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COMBUSTION HUMAN HEALTH RISK ASSESSMENT
FOR
ANGUS CHEMICAL COMPANY
STERLINGTON, LOUISIANA

Draft

Prepared by

US EPA Region 6
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FOREWORD

On May 18, 1993, the United States Environmental Protection Agency (EPA) announced a series of steps that the Agency would undertake, first, to achieve reductions in the amount of hazardous waste generated in this country and, second, to ensure the safety and reliability of hazardous waste combustion in incinerators, boilers, and industrial furnaces. With this announcement, EPA released its Draft Hazardous Waste Minimization and Combustion Strategy. Eighteen months later, EPA's released its Final Strategy which solidified the Agency's policy on "how best to assure the public of safe operation of hazardous waste combustion facilities." In short, EPA's Final Strategy specifically recognized the multi-pathway risk assessment as a valuable tool for evaluating and ensuring protection of human health and the environment in the permitting of hazardous waste combustion facilities.

In keeping with EPA's Final Strategy, Region 6 believes that those combustion facilities which are in close proximity to population centers can be evaluated by a multi-pathway risk assessment to ensure that permit limits are protective of human health. Furthermore, EPA Region 6 believes that multi-pathway risk assessments should consider the specific nature of process operations and the type of combustion units and air pollution control equipment utilized at each facility in order to be representative of actual facility operations. Therefore, although certain provisions of the Resource Conservation and Recovery Act (RCRA) program have since been delegated to the States, EPA Region 6 is committed to reviewing facilities on a site specific basis to evaluate the protectiveness of permits for combustion operations.

EPA Region 6, in partnership with the Louisiana Department of Environmental Quality (LDEQ), requested more comprehensive testing for boiler and industrial furnace (BIF) combustion facilities in the State of Louisiana as part of the regulatory trial burn testing conducted during early 1997 through 1998. Although the science of combustion risk assessments was still under development, BIF facilities agreed to conduct more comprehensive testing prior to EPA's completion of the revised national guidance documents for combustion emissions testing and risk assessment protocols. Based upon the nature of their operations, EPA allowed BIF facilities to demonstrate their performance at "normal operating conditions" during the trial burn by adding a separate "risk burn" test condition. The information from the risk burn was collected with the intent of EPA conducting facility-specific human health risk assessments.

In July 1998, EPA published its **Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft** (EPA530-D-98-001 A, B, and C), commonly referred to as the HHRAP. In August 1998, EPA issued its **Guidance on Collection of Emissions Data to support Site-Specific Risk Assessments at Hazardous Waste Combustion Facilities, Peer Review Draft** (EPA530-D-98-002). In the following year, EPA staff worked through several implementation issues in applying these guidance documents and in July 1999, EPA issued an **Errata to the HHRAP** (EPA Memo, July 1999) which addressed issues specific to conducting human health risk assessments. EPA utilized the above listed guidance documents, along with facility specific information, to complete this human health risk assessment. This risk assessment report documents the Agency's effort in ensuring protective permit limits and ensuring that normal combustion facility operations do not pose unacceptable risks to surrounding communities.

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EXECUTIVE SUMMARY

The Angus Chemical Company applied to the LDEQ for a RCRA permit to burn hazardous waste in two BIF units at their facility located in Sterlington, Ouachita Parish, Louisiana. In order to assist LDEQ in identifying any additional permit conditions which might be necessary to ensure protection of human health, EPA has conducted this risk assessment. This assessment evaluates those potential emissions from the two RCRA point sources at the Angus facility, Boiler No. 4 and Boiler No. 7, as well as potential fugitive emissions associated with the RCRA facility operations.

EPA's risk assessment indicates that "normal operations" of the BIF hazardous waste burning units at the Angus facility should not adversely impact human health. In addition, EPA's risk assessment evaluates risk-based permit limits that can be incorporated into the RCRA permit in order to *supplement* regulatory maximum allowable limits and ensure protection of human health over the long term.

Waste Feed Rates (g/s)

Metals of Concern	Recommended Risk-Based [1] Permit Limit Annual Average	"Normal Operations" Demonstrated via the Risk Burn [1] (3 Runs Data Average)
Antimony	**1.06E-2**	**1.33E-4**
Barium	**1.77E-2**	**2.37E-5**
Beryllium	**1.49E-4**	**ND [2] = 2.19E-5**
Cadmium	**1.98E-4**	**2.89E-5**
Chromium, Total	**2.94E-5 [3]**	**ND [2] = 1.10E-5**
Mercury, Total	**1.00E-7 [4]**	**ND [2] = 2.19E-6**

NOTES:

1. Recommended RCRA Permit Limits are based upon the annual average stack gas temperature of 453 K and an annual average stack gas flow rate of 11.7 m^3/s; these parameters were demonstrated during the risk burn.
2. **ND** means that the metal was ***not detected*** in the waste feed; the detection limit was used to calculate the emission rate shown.
3. Recommended RCRA Permit Limit for Chromium is actually based upon the assumption that Hexavalent Chromium is equal to 100% of the Total Chromium measured during the risk burn. Alternatively LDEQ may specify the permit limit for Hexavalent Chromium rather than Total Chromium.
4. Mercury is not believed to be present in the waste feed, but the analytical method used in the risk burn did not provide low enough detection limits for comparison with the Recommended RCRA Permit Limit. The Risk-Based Annual Average RCRA Permit Limit for mercury is achievable with modification of EPA's analytical method for quantifying mercury in wastewater for determination of mercury in liquid organic waste. Alternatively LDEQ may specify the recommended limit as an emission rate limit for mercury (lower detection limit is possible than for the feed) which would also demonstrate protectiveness.

EPA back-calculated the risk-based annual average permit limits listed above from the Adjusted Tier I limit for each metal of concern and then *used the calculated limits in the risk assessment* in order to show permit protectiveness over the long term. Therefore, EPA recommends that LDEQ incorporate the annual average

metal feed rate limits listed above into the RCRA permit.

EPA evaluated the most current information available to estimate potential impacts to human health, both directly via inhalation, incidental soil ingestion, and ingestion of drinking water (via surface water intakes), and indirectly via modeled deposition and uptake through the food chain. Emissions data collected as part of the risk burn, operational data specific to the Angus facility, and site-specific information based upon the facility's location, were evaluated and considered in making assumptions and in predicting risks associated with long term operations. The risk estimates provided in this risk assessment are conservative in nature and represent possible future risks, based upon those operating conditions evaluated for issuance of a final RCRA combustion permit. If operations change significantly, or land use changes occur which would result in more frequent potential exposure to receptors, risks from facility operations may need to be reevaluated.

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BACKGROUND INFORMATION

This risk assessment report presents a brief description of the facility and the emission sources evaluated, the air modeling effort conducted, the risk modeling effort conducted, and EPA's evaluation of risk estimates for the Angus Chemical Company ("Angus facility") located near Sterlington, Ouachita Parish, Louisiana. EPA utilized the Industrial Source Complex Short Term Version 3 Program (EPA, ISCST3 software) for air modeling and the Industrial Risk Assessment Program - Health (Lakes Environmental, IRAP-h View software Version 1.7) for risk modeling. EPA utilized the ArcView Program (Environmental Systems Research Institute, software Version 3.1), for desktop Geographical Information Systems (GIS), for all mapping efforts. All available information used to assess risks attributable to the Angus facility can be found in electronic format, converted mainly to pdf files, in appendices enclosed via compact disc with this risk assessment report as follows:

Appendix A: Air Modeling
- Audit Files
- Input and Output Air Files from the ISCT3 Model
- Plot Files
- ISC File (file built for import into the IRAP-h Project File)

Appendix B: Spreadsheets
- Surface Roughness Calculation
- Source Emission Rate Calculations
- Transport & Fate Parameters
- Total Organic Emissions (TOE) Factor

Appendix C: Mapping
- Background Maps
- Land Use Shape Files

Appendix D: Risk Modeling
- Source Information from the IRAP-h Project File
- Receptor Information from the IRAP-h Project File
- Risk Summary Information from the IRAP-h Project File

Appendix E: IRAP-h View Project Files
- Readme File
- Angus_fr.ihb - All Chemicals Run, with metals adjusted to risk-based permit limits

Since The HHRAP provides generic discussions of the uncertainties associated with each major component of the risk assessment process, this report only discusses those uncertainties particular to the site specific results evaluated for the Angus facility. References are provided at the end of this document.

Facility and Source Information

The Angus facility is an organic chemical manufacturing facility located along Louisiana State Highway 2 near Sterlington, Ouachita Parish, Louisiana. The facility is bordered on the north by Louisiana State Highway 2; on the east by residences, vacant land, and Koch, Inc. (an ammonia manufacturer); on the south by forested and agricultural land; and on the west by the Ouachita River. Land use surrounding the facility consists primarily of a mix of rural and industrial use, including residences, commercial businesses, industrial facilities, agricultural land, surface-water bodies, and wetlands.

The Angus facility manufactures nitroparaffins (NP) including nitromethane, nitroethane, nitrobutane, and nitropropane. The chemical manufacturing process generates RCRA hazardous and nonhazardous waste streams, which are burned in the facility's two BIF units, Boilers No. 4 and No. 7. The RCRA hazardous waste stream generated is termed "NP Heads." The NP Heads waste is an ignitible and corrosive liquid waste (assigned EPA waste codes D001 and D002) which is burned for energy recovery by producing steam that is used throughout the facility. Although both boilers can be used to burn hazardous waste, Boiler No. 4 is used only when Boiler No. 7 is shut down for preventive maintenance and repairs, which is about 2 to 6 weeks per year. Natural gas is the primary fuel of both boilers.

Boilers No. 4 and No. 7 are both Riley Stoker water-tube, forced-draft air boilers that have a steam-generating capacity of 110,000 pounds per hour (lb/hr). The maximum feed rate of hazardous waste to either unit is 6.8 gallons per minute (gpm). However, the maximum waste feed cutoff for each boiler is set a bit lower (Boiler No. 4 set at 6.1 gpm and Boiler No. 7 set at 6.6 gpm). Boiler No. 4 has a conical stack with a height of 17.7 meters above grade while Boiler No. 7 has a conical stack height of 12.5 meters above grade. Both units have a cross-sectional area of 3.93 square meters (m^2) at the stack exit. Each unit has a design stack gas exit velocity of 4.85 meters per second (m/sec) and an exit temperature of 478 K (400 °F). Boiler No. 7 has a design stack gas flow rate of 19.1 cubic meters per second (m^3/sec).

Due to the nature of their process, the BIF regulations do not require air pollution control devices on either of Angus's boilers. Both units are monitored continuously for carbon monoxide, nitrogen oxides, and oxygen emissions by an Horiba analyzer. The facility is capable of storing about 1,500 gallons of waste feed material from the NP process area. Angus reports that the typical feed rate of the waste feed to the units is 2 to 6 gpm. Therefore, based on the facility's waste generation rate and the waste feed rate to the boilers, the hazardous waste feed is burned at essentially the same rate as it is produced.

Angus operates each unit under an Adjusted Tier I status, which simply means that all of the metals fed to the unit are assumed to be emitted in the stack gas. Therefore, the regulations limit stack metal emissions based on the hourly feed rate of individual metals into the combustion unit. A destruction and removal efficiency (DRE) test for organic compounds was not performed on Boiler No. 7 because it meets the exemption from DRE testing in accordance with Title 40 of the Code of Federal Regulations (CFR) 266.104(a)(4) and (5), 266.109, and 110. However, the risk burn provided speciated organic emissions data.

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A risk burn is considered an additional operating condition of the trial burn during which data are collected to demonstrate that the hazardous waste-burning boiler unit does not pose an unacceptable health risk when operating at typical (or normal) operating conditions over the long term. Therefore, based upon Angus's normal operating conditions, the fact that Boiler No. 4 is only used when Boiler No. 7 is down for maintenance and the fact that both boilers are similar in construction and design capacity, the risk burn was conducted only on Boiler No. 7. The target feed rate during the risk burn was 4.2 gpm and consequently, the measurements taken during the risk burn demonstrated a stack gas flow rate of 11.7 m^3/sec, a stack gas exit velocity of 6.29 m/sec, and an exit temperature of 453 K (357 °F) for normal operating conditions (i.e., these measurements are averages for runs reported in the Angus Risk Burn Report, March 1998, Appendix G). LDEQ and EPA provided oversight at the risk burn testing for Boiler No. 7 at the Angus facility.

Air Modeling

EPA used the ISCST3 for determining air dispersion and deposition of compounds resulting from operations at the Angus facility in accordance with the HHRAP. EPA evaluated emission sources using primarily the data and information provided in the Angus Risk Burn Report dated March 1998 and supplemental information requested by EPA and provided by Angus in the "Fugitive Emission Estimating Data Report" dated August, 1998.

EPA modeled four separate emission sources for the Angus facility: one stack source, Boiler No. 7 ("B807"); two volume area sources to account for fugitive emissions associated with ancillary equipment to Boiler No. 7 ("Combustion Unit Fugitives, Area 2" or "CUF2") and Boiler No. 4 ("Combustion Unit Fugitives, Area 1" or "CUF1"); and one volume area source to account for fugitive emissions associated with the waste feed storage area ("Storage Area Fugitives" or "SAF"). Since Boiler No. 4 only operates 2 to 6 weeks per year when Boiler No. 7 is off-line, EPA evaluated emissions from Boiler No. 7 as if operations occur for 365 days per year in order to account for the periodic operation of Boiler No. 4. EPA believes that this is a reasonable approximation of emissions from both boilers since both boilers are similar in design capacity and construction, burn exactly the same waste, and are located in close proximity to each other. Since the fugitive areas are not identical in dimension, and since the lines for equipment surrounding Boiler No. 4 are not purged, EPA modeled fugitives associated with ancillary equipment to both boilers.

Universal Transverse Mercator (UTM) projection coordinates in North American Datum revised in 1983 (NAD83) for each source are as follows: for B807, (585828.3, 3617330.0); for CUF1 (585879.5 3617349.2); for CUF2 (585845. 3617324.7); and for SAF (586154.5 3617648.2). EPA used a stack gas flow rate of 11.7 m^3/sec, a stack gas exit velocity of 6.29 m/sec, and a stack gas exit temperature of 453 K (357 °F) for B807 as input to ISCST3. EPA used a height of 5 meters (assumed midpoint of height of equipment) and an area of approximately 68 square meters (m^2) for evaluation of CUF1 and a height of 5 meters and an area of approximately 36 m^2 for CUF2. EPA used a height of 5 meters and an area of 29 m^2 for evaluation of SAF.

Modeling for the Angus facility was based upon an array of receptor grid nodes at 100-meter spacing out to a distance of 3 kilometers from the facility and an array of receptor grid nodes at 500-meter spacing between a distance of 3 kilometers and out to a distance of 10 kilometers from the facility. Unitized concentration and deposition rates were determined by the ISCST3 model for each receptor grid node for use in assessing risks. Consistent with the HHRAP, water body and watershed air parameter values were obtained from the single receptor grid node array without need for executing values to a separate array.

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Terrain elevations based on 90-meter spaced USGS digital elevation data were specified for all receptor grid nodes. Other site-specific information used to complete the ISCST3 model included the most current surrounding terrain information, surrounding land use information, facility building characteristics, and meteorological data available. Meteorological data collected over a 5-year period from representative National Weather Service (NWS) stations near the facility were used as inputs to the ISCST3 model. The surface data was collected from the Shreveport NWS station. The upper air data was collected from the Longview, Texas NWS station.

Model runs were executed for accurate evaluation of partitioning of all compounds specific to vapor phase, particle phase, and particle-bound phase runs. In addition, particle diameter size distributions and mass fractions for each source stack were based on the values determined during the risk burn. **Appendix A** contains all air modeling information utilized and generated for the Angus facility.

Compounds of Potential Concern (COPCs)

EPA identified Compounds of Potential Concern (COPCs) in accordance with the HHRAP. EPA dropped phthalate compounds from the risk analysis since the Angus facility does not burn plastics or materials with phthalate plasticizers and since phthalate compounds were not detected in any of the risk burn runs. In addition, EPA eliminated some compounds from the quantitative risk analysis based upon availability of toxicity data and/or transport and fate data. Those few chemicals which were detected, but dropped from the risk analysis, are qualitatively discussed in the Uncertainty Section of this report. **Appendix B** contains EPA-calculated COPC-specific emission rates used in the risk assessment for each source, including the fugitives areas, and provides justification for all chemicals dropped from the risk analysis. EPA input these COPC-specific emission rates directly into the risk model, which allowed calculation of compound-specific media concentrations in order to estimate risks.

EPA evaluated stack emissions data for organic compounds collected during the risk burn conducted between April 1 and 3, 1997, in order to calculate emission rates. EPA estimated stack emissions for inorganic compounds from the waste feed data collected during the risk burn since Angus sampled the waste feed rather than emissions, in accordance with their Adjusted Tier I status for these compounds. EPA reviewed a letter report from the facility entitled “BIF Risk Assessment Information”, dated August 5, 1999, in order to determine a site-specific upset factor of 1.001 for use in calculation of COPC-specific emission rates for organic compounds. EPA used an upset factor of 1.0 for inorganic compounds since operation under an Adjusted Tier I status meant evaluation of waste feed measurements and not actual emissions data (i.e., all of the metals fed to the unit are assumed to be emitted in the stack gas). EPA also reviewed the Certification of Compliance (COC) forms on file, dated 1993 and 1996, for the Angus facility in order to compare the Adjusted Tier I levels with operations data collected during the risk burn. Finally, in order to properly assess fugitive emissions associated with Angus’s typical operations, EPA evaluated supplemental information provided by Angus in the “Fugitive Emission Estimating Data Report” dated August, 1998. This document provided historical information on the typical mix of specific compounds in the waste feed and the engineering details for equipment in the areas being evaluated.

Of special note, EPA initially evaluated Adjusted Tier 1 Feed Rate Limits (i.e., maximum allowable regulatory limits) for the Angus boiler and found that the limits for several metals would need to be supplemented with lower annual average limits (risk-based limits) in order for the *permit* to be protective of human health. Since the risk burn data as well as the COC forms for the Angus facility show that typical operations result in emission rates which are orders of magnitude below the maximum allowable regulatory

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limits, EPA back-calculated risk-based annual average permit limits from the Adjusted Tier I limit for each metal of concern.

Waste Feed Rates
(g/s)

Metals of Concern	Adjusted Tier I Regulatory Permit Limit Maximum Allowable	Recommended Risk-Based [1] Permit Limit Annual Average	"Normal Operations" Demonstrated via the Risk Burn [1] (3 Runs Data Average)
Antimony	**1.06E-1**	**1.06E-2**	**1.33E-4**
Barium	**1.77E+1**	**1.77E-2**	**2.37E-5**
Beryllium	**1.49E-3**	**1.49E-4**	**ND [2] = 2.19E-5**
Cadmium	**1.98E-3**	**1.98E-4**	**2.89E-5**
Chromium, Total	**2.94E-4**	**2.94E-5 [3]**	**ND [2] = 1.10E-5**
Mercury, Total	**2.83E-2**	**1.00E-7 [4]**	**ND [2] = 2.19E-6**

NOTES:

1. Recommended RCRA Permit Limits are based upon the annual average stack gas temperature of 453 K and an annual average stack gas flow rate of 11.7 m^3/s; these parameters were demonstrated during the risk burn.
2. **ND** means that the metal was ***not detected*** in the waste feed; the detection limit was used to calculate the emission rate shown.
3. Recommended RCRA Permit Limit for Chromium is actually based upon the assumption that Hexavalent Chromium is equal to 100% of the Total Chromium measured during the risk burn. Alternatively LDEQ may specify the permit limit for Hexavalent Chromium rather than Total Chromium.
4. Mercury is not believed to be present in the waste feed, but the analytical method used in the risk burn did not provide low enough detection limits for comparison with the Recommended RCRA Permit Limit. The Risk-Based Annual Average RCRA Permit Limit for mercury is achievable with modification of EPA's analytical method for quantifying mercury in wastewater for determination of mercury in liquid organic waste. Alternatively LDEQ may specify the recommended limit as an emission rate limit for mercury (lower detection limit is possible than for the feed) which would also demonstrate protectiveness.

As the above comparison shows, Angus demonstrated during the risk burn that feed rate limits during "normal operations" fall below the recommended permit feed rate limits, or in the case of mercury, can be achieved and demonstrated during future sampling events. *Therefore, EPA used the calculated (or "recommended risk-based") permit limits in the final risk assessment model–along with actual emissions data for all the other COPCs being evaluated–in order to show permit protectiveness over the long term*.

EXPOSURE ASSESSMENT

Exact locations where people can potentially be exposed to contaminants in the air, surface water, or soil are determined by the grid spacing used in the air model and subsequently imported into the risk model. These

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specific locations can be used for assessing exposure for a particular type of receptor based upon the land use type being evaluated (i.e., farming or residential). Since plants or animals can also be exposed to contaminants at these coordinates points, possible uptake through the food chain can be assessed based upon the type of land use designated.

The potential exposure scenarios evaluated in this risk assessment include both adult and child receptors for the following land use types: residential, subsistence farming, and subsistence fishing. In all cases, EPA used default values for receptor specific parameters, as outlined in the HHRAP. Current land use was considered in determining those receptors potentially impacted by identified emission sources, while potential future land use was assumed to be the same as current land use.

Study Area Characterization

Figure 1 depicts the general study area being evaluated. Although the study area for air modeling purposes extends out approximately 10 kilometers from Boiler No. 7, the risk assessment evaluated possible exposure based upon potential receptors located closer to the facility where the ***reasonable maximum risks*** to various types of receptors might occur. Specifically, discrete land use areas where results of the air modeling indicated maximum air concentration or maximum deposition of COPCs might occur typically fell within a 3 kilometer radius from Boiler No.7. EPA then evaluated multiple locations within each discrete land use area potentially impacted, in accordance with the HHRAP. This ensured that all possible receptors were evaluated for identifying reasonable maximum risks for each exposure scenario type.

Potentially impacted water bodies and their associated effective watershed areas were also evaluated as part of the risk assessment. EPA evaluated the following water bodies: Ouachita River, Sterlington Brake, Devil's Hole, Keystone Road Pond, Highway 2 Pond, West Sterlington Pond, and Lake Bartholomew. Although some of the ponds may not currently be used for fishing, EPA evaluated each pond for fishing consumption based upon the potential for fishing to occur. Additionally, Sterlington currently obtains its drinking water from deep wells rather than any surface water bodies within the study area. However, for the risk modeling effort, EPA specified the river adjacent to the facility as a potential future drinking water source. These assumptions may have been overly conservative for evaluation of current use, but did not require further evaluation since resulting risks for the drinking water and fish consumption pathways were well below EPA levels of concern.

EPA contractors conducted a site visit to verify information shown on digitized land use land cover maps, topographic maps, and aerial photographs. EPA utilized the internet to locate and verify local schools and daycare facilities on the topographic maps. EPA also requested and obtained input from LDEQ and facility representatives on actual land use designations used. **Appendix C** contains the topographic, land use, and watershed maps which show the specific areas evaluated as part of the study area–as well as those effective watershed areas specific to this risk assessment.

Exposure Scenario Locations

The exposure scenario locations in this risk assessment were chosen to be representative of potential maximally exposed individuals, or receptors, within each representative land use type. EPA also evaluated receptors where actual land use dictated consideration of *special sub-populations*, as defined in the HHRAP. Since the Smith School campuses have elementary-age children, EPA utilized the child residential scenario at each of the campus locations. Infant potential exposure to dioxins and furans via the ingestion of their

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mother's breast milk is evaluated at corresponding adult scenario locations (i.e., locations where the mother may live). Receptor locations for a child's potential exposure to lead in soil and air are the same as the various child scenario locations. Fisher receptors were placed at residential scenario locations near each water body evaluated. All exposure scenario locations are shown on those topographic maps provided in **Appendix C**, and are also provided via a coordinate list exported from the risk model project file in **Appendix D**.

Transport and Fate Parameters

EPA used transport and fate equations presented in the HHRAP to determine air, soil, and surface water COPC-specific concentrations. Those equations which determine uptake of specific COPCs in the food chain (i.e., COPC concentrations in fish, pork, milk, eggs, etc.) allow the use of parameters derived as either default values, also provided in the HHRAP, or facility/site-specific values, as available and appropriate. Site-specific transport and fate parameters utilized for the Angus facility include universal soil loss constants, delineation of water body and effective watershed areas potentially impacted by facility sources, water body depth, and average annual total suspended solids concentration.

Of special note is EPA's decision to use 40 years for the time of COPCs deposition (i.e., facility operational time), rather than the 100 years recommended by the HHRAP. EPA Region 6 considerations in using 40 years as opposed to 100 years include the following: 1) the longest receptor exposure duration is 40 years; and 2) RCRA permit renewals are required every 10 years so risks can be reevaluated at any time utilizing the most current transport and fate information available at that time.

Site-specific transport and fate parameters are provided in the spreadsheet provided in **Appendix B**. COPC-specific chemical and physical parameters are not provided in this risk assessment report since they can be found in Appendix A of the HHRAP and also in EPA's July 1999 Errata to the HHRAP. The IRAP-h View Version 1.7 utilizes all updated information found in EPA's Errata to the HHRAP.

RISK CHARACTERIZATION

In this risk assessment, EPA evaluated chronic excess risk estimates for both ***direct exposure pathways***, or those pathways where contact may occur with a contaminated media (i.e, inhalation, incidental soil ingestion, and ingestion of drinking water), and also ***indirect pathways*** (i.e., those risks associated with uptake through the food chain). EPA also evaluated the potential for non-carcinogenic health effects to occur by calculation of hazard indices (HIs) for the various COPCs identified at the Angus facility. In addition, EPA assessed the following: 1) potential acute effects (i.e., risks associated with short-term emissions) from inhalation; 2) potential impacts from possible accumulation of dioxin and furan compounds in breastmilk; and 3) potential adverse impacts for small children (i.e., children under 6 years old) who are susceptible to lead exposure in surface soils and ambient air.

For those chemicals detected in stack gas emissions or quantified as fugitive source emissions at the Angus facility, EPA found that RCRA operations should not pose adverse impacts for any of the receptors evaluated. For those chemicals not actually detected in stack gas emissions or not detected in the waste feed analysis, please see the Uncertainty Section of this report. EPA used target action levels identified in the **Region 6 Risk Management Addendum** - ***Draft Human Health Risk Assessment Protocol for***

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Hazardous Waste Combustion Facilities (EPA-R6-98-002, July 1998) to evaluate resulting risk estimates.

Excess Cancer Risks

For those COPCs detected in stack gas emissions or quantified as fugitive source emissions at the Angus facility, chronic excess cancer risk estimates attributed to both ***direct exposure pathways*** and ***indirect exposure pathways*** are all well below EPA's 1 x 10^{-5} level of concern for all receptors evaluated. This means that there is less than one chance in one hundred thousand of a person getting cancer from possible exposure to RCRA combustion emissions associated with the Angus facility.

Excess cancer risk estimates for each receptor, delineated by source and specific COPC, are provided via a summary table exported from the risk model project file, "copc_risk" in **Appendix D**. In addition, excess cancer risk estimates for each receptor, delineated by pathway, are provided in a summary table exported from the risk model project file, "pathway" in **Appendix D**. The next to last column of each table contains the excess cancer risk estimates.

Non-Carcinogenic Health Effects

For those COPCs detected in stack gas emissions or quantified as fugitive source emissions, the HIs associated with both direct and indirect pathways are all well below EPA's 0.25 level of concern for all receptors evaluated. This means that a person's health should not be adversely effected by possible exposure to RCRA combustion emissions at the Angus facility.

The HI estimates for each receptor, delineated by source and specific COPC, are provided via a summary table exported from the risk model project file, "copc_risk" in **Appendix D**. In addition, HI estimates for each receptor, delineated by pathway, are provided in a summary table exported from the risk model project file, "pathway" in **Appendix D**. The last column of each table contains the HI estimates.

Other Risks

Acute Hazard Quotients are all less than 1.0 for those receptors evaluated. This means that a person's health should not be adversely effected from direct inhalation of the maximum 1-hour concentration of vapors and/or particulates associated with RCRA combustion emissions at the Angus facility. An acute adverse health effect is defined here as a concentration intended to protect the general public from discomfort or mild adverse health effects over 1 hour of possible exposure. See the summary table exported from the risk model project file, "acute" in **Appendix D**.

For dioxin-like compounds, calculations show that projected possible intakes for babies who are breastfed are all well below the average infant intake target level of 60 pg/kg-day of 2,3,7,8-TCDD Equivalents. See the summary table exported from the risk model project file, "b-milk" in **Appendix D**. More detailed information relating to dioxins and potential exposure and risk characterization for dioxins can be found at the EPA website http://www.epa.gov/nceawww1/dioxin.htm (contains documents generated as part of the Dioxin Reassessment Initiative).

For lead, calculations show that projected possible concentrations in surface soils and ambient air should not exceed EPA target levels of 100 mg/kg and 0.2 ：g/m^3, respectively. This means that concentrations of lead predicted to occur in soils and ambient air from RCRA combustion emissions at the Angus facility are at levels which should not adversely impact the health of children under the age of 6 years old (i.e., those

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children who are susceptible to health impacts from lead exposure). See the summary table exported from the risk model project file, "lead" in **Appendix D**.

UNCERTAINTY DISCUSSION

Uncertainty is inherent in any risk assessment process, and in the case of combustion risk assessments, can become complex in consideration of the necessary integration of various data, process parameters, and modeling efforts undertaken. Uncertainties and limitations of the risk assessment process are discussed in general in Chapter 8 of the HHRAP and in more detail in each separate chapter of the HHRAP. Therefore, this risk assessment will not reiterate that lengthy discussion, but will complement it by addressing specific key areas of interest which were identified during EPA's evaluation of resulting risk estimates at the Angus facility. Some, if not all, of these areas of interest have been identified by other EPA regions and/or State partners conducting risk assessments at similar combustion facilities across the country.

Bio-Transfer Factors

In completing the evaluation of risk estimates for the Angus facility, EPA has noted that biotransfer factors are primarily responsible for artificially high risk estimates for certain compounds. Specifically, two polycyclic aromatic compounds (PAHs) were identified for further evaluation when resulting risk estimates seemed disproportionate for the low level emission rates (i.e., rates based upon non-detected levels) used in the Angus risk assessment:

indeno(1,2,3-cd)pyrene and dibenz(a,h)anthracene

The farmer scenario uses beef and milk biotransfer factors based upon the *n*-octanol/water partition coefficient (K_{ow}), as specified in the HHRAP. However, the HHRAP also provides discussion about the possibility of decreasing (rather than increasing) biotransfer values with increasing K_{ow} values. The two PAH compounds in question fall within the range cited (log K_{ow} between 6.5 and 8.0). The HHRAP suggests that this trend may be due to a greater rate of metabolism of higher K_{ow} compounds (HHRAP, Volume 2, Appendix A pages A-3-25 thru A-3-26). In addition, other literature sources (Gorelova and Cherepanova, 1970; Gorelova et al., 1970) acknowledge that PAHs with large K_{ow} values are readily metabolized by the mixed function oxidase metabolic pathway in mammals to water-soluble substances, which are then excreted. Therefore, the resulting risk estimates for these two PAHs may be biased high. In other words, EPA believes that the potential risk from exposure to these two compounds is not of concern since these two PAHs tend not to bioaccumulate in animal or human tissue, but rather to be metabolized and excreted.

Use of Non-Detected Compounds

Compounds which were quantified as not present at or above a laboratory specified reporting limit but could possibly be formed as products of incomplete combustion, were used in calculation of risk estimates. For example, PAHs are semi-volatile compounds typically associated with combustion sources. Therefore, EPA retained and considered these compounds in the risk assessment in accordance with the HHRAP even though they were not detected in any of the analyses conducted.

Additionally, EPA followed the HHRAP in determining the appropriate detection limits to use in estimating emission rates for non-detected compounds. However, since the HHRAP does not address the appropriate detection limit for waste feed samples, EPA used Sample Quantitation Limits (SQLs) to calculate emission

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rates for non-detected compounds, as reported by the laboratory. Conceptually, SQLs are the most appropriate detection limit to use for waste matrices where compounds are suspected to be present but interferences may occur to obscure the detection of certain compounds as presented in EPA's **Guidance for Data Useability in Risk Assessment** (Publication 9285.7-090A; April 1992).

Although using non-detected compounds may tend to overestimate risks to some degree, all compounds which were retained in the Angus risk assessment resulted in risk estimates well below EPA levels of concern with the exception of two PAH compounds. The same two PAH compounds discussed in the prior section were not detected in stack emissions, but were assumed to be present at their Reliable Detection Level (RDL). In other words, in addition to risk estimates for these two compounds being biased high due to use of biotransfer factors which do not account for metabolization, the risk estimates may also be biased high due to use of emission rates based upon non-detected values. Therefore, EPA believes that these two PAH compounds do not actually pose adverse health impacts–even assuming the compounds are present at their RDLs.

Compounds Dropped from Quantitative Analysis

Of those compounds dropped from the risk analysis due to a lack of toxicity or transport and fate information, only the following chemicals were actually detected in the emissions data:

bromobenzene, n-propylbenzene, n-butylbenzene, and p-cymene

All of these compounds are volatile organic compounds which were detected only in a portion of the train for certain runs and only at extremely low values. Since these compounds do not have toxicity data and/or transport and fate information, they can not be quantitatively evaluated in the risk assessment. However, EPA did examine the data for each of these chemicals in relation to their corresponding Region 6 "Risk-Based Screening Level" benchmark values as available for Ambient Air, Residential Scenario (please see EPA's website http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm for more information on the benchmark values). Although p-cymene does not have a benchmark value, it is similar in chemical structure to benzene, which does have a benchmark value for qualitative comparison. All of the detected values were well below the corresponding screening level values, which would indicate that further evaluation of risk is unnecessary based upon the low levels emitted.

Unidentified Organic Compounds

Angus conducted Total Organic Emissions (TOE) testing in accordance with the HHRAP. Permitting authorities need this information to address concerns about the unknown fraction of organic emissions from combustion units. Using the TOE test results, and the speciated data from the Risk Burn, EPA calculated a TOE factor which falls at the low end of the range anticipated in the HHRAP (2 -40). Based upon these results, and the process information available for the Angus facility, EPA believes that unidentified organic compounds do not contribute significantly to those risk estimates calculated in this risk assessment.

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CONCLUSION & RECOMMENDATIONS

EPA's risk assessment indicates that "normal operations" of the BIF units at the Angus facility should not adversely impact human health. Additionally, EPA's risk assessment shows that the appropriate regulatory maximum permit limits (Adjusted Tier 1 Feed Rate Limits) for the Angus hazardous waste combustion units should be supplemented with lower annual average limits (risk-based limits) for several metals in order for *the permit* to be protective of human health. Therefore, EPA recommends that LDEQ incorporate the annual average metal feed rate limits listed below into the RCRA permit.

Waste Feed Rates
(g/s)

Metals of Concern	**Adjusted Tier I Regulatory Permit Limit Maximum Allowable**	**Recommended Risk-Based [1] Permit Limit Annual Average**	**"Normal Operations" Demonstrated via the Risk Burn [1] (3 Runs Data Average)**
Antimony	**1.06E-1**	**1.06E-2**	**1.33E-4**
Barium	**1.77E+1**	**1.77E-2**	**2.37E-5**
Beryllium	**1.49E-3**	**1.49E-4**	**ND [2] = 2.19E-5**
Cadmium	**1.98E-3**	**1.98E-4**	**2.89E-5**
Chromium, Total	**2.94E-4**	**2.94E-5 [3]**	**ND [2] = 1.10E-5**
Mercury, Total	**2.83E-2**	**1.00E-7 [4]**	**ND [2] = 2.19E-6**

NOTES:

1. Recommended RCRA Permit Limits are based upon the annual average stack gas temperature of 453 K and an annual average stack gas flow rate of 11.7 m^3/s; these parameters were demonstrated during the risk burn.
2. **ND** means that the metal was ***not detected*** in the waste feed; the detection limit was used to calculate the emission rate shown.
3. Recommended RCRA Permit Limit for Chromium is actually based upon the assumption that Hexavalent Chromium is equal to 100% of the Total Chromium measured during the risk burn. Alternatively LDEQ may specify the permit limit for Hexavalent Chromium rather than Total Chromium.
4. Mercury is not believed to be present in the waste feed, but the analytical method used in the risk burn did not provide low enough detection limits for comparison with the Recommended RCRA Permit Limit. The Risk-Based Annual Average RCRA Permit Limit for mercury is achievable with modification of EPA's analytical method for quantifying mercury in wastewater for determination of mercury in liquid organic waste. Alternatively LDEQ may specify the recommended limit as an emission rate limit for mercury (lower detection limit is possible than for the feed) which would also demonstrate protectiveness.

As the above comparison shows, Angus demonstrated during the risk burn that feed rate limits during "normal operations" fall below the recommended permit feed rate limits, or in the case of mercury, can be achieved and demonstrated during future sampling events. *Therefore, EPA used the calculated (or "recommended risk-based") permit limits in the final risk assessment model–along with actual emissions data for all the other COPCs being evaluated–in order to show permit protectiveness over the long term*.

EPA evaluated the most current information available to estimate potential impacts to human health, both directly via inhalation, incidental soil ingestion, and ingestion of drinking water (via surface water intakes), and indirectly via modeled deposition and uptake through the food chain. Emissions data collected as part of the risk burn, operational data specific to the Angus facility, and site-specific information based upon the facility's location, were evaluated and considered in making assumptions and in predicting risks associated with long term operations. The risk estimates provided in this risk assessment are conservative in nature and represent possible future risks, based upon those operating conditions evaluated for issuance of a final RCRA combustion permit. If operations change significantly, or land use changes occur which would result in more frequent potential exposure to receptors, risks from facility operations may need to be reevaluated.

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REFERENCES

1. **Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft** (EPA530-D-98-001 A, B, and C; July 1998); **Errata to the HHRAP** (EPA, July 1999).

2. **Guidance on Collection of Emissions Data to Support Site-Specific Risk Assessments at Hazardous Waste Combustion Facilities, Peer Review Draft** (EPA530-D-98-002; August 1998).

3. **Risk Burn Report for Angus Chemical Company** (July 1997).

4. **"Fugitive Emission Estimating Data Report"** for Angus Chemical Company (August, 1998).

5. *Letter Report* **"BIF Risk Assessment Information"** (August 5, 1999).

6. **Certificates Of Compliance** for the Angus facility (1993, 1996).

7. **Region 6 Risk Management Addendum - *Draft Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*** (EPA-R6-98-002, July 1998).

8. **Federal Register, 40 CFR Parts 148, 261, 266, etc. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; et al.; Final Rule and Proposed Rule; Thursday, August 6, 1998** (Bioavailability and Bioaccumulation, pages 42148 - 42149).

9. **On the Possibility of Accumulation of 3,4-Benzpyrene in Tissues and Organs of Cows and Calves, As Well as in Milk in Case of Presence of This Carcinogen in Fodder** (Gorelova and Cherepanova; The N. N. Petrov Research Institute of Oncology of the USSR Ministry of Public Health, Leningrad; 1970).

10. **Correlation Between The Content of Polycyclic Carcinogens in Animal Food Products and In Fodder for Farm Animals** (Gorelova, Dikun, Dmitrochenko, Krasnitskaya, Cherepanova, and Shendrikova; The N. N. Petrov Research Institute of Oncology of the USSR Ministry of Public Health, Leningrad; 1970).

11. **EPA Region 6 Human Health Medium Specific Screening Levels** (EPA June 1999).

12. **Guidance for Data Useability in Risk Assessment (Part A) Final** (EPA 9285.7-09A, April 1992).

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