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DISPERSON CALCULATIONS FOR NON-RADIOLOGICAL HAZARDOUS CHEMICAL EMISSIONS FROM THE DEFENSE WASTE PROCESSING FACILITY AND RELATED ACTIVITIES (U)

C. H. Hunter C. H. Hunter

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

SUMMARY

The Environmental Protection Agency's (EPA) Industrial Source Complex - Short Term (ISCST) air dispersion model was used to examine potential atmospheric impacts of routine benzene and mercury emissions from the Defense Waste Processing Facility (DWPF), In-Tank Precipitation (ITP) facilities, and the Saltstone Facility. The EPA has designated ISCST as a preferred model for regulatory applications. Dispersion calculations were performed with the most recent set of quality assured onsite meteorological data and recently revised design emissions information. These calculations were designed to provide ambient concentration values suitable for comparison to pertinent regulatory standards.

The highest model estimated 8-hour average ground-level benzene concentrations were found to occur in the immediate vicinty of the ITP filter/stripper building (241-96H). Estimated concentrations resulting from the interaction of ITP Tank 48 and Tank 49 emissions with the windward face of this building during easterly winds were greater than the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for routine workplace benzene exposure. The OSHA 8-hour time weighted average PEL is one part per million (ppm). Subsequent model calculations were used to determine minimum stack release heights that would be necessary to achieve compliance with this workplace exposure standard for currently anticipated emission levels.

The highest 24-hour average site boundary concentrations of benzene and mercury generally occurred to the north of S and H areas. Concentrations were well below the ambient concentration standards that have been identified for these substances in an air toxics policy proposed by the State of South Carolina.

Estimates of annual average benzene concentrations for offsite locations were used to estimate the excess lifetime cancer risk to the hypothetical maximum exposed individual and to all exposed population within 50-miles of SRS. Assuming a continuous 70-year exposure to the estimated annual benzene concentrations, the excess cancer risk to the maximum exposed individual was estimated to be 3 X 10-7. Similar lifetime exposure summed over the surrounding population resulted in an estimated average of 6 X 10-4 excess cancers per year. These calculations were performed using a risk assessment methodology suggested by EPA.

INTRODUCTION

Operation of the Defense Waste Processing Facility (DWPF), and associated facilities in Z-area and in the H-area tank farm, is expected to result in routine

emissions of relatively large amounts of alcohols, phenolic compounds, benzene, formic acid, mercury, and nitrous oxide to the atmosphere. Previous evaluations have indicated that benzene and mercury are the most environmentally significant of these emissions (ref. 1). Benzene is considered a human carcinogen and can produce acute toxicological effects from exposure to concentrations as low as one ppm. Mercury is an acute toxicological agent (ref. 2).

Construction permits issued by the South Carolina Department of Health and Environmental Control (DHEC) have established allowable amounts of benzene that can be emitted from the DWPF Vitrification Facility, the In-Tank Precipitation (ITP) process in the H-area tank farm, and the Saltstone Facility in Z-area. Mercury emissions from the DWPF are also permitted. In addition, a draft air toxics policy has been proposed by DHEC to regulate routine emissions of approximately 200 toxic air pollutants, including benzene and mercury. Dispersion modeling must be used to demonstrate that emissions of any of these pollutants from a proposed facility will not result in maximum site boundary 24-hour average ground-level concentrations in excess of a given concentration standard.

Air dispersion modeling has previously been conducted for DWPF-related benzene and mercury emissions. The results of one of these calculations indicated that estimated 24-hour average site boundary concentrations of both benzene and mercury were well below the proposed DHEC draft air toxics standards (ref. 1) . The source of meteorological data used for this analysis was not identified; however, recent onsite data are not believed to have been used.

A second study examined potential short-term exposure of workers in the H-area tank farm to ambient concentrations of benzene. This study considered benzene emissions associated with the ITP process. Estimated concentrations were found to be below 0.5 ppm, provided that the height of the ITP Tank 48 stack was increased from the original design stack height. The dispersion calculations for that study were based on meteorological data from the Atlanta, Georgia National Weather Service (NWS) office.

To support preparation of a supplemental DWPF Environmental Impact Statement (EIS), potential impacts of benzene and mercury emissions from the DWPF, the ITP process facilities, and the Saltstone Facility have been re-examined. Dispersion calculations were performed using the most recent set of quality assured onsite meteorological data and recently revised benzene emissions information. These calculations were designed to determine estimates of:

- Maximum onsite 8-hour average benzene concentrations for comparison to the Occupational Safety and Health Administration

(OSHA) permissible exposure limit (PEL) for 8-hour time weighted average workplace exposure to benzene.

- Maximum site boundary 24-hour average benzene and mercury concentrations for comparison to the proposed DHEC ambient concentration standards.

- Annual average benzene concentrations for assessing the probability of offsite carcinogenic effects due to long-term benzene exposure.

Potential impacts of accidental releases of hazardous materials from the DWPF and related facilities were not considered in this study.

AIR DISPERSION MODELING

General Model Description

Dispersion calculations were performed with the Industrial Source Complex-Short Term (ISCST) atmospheric dispersion model. This model has been designated by the Environmental Protection Agency (EPA) as a preferred model for regulatory applications involving complex source geometry (ref. 3). In addition, the DHEC draft air toxics policy recommends ISCST as an approriate dispersion model.

The ISCST model simulates steady state Gaussian dispersion of emissions from individual or multiple point, area, or volume sources. Model output consists of ambient ground-level pollutant concentrations on a user-specified grid of receptor locations. Concentration averaging periods, ranging from one hour to one year, are also specified by the user. The meteorological data required by ISCST consists of sequential hourly averages of wind speed, wind direction, temperature, Pasquill-Gifford (P-G) stability class, and mixing depth. Pollutant emissions are expressed as an hourly emission rate.

Two noteworthy features of ISCST are simulation of plume rise and aerodynamic downwash of the plume in the turbulent wake of adjacent structures. The plume rise calculations, based on the generalized Briggs equations, account for the effects of momentum and bouyancy of the effluent. The effects of aerodynamic downwash on dispersion is simulated by a combination of two algorithms. If the calculated height of the plume is less than or equal to the sum of the height of an adjacent structure (H) and one and one-half times the lesser of the height or projected width of the structure (L), an algorithm developed by Huber and Snyder is used. The second algorithm, developed by Schulman and Scire, is applied if the release height is less than H+0.5L, and the plume height is less than H+2L. The Schulman-Scire algorithm allows the dimensions of adjacent buildings to be specified as a function of direction from the source. The term "adjacent" is defined to be

those structures that are within 5L downwind, 3L upwind, and 0.5L crosswind of the release. The Huber-Snyder algorithm does not account for direction dependent geometry of adjacent structures.

In addition, the following ISCST modeling options were selected for these calculations:

- Dispersion due to the turbulence that is induced by plume bouyancy.
- Modification of the actual stack height to account for downwash induced by the stack.
- Model default values of the exponent value for the wind speed profile power law expression.
- Model default values for the vertical potential temperature gradient.

All features of the ISCST model are described in detail in reference 4.

Emissions Estimates

Benzene and mercury are considered to be the most environmentally significant of the non-radiological hazardous chemicals that are to be routinely released to the atmosphere from DWPF, ITP, and Saltstone operations (ref 1). A brief description of the processes which result in emissions of these substances is given in Appendix A. Quantitative emissions data used for this modeling study are summarized in the following sections.

Benzene

Estimated annual emissions of benzene from all DWPF-related sources are summarized in Table 1. These data were taken from Appendix G of the DWPF basic data report (ref. 5). Sources which contributed at least one percent to the total benzene emissions were included in the dispersion calculations. These sources consisted of the DWPF Vitrification Facility 291-S stack, the ITP Tank 48 stack, the ITP Tank 49 stack, and the ITP stripper building stack. Sources contributing less than one percent to the total emissions were considered to have a negligable ambient impact.

To meet the objectives that were defined for this study, 8- and 24-hour average hourly emission rates were determined for each significant source. These data are summarized in Table 2. The DWPF Vitrification Facility, Tank 48, and stripper facility operations are batch processes. Consequently, the listed values represent the highest average hourly emission rate for any 8- or 24-hour period during the batch cycle.

Emissions were further defined in terms of "expected" and "maximum" emission rates. The expected emission rates represent anticipated emissions during normal design operations. The maximum emission rates represent either emissions that would occur during credible worst case operating conditions for benzene generation, or emissions limits stipulated by the DHEC air permits.

For the DWPF 291-S stack, the expected and maximum annual average hourly benzene emission rates listed in Table 2 were taken from reference 5 and DHEC air construction permit 0080-0066-CA, respectively. The 8- and 24-hour average emission rate estimates were based on an assumption that all of the benzene emissions occur during one twelve hour period of each 84 hour batch cycle. The expected and maximum emission rates for each ITP benzene source for all averaging intervals were based on analyses reported in reference 6.

Mercury

Design emissions estimates listed in the DWPF basic data report indicate that the 291-S stack is the only significant source of mercury emissions. Expected and maximum annual average hourly mercury emission rates are 0.0094 and 0.02 pounds per hour, respectively. The expected emission rate was taken from reference 5; the maximum emission rate was taken from the DHEC air permit. The 24-hour average hourly emission rate was assumed to be the same as the annual value, since the change in mercury emissions with time is expected to be small (ref. 7).

Additional source characteristics required by the ISCST model are summarized in Table 3.

Meteorological Data Base

The meteorological data used for this study were collected from the onsite meteorological tower network during the five year period from January 1982 through December 1986. Five annual onsite data sets were prepared. Each data set consisted of quality assured hourly averaged values of wind speed, wind direction, temperature, and sigma-azimuth (standard deviation of the horizontal wind direction fluctuations). Values for the P-G stability class, required for the ISCST input data base, were determined from the hourly sigma-azimuth values using the classification scheme given in ANSI/ANS-2.5-1984 (ref. 8). A description of the onsite meteorological monitoring program is given in reference 9.

The ISCST meteorological data base is required to contain data for all hours in an annual period. To generate a data base containing as many hours of

valid onsite data as possible, data sets for each of the seven available onsite towers were merged to form a single composite data set. Onsite tower data are collected at 62 meters (m) above ground. The H-area tower data were used as the reference wind data set. Hours for which H-area tower data were missing or invalid were filled with valid data from the C, F, K, P, A, and D-area towers, respectively. Hourly temperature data were taken primarily from measurements collected at the 36-m level of the WJBF-TV tower. These data were supplemented with data from the 18-m and 91-m levels of the tower, respectively.

The composite of valid onsite and TV tower data accounted for 94 percent of the hours in the five year period. The ISCST data base was completed with hourly observations collected by the NWS office at Bush Field, Augusta, Georgia. Although the Bush Field data are considered the most reasonable alternative to onsite data, these data may not be representative of onsite conditions during certain meteorological situations. Consequently, model estimated concentrations based on this data base required careful examination to identify possible unrepresentative results.

Mixing height data, obtained through the Southeast Region Climate Center, Columbia, SC, were determined from Athens, Georgia radiosonde data and surface observations taken at Bush Field.

Preparation of the meteorological data base used for this study is described in more detail in reference 10.

CALCULATIONS AND RESULTS

A site-wide polar receptor grid was used to perform a preliminary set of ISCST calculations using each of the five annual meteorological data bases. These calculations were set up to provide 8-hour, 24-hour, and annual average concentrations using the emissions data from all sources listed in Table 2. The data base for 1983 was selected for subsequent detailed calculations because these data produced relatively conservative results and contained relatively few hours of offsite data. These preliminary runs were also used to better define receptor grids for the more detailed calculations.

Eight-hour Average Benzene Concentrations

Basic Calculations

Detailed calculations of 8-hour average benzene concentrations were limited to a portion of the H-area tank farm which surrounds ITP operations. Results from the preliminary ISCST calculations indicated that 8-hour average benzene concentrations at all other onsite production areas would be much below the OSHA 8-hour exposure limit of 1 ppm.

The tank farm calculations were conducted on a receptor grid defined by a Cartesian coordinate system centered just southwest of the Tank 48 stack (plant coordinates 62600E, 70900N). The computational domain was defined by a 16 by 16 grid point array with a 100 foot spacing. A plan map of the ITP operations area is shown in Figure 1.

Emissions from the Tank 48, Tank 49, and the ITP stripper building stack were included in these calculations. Because of the relatively large distance from S-area to the grid of receptor locations, the contribution of the DWPF 291-S stack benzene emissions to ambient concentrations in the tank farm area was considered to be negligible.

Dispersion calculations were performed for six emissions scenarios defined by various combinations of facility operations. These scenarios are described in Appendix B. In general, the stripper facility was assumed to operate at the lower of the two effluent exit velocities identified in Table 3. However, scenario Case 4 calculations were made for both low (case 4) and high (case 4a) exit velocities to provide an indication of the effect of this operating characteristic on model estimated concentrations.

The results of the 8-hour calculations showed that higher concentrations generally occurred at receptors several hundred feet east of the receptor grid origin, near the ITP cold feeds storage area. Relatively high concentrations also occurred at receptors a short distance west of Building 241-96H. These results were used to identify the maximum receptor concentration for each emission scenario. Maximum values are listed in Table 4. In each case, the maximum estimated concentration was less than the OSHA 8-hour PEL.

The concentrations listed in Table 4 for cases 4 and 4a show that operation of the stripper stack at the higher exit velocity resulted in a 60 percent decrease in the maximum estimated ground-level concentration. In general, the higher stack exit velocity would be expected to result in lower ground-level concentrations for all cases. However, the magnitude of this decrease would be less for the other five cases since the stripper emissions in those cases account for a much smaller percentage of the total ITP benzene emissions.

Supplemental Calculations

The ISCST model does not calculate concentrations for receptors at distances from an "adjacent" structure that are less than three times the height of the structure. Consequently, supplemental calculations were necessary to estimate ground-level concentrations in the immediate vicinity of building 241-96H due to benzene emissions from the Tank 48 and Tank 49 stacks during easterly winds.

Experimental results from a study of a similar source-building relationship are reported by Wilson and Netterville (ref. 11). For this study, a wind tunnel was used to examine diffusion resulting from the interaction of a roof-level pollutant plume with a downwind building. Experimental data indicated that pollutant downwash caused by the recirculating eddies on both the windward and leeward side of the building resulted in ground-level concentrations two to five times higher than concentrations that occurred if the building was not present. In general, ground-level concentrations in the immediate vicinity of a building were found to be approximately equal to the average of the roof-height and ground-level concentrations calculated with no building present. However, to ensure a reasonable margin of safety, the authors recommended that the ground-level concentration be approximated by the maximum concentration at any point on the building surface.

A "flagpole" feature of ISCST allows calculations for receptors at designated elevations above ground. For this analysis, four "flagpoles" were specified along a line representing the windward face of 241-96H. Receptors were located on each flagpole at heights of 2, 8, 13, 18, and 23 meters above ground.

Calculations were performed for emissions cases 1, 3, and 5. The results of these calculations, summarized in Table 5, indicate a potential for either source to cause an exceedance of the OSHA 8-hour PEL under normal or worst case operating conditions.

Subsequent calculations were performed to determine minimum stack heights that would provide reasonable assurance of compliance with the OSHA standard. The first step was to estimate an appropriate stack height for Tank 48 using a simple procedure reported by Hosker (ref. 12). The resulting estimate, 23 meters above ground, was used to recalculate the "flagpole" receptor concentrations using ISCST. In all cases, 8-hour concentrations were below 1 ppm. Similar ISCST calculations were performed for a postulated Tank 49 release height of 20 meters above ground. This stack height value was arbitrarily selected based on the results of the calculations for the Tank 48 stack and the relative magnitude of Tank 49 emissions. Again, benzene concentrations were below the OSHA standard. The results of the ISCST calculations for these suggested minimum stack heights are summarized in Table 5.

Twenty-Four Hour Average Concentrations (Benzene and Mercury)

Twenty-four hour average benzene and mercury concentrations were calculated on a grid defined by a polar coordinate system with an origin located at the center of SRS. The regular grid consisted of receptors located every 10 degrees of azimuth at a radial distance from the origin equal to the minimum distance from the DWPF to the site boundary (approximately 15 km). Additional discrete receptors were placed at locations that have been

designated as the nearest offsite individual for National Emissions Standards for Hazardous Air Pollutants (NESHAPS) compliance dose calculations. To account for relative differences in the surrounding terrain in the dispersion calculations, elevations above sea level were specified for all sources and receptors. These elevations were interpolated from a U. S. Geological Survey 1:48000 scale topographic map.

The calculations were performed for benzene emission rates based on operating scenario cases 1 and 3. These cases result in the greatest total DWPF-related benzene emissions for the normal and worst case operations, respectively.

An examination of the results of these calculations showed that relatively high maximum 24-hour average concentration values occurred at receptors located towards the northeast through northwest of the S and H-areas. Maximum 24-hour average benzene concentrations for receptors in those directions ranged between 2 and 7 micrograms per cubic meter (ug/m^3); maximum mercury concentrations ranged between 0.001 and 0.002 ug/m^3 (normal operations). The highest maximum receptor concentrations at the site boundary are summarized in Table 6 (benzene) and Table 7 (mercury). Table 6 lists highest maximum site boundary concentrations resulting from ITP operations only, from Vitrification Facility operations only, and from all sources combined. The proposed DHEC standard for each substance is also listed in the appropriate table. In each case, estimated maxima are well below the proposed DHEC standard.

Annual Average Benzene Concentrations

The calculations of annual average benzene concentrations were performed on a polar receptor grid similar to that used for the 24-hour average calculations. The regular grid consisted of receptors located along the midpoint of each of the sixteen cardinal wind direction sectors at radial distances of 1, 2, 3, 4, 5, 7.5, 15, 25, 35, and 45 miles from the origin. The NESHAPS compliance locations were also used to define additional discrete receptors. Source and receptor elevations above sea level were specified using the USGS site topographic map. Emission rates were based on operating scenarios 1 and 3.

The results of these calculations showed relatively high annual average concentration values for receptors toward the north of the H and S areas. The highest concentrations among receptors on or near the site boundary are listed in Table 6. The value listed for emissions from all sources operating under normal conditions (Case 1), approximately 0.05 ug/m^3, occurred at a receptor located north-northwest of S Area, near Johnson's Crossroads, SC.

Results of the annual average calculations were subsequently used to estimate maximum individual and population excess cancer risk from long-term exposure to DWPF-related benzene emissions. These risk estimates were determined using methodologies suggested by EPA (ref. 13).

Dose-response relationships for carcinogenic substances are frequently quantified by a "unit risk factor". This unit risk value estimates the excess lifetime probability of cancer incidence (i. e., risk) due to a continuous 70 year exposure to one unit of concentration. These risk factors generally are based on a linear extrapolation from experimentally observed responses at high doses. The unit risk factor for benzene, supplied by the EPA Air Risk Support Center, is 8.3 X 10-6 m^3/ug.

The maximum estimated annual average benzene concentration for the site boundary (0.05 ug/m^3) was multiplied by the benzene unit risk factor to determine the excess lifetime cancer risk to a hypothetical individual at this location. The resulting estimated excess lifetime cancer incidence probability was 4 X 10-7. An identical calculation for the maximum exposed individual defined for NESHAPS determinations (0.04 ug/m^3) resulted in an estimated excess cancer risk of 3 X 10-7. An excess lifetime cancer risk of between 1 X 10-4 and 1 X 10-6 is frequently cited by EPA as an acceptable risk.

Population risks were estimated using concentration values computed for the offsite receptor grid array. Each offsite grid point defined the center of an area defined by a 22.5 degree wind direction sector and radial downwind distance increments of 5-10, 10-20, 20-30, 30-40, or 40-50 miles. Annual average benzene concentrations were assumed to be uniform over any given area and equal to the estimated value at the grid point location. Each area concentration was multiplied by the total population for that area to determine an area-wide benzene exposure. The population cancer risk estimate is given by the product of the cumulative exposure for all areas and the benzene unit risk factor. These calculations resulted in an estimated 0.04 persons contracting cancer over a 70 year period from exposure to DWPF-related benzene emissions. This is equivalent to an average of 6 X 10-4 excess cancers per year. Population data, valid for the year 2010, were taken from reference 14.

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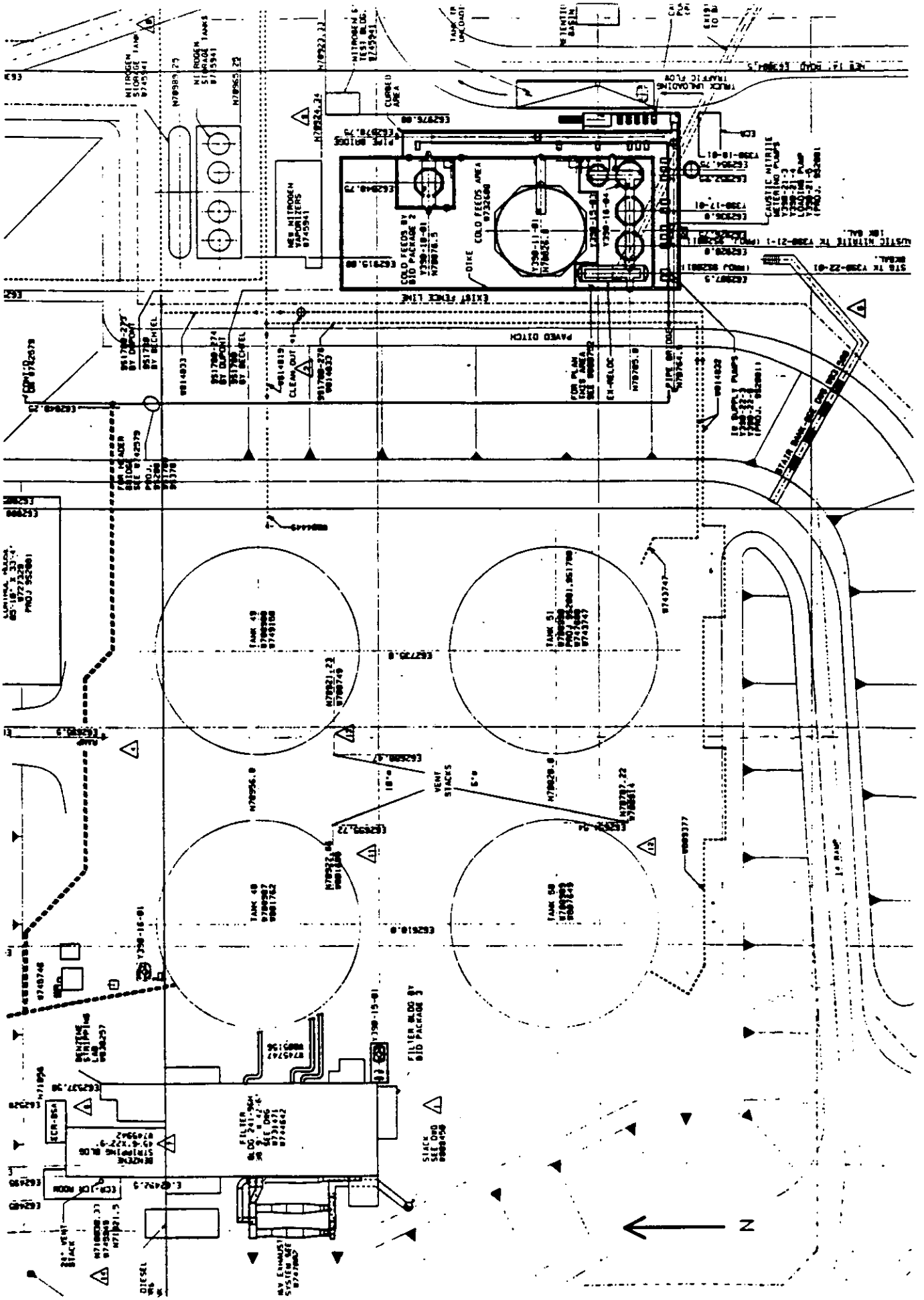

Figure 1. ITP Area Plot Plan (W742849 Rev 16)

TABLE 1

Estimated Annual Atmospheric Emissions of Benzene from the DWPF, the ITP Process, and the Saltstone Facility

Source	Average Emission Rate (lb/hr)	Total Annual Emission (tons)
DWPF:		
Stack	5.30 E-0	2.32 E+1
Organic Storage Tank	5.25 E-3	2.30 E -2
DWPF Total		2.32 E+1
ITP:		
Tank 22 Stack	1.30 E-3	5.69 E-3
Tank 48 Stack	5.20 E-1	2.28 E-0
Tank 49 Stack	3.60 E-0	1.58 E+1
Tank 50 Stack	2.30 E-3	1.01 E-2
Stripper Stack	7.10 E-1	3.11 E-0
Low Point Pump Tank	4.25 E-7	1.86 E-6
ITP Total		2.11 E+1
Z-Area (Saltstone):		
Saltstone Vault	2.30 E-13	1.01 E-12
Saltstone Stack	2.30 E-9	1.01 E-8
Z-Area Total		1.01 E-8

Source: Reference 5

TABLE 2

Estimated Expected and Maximum Hourly Benzene Emission Rates, in Pounds per Hour, For Air Dispersion Modeling

	DWPF	ITP		
	291-S	Tank48	Tank49	Stripper
Expected:				
8-hour (a)	40.0	18.0	3.9	11.0
24-hour (a)	18.5	18.0	3.9	10.0
Annual	5.3	0.52	3.6	0.91
Maximum:				
8-hour (a)	60.0	27.0	8.0	32.0
24-hour (a)	28.7	27.0	8.0	31.0
Annual	8.2	0.91	7.1	2.2

Peak average hourly emission rate for any given 8- or 24-hour period.

Sources: Expected DWPF emissions rates based on Reference 5; Maximum DWPF emission rates based on DHEC construction permit 0080-0066-CA; Expected and maximum ITP emissions from Reference 6.

TABLE 3

Design Source Characteristics for ISC Modeling

	DWPF	ITP		
	291-S	Tank48	Tank 49	Stripper
Plant Coordinates:	64000E 73750N	62656E 70922N	62688E 70921N	62495E 71030N
Stack Height (m):	46.0	17.6	8.5	27.4
Stack Diameter (m):	1.5	0.25	0.25	0.61
Effluent Temp (K):	300	308	308	300
Effluent Exit Velocity (m/sec)				
Normal:	25.9	4.7	4.7	0.5/18.4
Worst Case:		2.8	2.8	

Note: The filter/stripper building qualifies as an ISCST "adjacent" structure for the stripper, Tank 48, and Tank 49 stacks. Building dimensions are 18.3 m high, 44.5 m long, and 15.3 m wide.

Sources: ITP Plot Plan Drawing No. W742849, Rev. 16; Defense Waste Processing Facility Construction Air Permit 0080-0066-CA; Reference 6

TABLE 4

Estimated Highest Maximum 8-Hour Average Ground-Level Benzene Concentrations in the H-Area Tank Farm For Various ITP Operating Scenarios

	Maximum Receptor Concentration(ppm)
Case 1:	0.39
Case 2:	0.18
Case 3:	0.60
Case 4:	0.35
Case 4A:	0.15
Case 5:	0.48
Case 6:	0.32

Note: The OSHA 8-hour time weighted average PEL for benzene is 1 ppm (approximately 3100 ug/m^3). Operating scenarios are defined in Appendix B.

TABLE 5

Estimated Highest 8-Hour Average Benzene Concentrations on or Near Building 241-96H (ITP Filter/Stripper Building), in ppm. Emissions from Tank 48 and Tank 49 Stacks Using Design and Postulated Stack Heights

		Current Design Stack Height:		Postulated Stack Height(1):		
		Tank 49	Tank 48	Tank49	Tank 48	Combined
Case 1:	Maximum(2)	1.10	6.26	0.29	0.40	0.43
	Average(2)	0.58	3.06	0.15	0.20	0.22
Case 3:	Maximum	1.10	14.53	0.29	0.76	0.88
	Average	0.58	7.26	0.15	0.38	0.44
Case 5:	Maximum	1.94	6.26	0.83	0.40	0.86
	Average	1.10	3.06	0.42	0.20	0.43

Note: The OSHA permissible exposure limit for benzene is 1 ppm.

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(1) Postulated stack heights were 20 meters above ground for the Tank 49 and 23 meters above ground for Tank 48.

(2) The "maximum" value is the highest concentration of any receptor located on the east face of 241-96H; the "average" value is the average of the "maximum" concentration and concentrations for receptors at 2 meters above ground.

TABLE 6

Estimated Highest Maximum 24-Hour and Annual Average Ground-Level Benzene Concentrations at the SRS Boundary

Averaging Period	Concentration (ug/m3) DWPF	ITP	Cumulative	DHEC Proposed Standard (ug/m3)
"Expected" Emissions:				
24-Hour	1.4	5.1	6.6	150
Annual	0.02	0.03	0.05	----
"Maximum" Emissions:				
24-Hour	2.2	7.9	10.1	150
Annual	0.03	0.06	0.08	----

TABLE 7

Estimated Highest Maximum 24-Hour Average Mercury Concentrations at the SRS Boundary

	Concentration (ug/m^3)	DHEC Proposed Standard (ug/m^3)
"Expected" Emissions:	0.002	2.0
"Maximum" Emissions:	0.004	2.0

APPENDIX A

Benzene and Mercury Source Descriptions

In-Tank Precipitation

Radioactive waste salt solutions, transferred to Tank 48 from F-and H-area waste tanks, are mixed with sodium tetraphenylborate to precipitate radioactive Cesium from the solution. Benzene is generated in Tank 48 from radiolytic decomposition of the tetraphenylborate salts and will be present in all subsequent ITP process streams.

The salt solution/precipitate slurry produced in Tank 48 is transferred to the filter/stripper building (241-96H) for separation of the precipitate slurry from the decontaminated salt solution. The salt solution is processed through a stripping system, also located in building 241-96H, to remove benzene and alcohols and tested to determine acceptance for processing at the Saltstone Facility. An acceptable solution is transferred to Tank 50 (Saltstone feed tank). Unacceptable solution is transferred back to Tank 48 for reprocessing.

The filtered precipitate slurry is returned to Tank 48, washed to ensure that chemical concentrations are within DWPF Vitrification Facility acceptance levels, and filtered again. The resulting spent waste is passed through the stripper and tested. Acceptable waste water is transferred to Tank 22; unacceptable waste water is returned to Tank 48. The washed slurry is pumped to Tank 49 (DWPF Vitrification Facility feed tank).

Benzene releases to the atmosphere will result from routine venting of vapors from tanks 48, 49, 22, and 50 and from operation of the stripper facility.

DWPF Vitrification Facility

Acceptable precipitate slurry from the ITP is pumped from H-area to the Vitrification Facility. The precipitate undergoes hydrolysis in the Salt Processing Cell (SPC) to decompose the slurry into an organic stream low in radioactivity and an aqueous stream containing Cesium, Strontium, and Plutonium. Hydrolysis of the precipitate is conducted in batches that require about 84 hours to complete.

Most of the organic vapors generated in the precipitate reactor are condensed and transferred to the organic waste storage tank. Vapors that are not condensed are vented from the SPC, diluted with air, filtered, and released to the atmosphere through the 291-S process stack. Approximately 90 percent of the organic stream produced in a batch is benzene.

Residual amounts of mercury are are present in most Vitrification Facility processes and are released through the 291-S process stack.

Saltstone

ITP salt solution stored in Tank 50 is transferred to Z-area through an interarea pipeline. The solution is introduced into the saltstone mixer and mixed with flyash, slag, and lime to produce saltstone. The final product will be stored in adjacent concrete vaults. Since most of the benzene in the salt solution is removed by the ITP stripper, benzene emissions from the mixer process vent and the vault are extremely small.

APPENDIX B

Six emission scenarios were defined to examine a wide range of possible benzene impacts. These scenarios are listed in Table B-1. One basic scenario group was characterized by normal facility operations; a second group was defined by worst case operations. For each group, scenarios were defined by the operational characteristics of the various processes and anticipated administrative controls. For example, peak emissions from the Tank 48 stack will not occur simultaneously with the peak emissions from the stripper stack since benzene generation from these sources occur in different parts of the ITP cycle. In addition, administrative controls are expected to prevent operating conditions conducive for maximum credible benzene generation in Tank 49 simultaneously with conditions producing maximum benzene emissions from either the Tank 48 or the Stripper stack.

Table B-1
Emissions Scenarios for ISCST Model Calculations

Case 1: Normal operations.

DWPF - peak expected emission rate
Tank 49 - peak expected emission rate
Tank 48 - peak expected emission rate
Stripper - 25% of peak expected emission rate.

Case 2: Normal operations.

DWPF - peak expected emission rate
Tank 49 - peak expected emission rate
Tank 48 - 25% of peak expected emission rate
Stripper - peak expected emission rate.

Case 3: Worst case operations.

DWPF - peak maximum emission rate
Tank 49 - peak expected emission rate
Tank 48 - peak maximum emission rate
Stripper - 25% of peak maximum emission rate.

Case 4: Worst case operations.

DWPF - peak maximum emission rate
Tank 49 - peak expected emission rate
Tank 48 - 25% of peak maximum emission rate
Stripper - peak worst case emission rate.

Case 5: Worst case operations.

DWPF - peak maximum emission rate
Tank 49 - peak maximum emission rate
Tank 48 - peak expected emission rate
Stripper - 25% of peak expected emission rate.

Case 6: Worst case operations.

DWPF - peak maximum emission rate
Tank 49 - peak maximum emission rate
Tank 48 - 25% of peak expected emission rate
Stripper - peak expected emission rate

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