100-m spacing along high impact areas of the INEEL site boundary
Highway	583	Non-carcinogens	100-m spacing along U.S. Highway 20 and 26
Offsite	370	All pollutants/all averaging periods	Polar grid with 10° intervals – offsite only 50-m spacing, 50 – 500 m from source 100-m spacing, 400-1,000 m from source 200-m spacing, 1,200-3,000 m from source 500-m spacing, 3,500-10,000 m from source 1,000-m spacing, 11,000-15,000 m from source 5,000-m spacing, 20,000-50,000 m from source
Onsite	1467	Criteria pollutants, 24-hour and less averaging period	Polar grid with 10° intervals – onsite only 50-m spacing, 50 – 500 m from source 100-m spacing, 400-1,000 m from source 200-m spacing, 1,200-3,000 m from source 500-m spacing, 3,500-10,000 m from source 1,000-m spacing, 11,000-15,000 m from source 5,000-m spacing, 20,000-50,000 m from source
Special	22	TAPs 24-hour (only EBR-I)	Receptors at all other INEEL facility areas, all locations of population groups with the 50-km radius of the source, tourist sites (e.g., EBR-I, Craters of the Moon National Monument Ranger Station), and locations (i.e., points of higher elevation) beyond the site boundary to determine off-site concentrations decreased.

2.3.4 Elevation Data

SAIC obtained terrain elevations from the INEEL Graphical Information System database. This data is appropriate for use in the application.

2.3.5 Meteorological Data

SAIC used five years of site specific surface meteorological data obtained between 1994 - 1998. The National Oceanic and Atmospheric Administration Air Resources Laboratory has a network of 31 meteorological stations located in and around the INEEL. SAIC chose the station located at the Central Facilities Area because it is the closest to the AMWTF that has a complete set of hourly data for 1994 – 1998. SAIC used the Meteorological Processor for Regulatory Models to process the site-specific data. SAIC used two methods for the upper air data. The first method involved using mixing heights that were calculated from the Salt Lake City National Weather Service data for the years 1994 and 1995. The second method was used for the years 1996 through 1998. SAIC states that for these years the mixing height was fixed at 150 meters.

After review of the meteorological file, DEQ determined that the urban mixing height was fixed at 150 meters and the rural mixing height had a maximum value of 150 meters (i.e., lower values were present). Since the rural dispersion coefficients were used, it seems that a maximum mixing height of 150 meters was used instead of a fixed mixing height.

This review of the meteorological file found other inconsistencies with the report. According to the application, wet plume depletion was accounted for. ISCST3 uses a scavenging ratio approach to model deposition of gases and particles through wet removal. The scavenging ratio is computed from a scavenging coefficient and a precipitation rate. A scavenging coefficient of 0.00017 hr/s-mm was used in the model. However, the precipitation rate in the meteorological file is zero for all hours. Therefore, wet depletion is not really accounted for. In addition, all five years of meteorological data is in one file. This is acceptable for computing concentrations with averaging periods shorter than annual. However, for the annual averaging periods, the standard is not to be exceeded in any calendar year. If five years of meteorological data is run as one file, the annual average concentration is based on five years worth of data. This method does not demonstrate compliance with the standard.

After the review of the application, meteorological file, and modeling results, DEQ modeling staff determined that these inconsistencies would not substantially change the results. However, in future modeling analyses for the INEEL, these issues must be addressed prior to the application being submitted.

2.4 Modeling Results

SAIC presented results for ozone using the 1-hour dispersion coefficient and the total VOC emission rate. This is not the correct method. ISCST3 does not handle the formation of ozone. Therefore, ambient concentrations for ozone are not presented in the results. Dispersion coefficients are presented in Table 8. Ambient impacts for TAPs and criteria pollutants are presented in Tables 9 and 11, respectively. Because this project is connected with the AMWTF project, the ambient impacts from the two are combined and the total impacts are compared to the appropriate regulatory limit. This comparison is presented in Tables 10 and 12 for TAPs and criteria pollutants, respectively

Table 8. Dispersion Coefficients for the AMWTF.

Averaging Period	Dispersion Coefficient ($\mu g/m^3$ per lb/hr)[a]	Receptor Grid	UTM[b] (meters) Easting	UTM[b] (meters) Northing
Main Stack				
Annual – TAPs[c] and criteria pollutants	1.04	On-site	335247.41	4817648
24-hour – TAPs and criteria pollutants	11.24	On-site	335271.09	4817637
Boiler Stack				
Annual	2.97	On-site	335322.41	4817678
24-hour	24.94	On-site	335322.41	4817678
8-hour	46.7	On-site	335339.81	4817680
3-hour	82.5	On-site	335372.41	4817691
1-hour	209.9	On-site	335372.41	4817691
Heater Stack				
Annual	8.95	On-site	335369.41	4817795
24-hour	73.8	On-site	335371.59	4817787
8-hour	120.7	On-site	335371.59	4817787
3-hour	174.8	On-site	335371.59	4817787
1-hour	368.9	On-site	335409	4817728

a. Micrograms per cubic meter per pound per hour.
b. Universal transverse mercator.
c. Toxic air pollutants

Table 9. Toxic air pollutants modeling results

Pollutant	Averaging Period	Ambient Concentration (µg/m³)[b]	Regulatory Limit[a]	Demonstrates Compliance
Non-Carcinogens				
Acetone	24-hour	4.83E-04	8.90E+04	YES
Barium	24-hour	4.74E-09	2.50E+01	YES
Butanol, n- (n-butyl alcohol)	24-hour	4.44E-04	7.50E+03	YES
Butanone, 2- (methyl ethyl ketone)	24-hour	4.64E-04	2.95E+04	YES
Chlorobenzene	24-hour	1.98E-05	1.75E+04	YES
Chromium	24-hour	4.74E-09	2.50E+01	YES
Cyanide	24-hour	5.51E-13	2.50E+02	YES
Cyclohexane	24-hour	4.64E-04	5.25E+04	YES
Ethoxyethanol, 2-	24-hour	1.98E-05	9.50E+02	YES
Ethyl benzene	24-hour	4.64E-04	2.18E+04	YES
Isoproponal (isopropyl alcohol)	24-hour	4.44E-04	4.90E+04	YES
Mercury	24-hour	4.93E-04	2.50E+00	YES
Methanol	24-hour	4.44E-04	1.30E+04	YES
Nitrobenzene	24-hour	4.64E-04	2.50E+02	YES
Selenium	24-hour	4.74E-09	1.00E+01	YES
Silver	24-hour	4.74E-09	5.00E+00	YES
Toluene	24-hour	4.64E-04	1.88E+04	YES
Trichloroethylene	24-hour	4.64E-04	1.35E+04	YES
Trimethylbenzene, 1,2,4-	24-hour	4.44E-04	6.15E+03	YES
Trimethylbenzene, 1,3,5-	24-hour	4.44E-04	6.15E+03	YES
Xylene	24-hour	4.44E-04	2.18E+04	YES
Carcinogens				
Arsenic	Annual	4.39E-10	2.30E-04	YES
Asbestos	Annual	1.98E-08	4.00E-06	YES
Benzene	Annual	4.30E-05	1.20E-01	YES
Beryllium	Annual	4.39E-10	4.20E-03	YES
Cadmium	Annual	4.39E-10	5.60E-04	YES
Carbon Tetrachloride	Annual	5.02E-05	6.70E-02	YES
Chloroform	Annual	4.30E-05	4.30E-02	YES
Chromium	Annual	4.39E-10	8.30E-05	YES
Dichloroethane, 1,2-	Annual	4.30E-05	3.80E-02	YES
Dichloroethylene, 1,1-	Annual	4.30E-05	2.00E-02	YES
Methylene chloride	Annual	4.12E-05	2.40E-01	YES
Nickel	Annual	5.10E-14	4.20E-03	YES
PCBs (Aroclor)	Annual	4.40E-10	1.00E-02	YES
Tetrchloroethane, 1,1,2,2-	Annual	4.11E-05	1.70E-02	YES
Tetrachloroethylene	Annual	4.30E-05	2.10E+00	YES
Trichloroethane, 1,1,2-	Annual	1.83E-06	6.20E-02	YES
Trichloroethylene	Annual	4.30E-05	7.70E-01	YES

a. Micrograms per cubic meters
b. 58.01.01.585 for non-carcinogens; and 58.01.01.586 for carcinogens.

Table 9. Combined total toxic air pollutants modeling results for TSA-RE and AMWTF

Pollutant	Averaging Period	Ambient Concentration (µg/m³)[a] AMWTF[c]	TSA-RE[d]	Total[e]	Regulatory Limit[b]	Demonstrates Compliance
Non-Carcinogens						
Acetone	24-hour	4.83E-04	1.55E-07	4.83E-04	8.90E+04	YES
Barium	24-hour	4.74E-09	5.82E-10	5.33E-09	2.50E+01	YES
Butanol, n- (n-butyl alcohol)	24-hour	4.44E-04	1.49E-07	4.44E-04	7.50E+03	YES
Butanone, 2- (methyl ethyl ketone)	24-hour	4.64E-04	1.55E-07	4.64E-04	2.95E+04	YES
Chlorobenzene	24-hour	1.98E-05	1.53E-07	1.99E-05	1.75E+04	YES
Chromium	24-hour	4.74E-09	5.82E-10	5.33E-09	2.50E+01	YES
Cyanide	24-hour	5.51E-13	5.78E-10	5.79E-10	2.50E+02	YES
Cyclohexane	24-hour	4.64E-04	1.55E-07	4.64E-04	5.25E+04	YES
Dichloroethylene, 1,2	24-hour	0.00E+00	1.50E-07	1.50E-07	3.95E+04	YES
Ethoxyethanol, 2-	24-hour	1.98E-05	1.53E-07	1.99E-05	9.50E+02	YES
Ethyl benzene	24-hour	4.64E-04	1.03E-03	1.49E-03	2.18E+04	YES
Hexane	24-hour	0.00E+00	1.88E-04	1.88E-04	9.00E+03	YES
Isoproponal (isopropyl alcohol)	24-hour	4.44E-04	1.49E-07	4.44E-04	4.90E+04	YES
Mercury	24-hour	4.93E-04	3.86E-07	4.94E-04	2.50E+00	YES
Methanol	24-hour	4.44E-04	1.49E-07	4.44E-04	1.30E+04	YES
Naphthalene	24-hour	0.00E+00	4.11E-03	4.11E-03	2.50E+03	YES
Nitrobenzene	24-hour	4.64E-04	1.55E-07	4.64E-04	2.50E+02	YES
Selenium	24-hour	4.74E-09	5.82E-10	5.33E-09	1.00E+01	YES
Silver	24-hour	4.74E-09	5.82E-10	5.33E-09	5.00E+00	YES
Toluene	24-hour	4.64E-04	1.42E-02	1.47E-02	1.88E+04	YES
Trichloroethylene	24-hour	4.64E-04	1.55E-07	4.64E-04	1.35E+04	YES
Trimethylbenzene, 1,2,4-	24-hour	4.44E-04	1.49E-07	4.44E-04	6.15E+03	YES
Trimethylbenzene, 1,3,5-	24-hour	4.44E-04	1.49E-07	4.44E-04	6.15E+03	YES
Xylene	24-hour	4.44E-04	2.64E-03	3.09E-03	2.18E+04	YES
Carcinogens						
Arsenic	Annual	4.39E-10	6.03E-11	4.99E-10	2.30E-04	YES
Asbestos	Annual	1.98E-08	2.66E-09	2.24E-08	4.00E-06	YES
Benzene	Annual	4.30E-05	4.37E-03	4.41E-03	1.20E-01	YES
Beryllium	Annual	4.39E-10	6.03E-11	4.99E-10	4.20E-03	YES
Cadmium	Annual	4.39E-10	6.03E-11	4.99E-10	5.60E-04	YES
Carbon Tetrachloride	Annual	5.02E-05	7.96E-08	5.03E-05	6.70E-02	YES
Chloroform	Annual	4.30E-05	1.60E-08	4.30E-05	4.30E-02	YES
Chromium	Annual	4.39E-10	6.03E-11	4.99E-10	8.30E-05	YES
Dichloroethane, 1,2-	Annual	4.30E-05	1.60E-08	4.30E-05	3.80E-02	YES
Dichloroethylene, 1,1-	Annual	4.30E-05	1.60E-08	4.30E-05	2.00E-02	YES
Methylene chloride	Annual	4.12E-05	1.55E-08	4.12E-05	2.40E-01	YES
Nickel	Annual	5.10E-14	5.99E-11	6.00E-11	4.20E-03	YES
PAHs	Annual	0.00E+00	2.60E-05	2.60E-05	3.00E-04	YES
PCBs (Aroclor)	Annual	4.40E-10	8.99E-10	1.34E-09	1.00E-02	YES
Tetrchloroethane, 1,1,2,2-	Annual	4.11E-05	1.55E-08	4.11E-05	1.70E-02	YES
Tetrachloroethylene	Annual	4.30E-05	1.60E-08	4.30E-05	2.10E+00	YES
Trichloroethane, 1,1,2-	Annual	1.83E-06	1.58E-08	1.85E-06	6.20E-02	YES
Trichloroethylene	Annual	4.30E-05	1.60E-08	4.30E-05	7.70E-01	YES

a. Micrograms per cubic meters
b. 58.01.01.585 for non-carcinogens; and 58.01.01.586 for carcinogens.
c. Total ambient impacts for the AMWTF PTC
d. Total ambient impacts for the TSA-RE PTC
e. Combined total ambient impacts for AMWTF and TSA-RE

3. CONCLUSIONS AND RECOMMENDATIONS:

After reviewing the modeling analysis, DEQ determined that there were inconsistencies between the modeling analysis presented by SAIC and state and federal guidance. However, based on the facts that SAIC modeled the facility-wide criteria pollutant and TAP emissions and that the ambient impacts were very low, DEQ determined that the inconsistencies in modeling methodology would not impact the results enough as to cause or significantly contribute to a violation of any ambient air quality standard. Also, the ambient impacts from this project, in conjunction with the AMWTF project, demonstrate compliance with the regulatory limits. Therefore, the modeling analysis presented in the application, and revised by DEQ, demonstrated compliance with all applicable standards. DEQ modeling staff recommends that DOE, INEEL, BNFL Inc. AMWTF be issued this PTC.

Electronic copies of the modeling analysis are saved on disk. Michael Stambulis reviewed this modeling memo to ensure consistency with the permit and Technical Memorandum.

MA: C:\CURRENT\AMWTP\MODELING TECH MEMO AMWTF.DOC

Table 11. Criteria pollutants ambient impacts for the AMWTF.

Pollutant	Averaging Period	Ambient Concentration ($\mu g/m^3$)[a] Main stack	Boiler stack	Heater stack	Total AMWTF	Background	Total[b]	NAAQS[c]	Demonstrates Compliance
Nitrogen dioxide	Annual		1.57E+01	2.77E+00	1.85E+01	40	5.85E+01	100	YES
PM10b	24-hour	4.72E-07	4.24E+00	6.49E-01	4.89E+00	86	9.09E+01	150	YES
	Annual	4.37E-08	5.05E-01	7.88E-02	5.84E-01	32.7	3.33E+01	50	YES
Carbon monoxide	1-hour		1.87E+02	1.55E+01	2.02E+02	11450	1.17E+04	40000	YES
	8-hour		4.16E+01	5.07E+00	4.66E+01	5130	5.18E+03	10000	YES
Lead	Quarterly	1.24E-07			1.24E-07	0.15	1.50E-01	1.5	YES
Sulfur dioxide	3-hour		3.47E+01	5.77E+00	4.04E+01	375	4.15E+02	1300	YES
	24-hour		1.05E+01	2.44E+00	1.29E+01	120	1.33E+02	375	YES
	Annual		1.25E+00	2.95E-01	1.54E+00	18.3	1.98E+01	80	YES

a. Micrograms per cubic meter
b. Sum of total AMWTF impacts and the background concentration
c. National ambient air quality standards

Table 12. Total combined ambient impacts for the AMWTF and the TSA-RE.

Pollutant	Averaging Period	Ambient Concentration ($\mu g/m^3$)[a] AMWTF[c]	TSA-RE[d]	Total[e]	Background	Total[f]	NAAQS[b]	Demonstrates Compliance
Nitrogen dioxide	Annual	18.52	4.99	23.50	40	63.50	100	YES
PM10[g]	24-hour	4.89	1.12	6.01	86	92.01	150	YES
	Annual	0.58	0.12	0.70	32.7	33.40	50	YES
Carbon monoxide	1-hour	202.30	30.12	232.43	11450	11682.43	40000	YES
	8-hour	46.63	11.98	58.61	5130	5188.61	10000	YES
Lead	Quarterly	1.24E-07	1.43E-08	1.38E-07	0.15	0.15	1.5	YES
Sulfur dioxide	3-hour	40.42	17.13	57.54	375	432.54	1300	YES
	24-hour	12.91	7.32	20.23	120	140.23	375	YES
	Annual	1.54	0.76	2.30	18.3	20.60	80	YES

a. Micrograms per cubic meter
b. National ambient air quality standards
c. Total ambient impacts for the AMWTF PTC
d. Total ambient impacts for the TSA-RE PTC
e. Combined total ambient impacts for AMWTF and TSA-RE
f. Sum of combined total TSA-RE and AMWTS impacts and the background concentration
g. Particulate matter with an aerodynamic diameter less than or equal to 10 micrometers

APPENDIX E

ADVANCED MIXED WASTE TREATMENT FACILITY

IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

COMBUSTION EVALUATION

Idaho Department of Environmental Quality
Office of Technical Services

Calculation Cover Sheet

Calc. Number: 1

Project No.: P-010503

Discipline:

Number of Sheets: 4

Project: PTC AMWTF

Title of Calculation: Combustion Evaluation

Item:

Source of Data:
IDAPA 58.01.01.676 and .677
AP-42, Table 1.5-1

Sources of Formulae/References/Assumptions:

☐ Preliminary Calculation ☒ Final Calculation Supersedes Calculation Number ______________

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date

Idaho Department of Environmental Quality
Office of Technical Services

CALCULATION SHEET

Project: FTC AMWTF | Work Order: P-010503 | File No.:

Title of Calculation: Combustion Evaluation | Prepared By: MJS | Date: 03/25/02

Item: IDAPA 58.01.01 676 & 677 | Checked By: | Date:

① 17.55 MMBtu/hr Boilers

Per stoichiometric combustion evaluation (attached), exhaust flow rate is ~ ~~420.0~~ 4357.5 dscfm @ 3% O_2. mjb 03/25/02

Emission factor for propane-based LPG from AP-42, Table 1.5-1

PM = 0.6 lb/1,000 gal for industrial boilers (between 10 and 100 MMBtu/hr)

Burn 277.4 gal/hr max per application

Emissions: $\frac{0.6\ lb}{1{,}000\ gal} \cdot \frac{277.4\ gal}{hr} \cdot \frac{1\ min}{\sout{420.0}\ 4357.5\ dscf} \cdot \frac{1\ hr}{60\ min} \cdot \frac{7000\ gr}{1\ lb} =$ ~~0.046~~ 0.0045 gr/dscf (mjb 03/25/02)

In compliance with standard listed in IDAPA 58.01.01.676

② 20 MMBtu/hr Potable Water Heaters

Per stoichiometric combustion evaluation (attached), exhaust flow rate ~ 344.9 dscfm @ 3% O_2

Burn 22.1 gal/hr max per application

Emissions: $\frac{0.6\ lb}{1{,}000\ gal} \cdot \frac{22.1\ gal}{hr} \cdot \frac{1\ min}{344.9\ dscf} \cdot \frac{1\ hr}{60\ min} \cdot \frac{7000\ gr}{1\ lb} = 0.0045$ gr/dscf

In compliance with standard listed in IDAPA 58.01.01.677

Combustion Evaluation - 12.55 MMBTU/hr Propane-Fired Boilers

Fuel Data (% by weight)

S	0.12
N2	0
C	82.1
H2	17.8
H20	0
O2	0

Fuel burned (lb/hr)	1200
Excess air (%)	2
Stk temp (F)	463.56
Stk press (atm)	1

Combustion Air Required

	O2 lb.mole	N2 lb.mole
S	0.04	0.17
N2	0.00	0
C	82.02	308.57
H2	53.00	199.39
O2	0.00	
	135.07	508.13

stioc. comb air = 696.9984 lb.mole/hr
stoic. dry comb air = 590.1984 lb.mole/hr

Flue Products

	lb.mole	lb/hr
SO2	0.04	2.87
N2	518.29	14512.16
CO2	82.02	3609.09
H2O(comb)	106.80	1922.40
O2	2.70	86.45
H2O(fuel)	0.00	0.00
dry	603.06	
wet	709.86	

Volume of flue gas (acfm)	7978.7
Volume of flue gas (sdcfm)	3816.4
Volume of flue gas (dscfm@7%O2)	5602.5
Volume of flue gas (dscfm@15%O2)	13072.5
Volume of flue gas (dscfm@8%O2)	6033.5
Volume of flue gas (dscfm@3%O2)	4357.5
Volume of flue gas (dscfm@10%O2)	7130.5

ombustion Evaluation - 2.0 MMBTU/hr Propane-Fired Potable Water Heate

Fuel Data (% by weight)

S	0.012
N2	0
C	82.1
H2	17.8
H20	0.5
O2	1.22

Fuel burned (lb/hr)	95
Excess air (%)	2
Stk temp (F)	463.56
Stk press (atm)	1

Combustion Air Required

	O2 lb.mole	N2 lb.mole
S	0.00	0.00
N2	0.00	0
C	6.49	24.43
H2	4.20	15.79
O2	-0.04	
	10.65	40.21

stioc. comb air = 55.1902 lb.mole/hr

stoic. dry comb air = 46.70881 lb.mole/hr

Flue Products

	lb.mole	lb/hr
SO2	0.00	0.02
N2	41.02	1148.54
CO2	6.49	285.72
H20(comb)	8.46	152.19
O2	0.21	6.82
H20(fuel)	0.03	0.48
dry	47.73	
wet	56.21	

Volume of flue gas (acfm)	631.8
Volume of flue gas (sdcfm)	302.0
Volume of flue gas (dscfm@7%O2)	443.4
Volume of flue gas (dscfm@15%O2)	1034.6
Volume of flue gas (dscfm@8%O2)	477.5
Volume of flue gas (dscfm@3%O2)	344.9
Volume of flue gas (dscfm@10%O2)	564.3

APPENDIX F

ADVANCED MIXED WASTE TREATMENT FACILITY

IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

PROCESS WEIGHT RATE EVALUATION

Idaho Department of Environmental Quality
Office of Technical Services

Calculation Cover Sheet

Calc. Number: 2

Project No.:	Discipline:	Number of Sheets:
P-010503		2

Project: PTC AMWTF

Title of Calculation: Process Weight Evaluation

Item:

Source of Data:

IDAPA 58.01.01.701

Sources of Formulae/References/Assumptions:

☐ Preliminary Calculation ☒ Final Calculation Supersedes Calculation Number ______

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date

Idaho Department of Environmental Quality
Office of Technical Services

CALCULATION SHEET

roject PTC AMWTF Work Order P-010503 File No.

itle of Calculation Process Weight Evaluation Prepared By MJS Date 03/25/02

em IDAPA 58.01.01.701 Checked By Date

① Zone 3 Flue:

According to application, box lines and DWHE exhaust to DWHE.

Maximum throughput for box lines is 1,862 lbs/hr

Maximum throughput for DWHE is 526.8 lbs/hr

∴ total maximum throughput is 2,389 lbs/hr

per IDAPA 58.01.01.701.01.a,

$E = (0.045)(PW)^{0.6}$

∴ E = 48 lbs/hr

Per application, emissions are 2.4×10^{-8} lbs/hr

∴ in compliance with standard.

② Glovebox Extract/Flue:

According to application, DWPG, supercompactor glovebox, and special case waste glovebox exhaust to glovebox extract flue.

Max throughput of:

DWPG is 562.8 lbs/hr

Supercompactor Glovebox is 1877.5 lbs/hr

Special Case Waste Glovebox is 0.49 lbs/hr

Total = 2,441 lbs/hr

E = 4.9 lbs/hr

PTE for PM is 2.3×10^{-8}

∴ in compliance with standard.