COMBUSTION HUMAN HEALTH RISK ASSESSMENT
FOR
DSM COPOLYMER INCORPORATED
ADDIS, LOUISIANA

PREPARED BY

US EPA REGION 6
CENTER FOR COMBUSTION SCIENCE AND ENGINEERING
DALLAS, TEXAS

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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." 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.

Region 6 believes that those combustion facilities which are in close proximity to population centers, sensitive ecosystems, sensitive receptors, or areas that may have high potential for cumulative environmental impacts, 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. Region 6 staff met with facility representatives and LDEQ staff prior to completing this assessment, in order to develop site-specific information. 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 October 1998, EPA released its **Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft** (EPA530-D-98-001 A, B, and C; dated July 1998), commonly referred to as the HHRAP. In February 2000, EPA released 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; dated August 1998). EPA has also released an **Errata to the HHRAP** (EPA Memo, July 1999), which addresses issues specific to conducting human health risk assessments. EPA Region 6 has utilized the information provided in the above listed guidance documents, as well as information gained from the External Peer Review of the HHRAP and Errata, and best professional judgement to complete this human health risk assessment. This risk assessment report documents the Agency's effort in ensuring protective permit limits so that normal combustion facility operations do not pose unacceptable risks to surrounding communities.

EXECUTIVE SUMMARY

DSM Copolymer, Incorporated (DSM) applied to the LDEQ for a RCRA permit to burn hazardous waste in one BIF unit at its facility located in Addis, West Baton Rouge 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 one RCRA point source at the DSM facility, Boiler No. 3, 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 unit at the DSM 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	**2.39E-2**	**ND [2] = 8.63E-5**
Arsenic	**2.39E-4**	**ND [2] = 2.20E-4**
Barium	**3.89E-1**	**ND [2] = 2.88E-5**
Beryllium	**3.33E-4**	**ND [2] = 2.88E-5**
Cadmium	**4.44E-4**	**5.75E-5**
Chromium (Total)	**6.67E-5 [3]**	**3.92E-4 [4]**
Lead	**7.22E-3**	**ND [2] = 1.15E-4**
Mercury (Total)	**2.39E-3**	**ND [2] = 2.22E-5**
Nickel	**ND @ 8.63E-5**	**ND [2] = 8.63E-5**
Silver	**2.39E-2**	**3.74E-4**
Selenium	**ND @ 2.97E-4**	**ND [2] = 2.97E-4**
Thallium	**4.78E-3**	**1.94E-4**

NOTES:

1. Recommended RCRA Permit Limits are based upon the average stack gas temperature of 486 K and an average stack gas flow rate of 46.8 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 Total Chromium is actually based upon the assumption that Hexavalent Chromium is equal to 100% of the Total Chromium measured during the risk burn.

4. Risk Burn data for Total Chromium may be based upon outliers (personal communication with LDEQ and DSM representatives, 2001). Therefore, the Tier I limit for Total Chromium is still considered as a regulatory permit limit that will require compliance and was used in the Risk Assessment.

EPA back-calculated the risk-based annual average permit limits listed above from the 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. For those metals where the Tier I limit did not result in risks above EPA levels of concern, EPA merely set the risk based limit at that tier limit evaluated in the risk assessment. For those metals not having regulatory maximum limits specified by the regulations (i.e., nickel and selenium), EPA calculated risk-based limits from the available risk burn data as appropriate. 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 DSM 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.

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 DSM facility located near Addis, West Baton Rouge 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
DSM.ihb - All Chemicals Run, with metals adjusted to risk-based permit limits
DSM_metals.ihb - Metals Only Run, Tier I limits for DSM facility evaluated

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 DSM facility. References are provided at the end of this document.

Facility and Source Information

The DSM facility is a synthetic rubber manufacturing facility located along Louisiana State Route 1 near Addis, West Baton Rouge Parish, Louisiana. The facility is bordered on the north by Borden Chemical Company (a manufacturer of polyvinyl chloride resin), sugar cane crops, and the town of Addis; on the east by the Mississippi River; on the south by Dow (an industrial organic chemical manufacturer); and on the west by sugar cane crop land. 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 DSM facility manufacturing process generates both solid and liquid polymer from ethylene, propylene and a third monomer (proprietary). Recovered monomers and solvent from solid and liquid polymerization are purified, dried and recycled to waste feed blending operations. The polymerization process generates RCRA hazardous and nonhazardous waste streams, which are burned in the facility's BIF unit, Boiler No. 3. These waste streams are burned for energy recovery by producing steam that is used throughout the facility. Natural gas is the primary fuel of the boiler (roughly 95%).

Boiler No. 3 is a Riley Stoker Union Type MWH steam generator outfitted with a Todd Combustion Low NOx Burner, and has a steam-generating capacity of 200,000 pounds of saturated steam per hour (lb/hr) at 350 psig. The maximum feed rate of hazardous waste to the unit is 14.7 pounds per minute (lb/min). Boiler No. 3 has a conical stack with a height of 11.6 meters above grade. The unit has a cross-sectional area of 2.34 square meters (m^2) at the stack exit. The unit has a design stack gas exit velocity of 19.9 meters per second (m/sec) and an exit temperature of 486 K (416 °F).

Due to the nature of the process, the BIF regulations do not require air pollution control devices on DSM's boiler. The unit is monitored continuously for carbon monoxide by a Siemens IR CO analyzer, and oxygen emissions by a Siemens Oxygen analyzer. The facility is capable of storing about 5,000 gallons of waste feed material from the process area. DSM reports that the typical feed rate of the waste feed to the unit is 1.5 gpm. As mentioned above, natural gas is the primary fuel of the boiler (roughly 95%) and supplements the facility waste generation rate of 0.76 gpm.

DSM operates Boiler No. 3 under a 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. 3 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.

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. The target feed rate during the risk burn was 1.5 gpm and consequently, the measurements taken during the risk burn demonstrated a stack gas flow rate of 46.8 m^3/sec, a stack gas exit velocity of 19.9 m/sec, and an exit temperature of 486 K (416 °F) for normal operating conditions (i.e., these measurements are averages for runs reported in the DSM Risk Burn Report, April-May 1997, Appendix G). LDEQ and EPA provided oversight at the risk burn testing for Boiler No. 3 at the DSM facility.

Air Modeling

EPA used the ISCST3 for determining air dispersion and deposition of compounds resulting from operations at the DSM facility in accordance with the HHRAP. EPA evaluated emission sources using primarily the data and information provided in the DSM Risk Burn Report dated April/May 1997 and supplemental information requested by EPA and provided by DSM in the “Fugitive Emission Information” memo dated December, 1998.

EPA modeled two separate emission sources for the DSM facility: one stack source, Boiler No. 3 (“B3"); and one volume source to account for fugitive emissions associated with the waste fuel day tank (“Day Tank Fugitives” or “DTF”).

Universal Transverse Mercator (UTM) projection coordinates in North American Datum revised in 1983 (NAD83) for each source are as follows: for B3, (668040.3, 3357679.0); and for DTF (667810.36, 3357328.35). EPA used a stack gas flow rate of 46.8 m^3/sec, a stack gas exit velocity of 19.9 m/sec, and a stack gas exit temperature of 486 K (416 °F) for B3 as input to ISCST3. EPA used a height of 3.65 meters (information provided by facility) and an area of approximately 68 square meters (m^2) for evaluation of DTF.

Modeling for the DSM 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.

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 Baton Rouge NWS station. The upper air data was collected from the

Lake Charles 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 DSM facility.

Compounds of Potential Concern (COPCs)

EPA identified Compounds of Potential Concern (COPCs) in accordance with the HHRAP. 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 both waste feed and stack emissions data for organic and inorganic compounds collected during the risk burn conducted between April 29 and May 1, 1997, in order to calculate emission rates. EPA reviewed a letter report from the Louisiana Chemical Association dated October 27, 1999, in order to determine a site-specific upset factor of 1.01 for use in calculation of COPC-specific emission rates for organic compounds. EPA used an upset factor of 1.00 for inorganic compounds since operation under a 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 Pre-Compliance (COC) form on file, dated 1991, for the DSM facility in order to compare the Tier I levels with operations data collected during the risk burn. Finally, in order to properly assess fugitive emissions associated with DSM's typical operations, EPA evaluated supplemental information provided by DSM in the "Submittal of Fugitive Emission Information" memo dated December, 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 Tier I Feed Rate Limits (i.e., maximum allowable regulatory limits) for the DSM boiler and found that the limits for several metals would need to be supplemented with lower annual average limits (i.e., risk-based limits) in order for the *permit* to be protective of human health. Since the risk burn data and the COC form for the DSM facility show that typical operations result in emission rates which are below the maximum allowable regulatory limits, with exception of Total Chromium in the Risk Burn, EPA back-calculated risk-based annual average permit limits from the Tier I limit for each metal of concern. For those metals not having regulatory maximum limits specified by the regulations (i.e., nickel and selenium), EPA calculated risk-based limits from the available risk burn data as appropriate.

With respect to Total Chromium, EPA found that the levels for this compound as reported in the 1997 Risk Burn Report exceeded the Tier I limit for the DSM facility. Therefore, EPA requested clarification from DSM as to the accuracy of the risk burn data reported for Total Chromium as well as clarification of the Tier I limits for all metals. DSM then evaluated historical waste feed sampling results for Chromium and provided this data to EPA in order to support the contention that Risk Burn Report values for this compound are based upon outliers, and that standard operations should actually result in a value lower than the Tier I limit on a regular basis.

Waste Feed Rates
(g/s)

Metals of Concern	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	**2.39E-2**	**2.39E-2**	**ND [2] = 8.63E-5**
Arsenic	**2.39E-4**	**2.39E-4**	**ND [2] = 2.20E-4**
Barium	**3.89E+0**	**3.89E-1**	**ND [2] = 2.88E-5**
Beryllium	**3.33E-4**	**3.33E-4**	**ND [2] = 2.88E-5**
Cadmium	**4.44E-4**	**4.44E-4**	**5.75E-5**
Chromium (Total)	**6.67E-5 [3]**	**6.67E-5 [3]**	**3.92E-4 [4]**
Lead	**7.22E-3**	**7.22E-3**	**ND [2] = 1.15E-4**
Mercury (Total)	**2.39E-2**	**2.39E-3**	**ND [2] = 2.22E-5**
Nickel	**N/A**	**ND @ 8.63E-5**	**ND [2] = 8.63E-5**
Silver	**2.39E-1**	**2.39E-2**	**3.74E-4**
Selenium	**N/A**	**ND @ 2.97E-4**	**ND [2] = 2.97E-4**
Thallium	**2.39E-2**	**4.78E-3**	**1.94E-4**

NOTES:

1. Recommended RCRA Permit Limits are based upon an average stack gas temperature of 486 K and average stack gas flow rate of 46.8 m^3/s; both of 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 Total Chromium is actually based upon the assumption that Hexavalent Chromium is equal to 100% of the Total Chromium measured during the risk burn.
4. Risk Burn data for Total Chromium may be based upon outliers (personal communication with LDEQ and DSM representatives, 2001). Therefore, the Tier I limit for Total Chromium is still considered as a regulatory permit limit that will require compliance and was used in the Risk Assessment.

As the above comparison shows, DSM demonstrated during the risk burn that feed rate limits during "normal operations" should fall below the recommended permit feed rate limits, with exception of Total Chromium (see Footnote 4, above, and proceeding discussion). *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 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, limited agricultural, and fishing. In all cases, EPA used default values for receptor specific parameters, as outlined in the HHRAP. However, for dioxins and furans, EPA used updated bioaccumulation factors and toxicity equivalency values based upon the results of the External Peer Review of the HHRAP Guidance (External Peer Review Meeting, May 2000). Please see the Uncertainty Section of this risk assessment for a discussion of those parameters modified for specific dioxin/furan congeners. 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

Although the study area for air modeling purposes extends out approximately 10 kilometers from Boiler No. 3, 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.3. 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 Mississippi River as the only significant water body within the 3 kilometer radius of Boiler No.3. EPA evaluated fishing consumption based upon the potential for fishing to occur. Additionally, Addis 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 pathway were well below EPA levels of concern.

EPA 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. Although no active schools or day-care facilities are located within the 3-kilometer radius of the DSM facility, the child residential scenario was included at the same locations as the adult receptors in Addis. Infant potential exposure to dioxins and furans via the ingestion of their 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.

Selection of agriculture scenario locations required special consideration. First, the predominant form of agriculture for the area being evaluated is sugar cane farming (confirmed by the LSU Agriculture Center and EPA/LDEQ site reconnaissance). Since sugar cane is processed prior to consumption, and actual exposures would be more in line with commercial farming, the default farmer scenario would not be representative for these areas. Therefore, EPA modified the default scenario for all sugar cane areas by setting the food ingestion pathways equal to zero. Since farmer receptors typically raise product for consumption (e.g., produce, livestock, etc.), it is unrealistic to evaluate all of these pathways for those sugar cane areas surrounding the facility. Second, grazing cattle were seen in fenced stretches along the levee of the Mississippi River during a tour of the DSM facility and its surrounding area. EPA believes that evaluation of beef ingestion for this one area is necessary. Therefore, EPA modified the default scenario for this particular agricultural area by setting all ingestion pathways equal to zero except for ingestion of beef. 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 DSM 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 DSM 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 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 DSM 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 DSM 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 DSM 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 DSM 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 $\mu g/m^3$, respectively. This means that concentrations of lead predicted to occur in soils and ambient air from RCRA combustion emissions at the DSM facility are at levels which should not adversely impact the health of children under the age of 6 years old (i.e., those 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 DSM 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.

Modified Parameters for Dioxins/Furans

Please see the "Modified Parameters" file in **Appendix D** for an all-inclusive parameter list of chemical-specific values used in this human health risk assessment (i.e., a side-by-side comparison of the modified value versus the original default value for each COPC-specific parameter). For the DuPont facility, the only compounds where chemical-specific values were modified include individual dioxin/furan congeners. Modifications are based upon input from the External Peer Review of EPA's HHRAP and Errata (External Peer Review Meeting, May 2000).

In determining the bioaccumulation factors for chickens ($Ba_{chicken}$) and eggs (Ba_{egg}), as published in the July 1999 Errata to the HHRAP, EPA assumed that the bioconcentration factors (BCFs) presented in the 1995 Stephens, Petreas, and Hayward paper were calculated as the ratio of the dioxin/furan concentration in tissue to the concentration in soil. However, the BCFs were actually calculated as the ratio of dioxin/furan concentration in tissue to the concentration in feed. Therefore, since the soil/feed mixture fed to the chickens was one part soil and nine parts feed (1:9), the bioaccumulation factors presented in the Errata would appear to be ten-fold too high. Therefore, EPA reduced the $Ba_{chicken}$ and BA_{egg} values provided in the Errata by a factor of 10 for those congeners evaluated (“Biotransfer and Bioaccumulation of Dioxins and Furans from Soil: Chickens as a Model for Foraging Animals”; Stephens, Petreas, and Hayward, 1995).

Additionally, since publication of the July 1999 Errata to the HHRAP, EPA’s Office of Solid Waste has recommended use of the 1997 World Health Organization (WHO, 1997) Toxicity Equivalency Factors (TEFs) for dioxin/furan congeners. Therefore, EPA Region 6 changed appropriately those three congeners where TEFs specified in the HHRAP were different than the WHO values recommended for human health risk assessments (i.e., 1997 WHO TEFs for fish, mammals, and birds).

Bio-Transfer Factors

In completing the evaluation of risk estimates for the DSM facility, EPA has noted that biotransfer factors are primarily responsible for artificially high risk estimates for certain compounds. Specifically, di-n-octylphthalate was 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 DSM risk assessment. The limited agricultural scenario uses a beef biotransfer factor 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 phthalate compound in question exceeds the lower bound (log K_{ow} of 6.5) of the range cited. 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 (ATSDR, 1987; U.S. EPA, 1995) acknowledge that phthalates 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 phthalates may be biased high. In other words, EPA believes that the potential risk from exposure to di-n-octylphthalate is not of concern since phthalates 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 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 DSM risk assessment resulted in risk estimates well below EPA levels of concern with the exception of one compound. The same phthalate compound discussed in the prior section (di-n-octylphthalate) was not detected in stack emissions, but was assumed to be present at its Reliable Detection Level (RDL). In other words, in addition to the risk estimate for this compound being biased high due to use of biotransfer factors which do not account for metabolization, the risk estimate may also be biased high due to use of emission rates based upon non-detected values. Therefore, EPA believes that di-n-octylphthalate does not actually pose adverse health impacts–even assuming the compound is present at its RDL.

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:

2-hexanone, n-propylbenzene, tert-butylbenzene, 1,2,4-trimethylbenzene, and n-butylbenzene

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 2-hexanone does not have a benchmark value, it is similar in chemical structure to methyl isobutyl ketone, 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

DSM 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 DSM facility, EPA believes that unidentified organic compounds do not contribute significantly to those risk estimates calculated in this risk assessment.

CONCLUSION & RECOMMENDATIONS

EPA's risk assessment indicates that "normal operations" of the BIF unit at the DSM facility should not adversely impact human health. Additionally, EPA's risk assessment shows that the appropriate regulatory maximum permit limits (Tier 1 Feed Rate Limits) for the DSM hazardous waste combustion unit 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	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	**2.39E-2**	**2.39E-2**	**ND [2] = 8.63E-5**
Arsenic	**2.39E-4**	**2.39E-4**	**ND [2] = 2.20E-4**
Barium	**3.89E+0**	**3.89E-1**	**ND [2] = 2.88E-5**
Beryllium	**3.33E-4**	**3.33E-4**	**ND [2] = 2.88E-5**
Cadmium	**4.44E-4**	**4.44E-4**	**5.75E-5**
Chromium (Total)	**6.67E-5 [3]**	**6.67E-5 [3]**	**3.92E-4 [4]**
Lead	**7.22E-3**	**7.22E-3**	**ND [2] = 1.15E-4**
Mercury (Total)	**2.39E-2**	**2.39E-3**	**ND [2] = 2.22E-5**
Nickel	**N/A**	**ND @ 8.63E-5**	**ND [2] = 8.63E-5**
Silver	**2.39E-1**	**2.39E-2**	**3.74E-4**
Selenium	**N/A**	**ND @ 2.97E-4**	**ND [2] = 2.97E-4**
Thallium	**2.39E-2**	**4.78E-3**	**1.94E-4**

NOTES:

1. Recommended RCRA Permit Limits are based upon the average stack gas temperature of 486 K and an average stack gas flow rate of 46.8 m^3/s; both of 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 Total Chromium is actually based upon the assumption that Hexavalent Chromium is equal to 100% of the Total Chromium measured during the risk burn.
4. Risk Burn data for Total Chromium may be based upon outliers (personal communication with LDEQ and DSM representatives, 2001). Therefore, the Tier I limit for Total Chromium is still considered as a regulatory permit limit that will require compliance and was used in the Risk Assessment.

As the above comparison shows, DSM demonstrated during the risk burn that feed rate limits during "normal operations" should fall below the recommended permit feed rate limits, with exception of Total Chromium (see Footnote 4, above). *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 DSM 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.

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 DSM Copolymer, Inc.** (April/May 1997).

4. **"Submittal of Fugitive Emission Information"** memo for DSM Copolymer, Inc. (December, 1998).

5. **Louisiana Chemical Association (LCA)** *Letter Report on Upset Factors* (October 27, 1999).

6. **Certification Of Pre-Compliance** for the DSM facility (1991).

7. ***External Peer Review Meeting, HHRAP and Errata***. (TechLaw, Inc.; Dallas, Texas; May 2000).

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

9. **Biotransfer and Bioaccumulation of Dioxins and Furans from Soil: Chickens as a Model for Foraging Animals** (Stephens, Petreas, and Hayward, 1995).

10. **World Health Organization (WHO)** *Meeting on the Derivation of Toxicity Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs, and other Dioxin-like Compounds for Human Health & Wildlife, June 15 - 18, 1997.* Institute of Environmental Medicene, Karolinska Institute, Stockholm, Sweden. Draft Report dated July 30, 1997.

11. **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).

12. **Draft Toxicological Profile for Di(2-ethylhexyl) Phthalate** (Agency for Toxic Substances and Disease Registry (ATSDR), Oak Ridge National Laboratory; December 1987).

13. **Waste Technologies Industries Screening Human Health Risk Assessment (SHHRA): Evaluation of Potential Risk from Exposure to Routine Operating Emissions** (EPA, Volume V. External Review Draft. EPA Region 5, Chicago, Illinois; 1995).

14. **EPA Region 6 Human Health Medium Specific Screening Levels** (EPA November 2000)

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