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**COMBUSTION HUMAN HEALTH RISK ASSESSMENT
FOR
DOW / UNION CARBIDE CORPORATION
HAHNVILLE, LOUISIANA**



Prepared by

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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

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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.

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EXECUTIVE SUMMARY

The Dow-Union Carbide Corporation applied to the LDEQ for a RCRA permit to burn hazardous waste in a BIF unit, Boiler No. 31, at their facility located on LA Highway 18 at LA Highway 3142 in Hahnville, St. Charles 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 risk assessment evaluates potential emissions from the RCRA point source at the Union Carbide facility, Boiler No. 31, as well as potential fugitive emissions associated with RCRA facility operations.

It should be noted that as of November 20, 2002, Dow-Union Carbide has informed LDEQ and EPA Region 6 of plans to close Boiler No. 31 and cease all hazardous waste management activities onsite. This Report will stand as a record of the risk assessment completed for Boiler No. 31. The recommended risk-based permit limits contained within may still be utilized in generating a permit, should closure for this unit not occur.

<i>Boiler No. 31 Waste Feed Rates (g/s)</i>		
<i>Metals of Concern</i>	Recommended Risk-Based ¹ Permit Limit Annual Average	“Normal Operations” Demonstrated via the Risk Burn ¹ (3 Runs Evaluated)
Antimony	1.17E-03	ND ² = 3.60E-05
Arsenic	4.50E-04	ND ² = 4.11E-06
Barium	9.75E-02	2.40E-03
Beryllium	3.94E-04	ND ² = 2.57E-06
Cadmium	5.47E-04	ND ² = 1.03E-06
Chromium, Total	1.17E-03 ⁴	9.21E-04
Lead	3.51E-01	ND ² = 2.57E-05
Mercury, Total	7.08E-05	2.36E-05 ⁵
Nickel ³	5.37E-03	1.79E-03
Selenium ³	6.12E-04	2.04E-04
Silver	1.17E-03	ND ² = 1.03E-05
Thallium	9.75E-04	ND ² = 1.54E-05
Zinc ³	2.37E-03	7.90E-04

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EPA's risk assessment indicates that "normal operations" of the BIF hazardous waste burning unit at the Dow-Union Carbide 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.

NOTES:

1. Recommended RCRA Permit Limits are based upon the annual average stack gas temperature of 402 K and an annual average stack gas flow rate of 34.7 m³/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. Not having regulatory maximum limits specified by the regulations, EPA calculated risk-based limits for this constituent from the available risk burn data, allowing three times the detected value for variance in waste feed.
4. 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.
5. Detection of Total Mercury very close to detection limit of 1.94E-05 g/s. Recommended RCRA Permit Limit is based upon toxic effects of Methyl Mercury.

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. For those metals where the Adjusted 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, selenium and zinc), 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.

Of special note, mercury is believed to be present at insignificant levels in the waste feed to Boiler No. 31. Due to the detected value being very close to the mercury detection limit (.04 ppm detection limit vs .046 ppm detection), as well as the detection occurring in only one of three sampling runs, EPA has set the recommended permit limit at three times the detected value reported in the Risk Burn. The recommended limit is consistent with EPA's primary goal of encouraging facilities to minimize mercury emissions to the greatest extent practical. The recommended permit limit for mercury should allow for occasional detections due to variance in the waste feed stream.

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 Dow-Union Carbide 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 Dow-Union Carbide Corporation ("Dow-UC facility") located near Hahnville, St. Charles 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 2.1) for risk modeling. EPA utilized the ArcView Program (Environmental Systems Research Institute, software Version 3.2), for desktop Geographical Information Systems (GIS), for all mapping efforts. All available information used to assess risks attributable to the Dow-UC 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

DowUc_fr.ihb - All Chemicals Run, with metals adjusted to risk-based permit limits

DowUc_mt.ihb - Metals Only Run, Adjusted Tier I limits for Union Carbide 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

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evaluated for the Dow-UC facility. References are provided at the end of this document.

Facility and Source Information

This Dow-UC petrochemical manufacturing facility, also referred to as the Taft-Star complex is located upriver from New Orleans, on the southwest bank of the Mississippi River in St. Charles Parish, LA. 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 entire western facility boundary is against other industrial plants (Praxair, Shell Chemical, Witco Chemical Company and Occidental Chemical Co.). The entire northern facility boundary is the Mississippi River. The facility is bounded on the east by residential property. The Dow-UC Taft-Star complex is bounded on the south by uninhabited marshland along the Eighty-Arpent canal.

Started up in 1966, the Taft-Star facility converts petroleum-based raw materials into a wide variety of basic building block and intermediate chemicals that are sold to numerous customers worldwide. The Dow-UC facility is situated on 1900 acres. The Facility contains fifteen individual production units with an aggregated output on the order of five billion pounds of product per year. The Facility manufactures a variety of ethylene-chain chemicals, including ethylene, ethylene oxide, ethylene glycol and other ethylene derivatives, acrylates, butanol, butadiene, methyl glycol ethers, alkaleneamines, acrolein, acrolein derivatives, acrylic esters, propylene and polyethylene. Applications for these materials include textiles, paints, plastic products, detergents, pharmaceuticals, antifreeze, lubricants, and a host of other consumer and industrial products. The chemical manufacturing process generates RCRA hazardous and nonhazardous waste streams, which are burned in the facility's BIF unit, Boiler No. 31. The UTM coordinates for Boiler No. 31 are 746342.55, 3318973.57. The RCRA hazardous waste stream generated is termed "NP Heads." The NP Heads waste is an ignitable 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.

Boiler No. 31 is a 241 MMBTU/hr package boiler designed to generate 125,000 lbs/hr steam. The unit is a water tube type boiler designed for liquid waste fuels, oil and fuel gas firing or a combination of these fuels. Boiler No. 31 is equipped with four liquid injection nozzles built into gaseous fuel burners with each nozzle having a maximum feed rate of hazardous waste to either unit is 10 gallons per minute (gpm). However, the normal flow per nozzle is 3 to 7 gpm. The exhaust from the boiler exits through an air pre-heater and then through a 71-inch diameter, 42-foot tall stack situated on top of the boiler. The effective top of the stack is 60 feet above grade. Stack sampling ports are located 36.33 feet downstream from the inlet to the stack and 6 feet upstream from the stack exit. The unit has a cross-sectional area of 2.55 square meters (m²) at the stack exit. The mean stack gas exit velocity during particle size sampling was 2,605 actual feet per minute (afpm) and an exit temperature of 388 °K (265 °F). The Boiler No. 31 stack gas flow rate during particle size sampling was 21.91 cubic meters per second (m³/sec).

Due to the nature of their process, the BIF regulations do not require air pollution control devices on the Dow-

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UC boiler. Boiler 31 is monitored continuously for carbon monoxide and oxygen emissions by dedicated Rosemount monitors. Liquid waste feeds from the process units are accumulated in generator (<90 day) hazardous waste tanks. Depending on the specific waste feed, it may be sent directly from the tank to the boiler or sent to another 90-day tank for blending with other waste feeds.

Dow-UC operates boiler 31 under an Adjusted Tier I status. Accordingly, all metals in the waste feed to the BIF unit are assumed to be emitted out 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. 31 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 5-15 gpm and consequently, the measurements taken during the risk burn demonstrated a stack gas flow rate of 34.7 m³/sec, a stack gas exit velocity of 13.65 m/sec, and an exit temperature of 401.6 K (263.2 °F) for normal operating conditions (i.e., these measurements are averages for runs reported in the Dow-UC Risk Burn Report, June 1998, Appendix C - Stack Sampling Report). LDEQ and EPA provided oversight at the risk burn testing for Boiler No. 31 at the Dow-UC facility.

Air Modeling

EPA used the ISCST3 for determining air dispersion and deposition of compounds resulting from operations at the Dow-UC Chemical facility in accordance with the HHRAP. EPA evaluated emission sources using primarily the data and information provided from the Dow-UC Chemical Risk Burn Report performed June 1998, and supplemental information requested by EPA and provided by Dow-UC in the “Fugitive Emission Information” Report dated May 4, 2001.

EPA modeled one point source for the Dow-UC Chemical facility: Boiler 31; and one volume source to account for fugitive emissions associated with ancillary equipment to this boiler.

MODELED POINT SOURCE LOCATION AND PARAMETERS

Stack Name	Stack Location*		Stack Height (m)	Stack Temp. (K)	Stack Velocity (m/s)	Stack Diameter (m)
	Easting	Northing				
Boiler 31	746342.55	3318973.57	18.3	401.6	13.65	1.80

* The stack locations are in the NAD83 coordinate system.

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MODELED FUGITIVE SOURCE LOCATION AND PARAMETERS

Fugitive Area Name	Stack Location*		Emission Rate (g/s)	Release Height (m)	Lateral Dimension (m)	Vertical Dimension (m)
	Easting	Northing				
F1	746324.50	3318997.00	0.18	2.5	26.60	1.16

* The stack locations are in the NAD83 coordinate system.

Modeling for the Dow-UC Chemical 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 and facility building characteristics. 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 (13970) NWS station. The upper air data was collected from the Lake Charles (03937) 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 point source were based on values determined during the risk burn. **Appendix A** contains all air modeling information utilized and generated for the Dow-UC Chemical 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

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estimate risks.

EPA evaluated both waste feed and stack emissions data for organic compounds collected during the risk burn conducted between March 4 and 6, 1998, in order to calculate emission rates. EPA estimated stack emissions for inorganic compounds from the waste feed data collected during the risk burn since Dow-UC is an Adjusted Tier I status for these compounds. 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 1.0 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 1995 and 1998, for the Dow-UC 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 Dow-UC's typical operations, EPA evaluated supplemental information provided by Dow-UC in the "Fugitive Emission Information" report dated May 4, 2001. This document provided historical information on the typical mix of specific compounds in the waste feed and the engineering details for waste stream transport and storage equipment in the areas being evaluated.

Of significant interest in the combustion risk assessment were the metals risk data calculated by EPA Region 6. The EPA Region 6 initially evaluated Adjusted Tier 1 Feed Rate Limits which serve as the maximum allowable regulatory limits for UC Boiler 31. The results of this evaluation indicated that the Adjusted Tier 1 Feed Rate 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. The risk burn data, as well as the COC forms for the Dow-UC Taft facility indicate that typical operations result in emission rates which are orders of magnitude below the maximum allowable regulatory limits for all metals. Those metals requiring lower annual average limits for the protection of human health are: Antimony, Barium, Total Chromium, Total Mercury, Silver, and Thallium (see Table 1). EPA back-calculated risk-based annual average permit limits from the Adjusted Tier I limit for each metal of concern. For those metals not having regulatory maximum limits specified by the regulations (i.e., nickel, selenium and zinc), EPA calculated risk-based limits from the available risk burn data as appropriate.

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<i>Boiler No. 31 Waste Feed Rates</i> (g/s)			
Table 1 <i>Metals of Concern</i>	Adjusted Tier I Regulatory Permit Limit Maximum Allowable	Recommended Risk-Based¹ Permit Limit Annual Average	“Normal Operations” Demonstrated via the Risk Burn¹ (3 Runs Evaluated)
Antimony	1.17E+00	1.17E-03	ND² = 3.60E-05
Arsenic	4.50E-04	4.50E-04	ND² = 4.11E-06
Barium	1.95E+01	9.75E-02	2.40E-03
Beryllium	3.94E-04	3.94E-04	ND² = 2.57E-06
Cadmium	5.47E-04	5.47E-04	ND² = 1.03E-6
Chromium, Total	2.92E-03	1.17E-03⁴	9.21E-04
Lead	3.51E-01	3.51E-01	ND² = 2.57E-05
Mercury, Total	3.12E-01	7.08E-05	2.36E-05⁵
Nickel³	Not Established	5.37E-03	1.79E-03
Selenium³	Not Established	6.12E-04	2.04E-04
Silver	1.17E+00	1.17E-03	ND² = 1.03E-5
Thallium	1.95E+00	9.75E-04	ND² = 1.54E-5
Zinc³	Not Established	2.37E-03	7.90E-04

NOTES:

1. Recommended RCRA Permit Limits are based upon the annual average stack gas temperature of 402 K and an annual average stack gas flow rate of 34.7 m³/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. Not having regulatory maximum limits specified by the regulations, EPA calculated risk-based limits for this constituent from the available risk burn data, allowing three times the detected value for variance in waste feed.
4. 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.
5. Detection of Total Mercury very close to detection limit of 1.94E-05 g/s. Recommended RCRA Permit Limit is based upon toxic effects of Methyl Mercury.

As the above comparison shows, Dow-UC demonstrated during the risk burn that feed rate limits during

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“normal operations” fall below the recommended permit feed rate limits. *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 of contaminated media 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, farming, and 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

Although the study area for air modeling purposes extends out approximately 10 kilometers from Dow-UC Boiler 31, 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 Dow-UC Boiler 31. 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: Mississippi River and Bonnet Carre Spillway Lake. Although the Bonnet Carre Spillway Lake may not currently be used for fishing, EPA evaluated this waterbody for fishing consumption based upon the potential for fishing to occur. Although this assumption may have been overly conservative for evaluation of current use, further evaluation is not warranted since resulting risks for the fish consumption pathways were well below EPA levels of concern. Additionally, because Hahnville currently obtains its drinking water from deep wells rather than any surface water bodies within the study area, EPA did not evaluate the drinking water consumption pathway for any of the receptor scenarios.

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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. 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. The predominant form of agriculture for the areas being evaluated is sugar cane farming (confirmed by the Louisiana Farm Services Agency 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 products for consumption (e.g., produce, livestock, etc.), it is unrealistic to evaluate all of these pathways for those sugar cane areas surrounding the facility. However, EPA believes that evaluation of beef ingestion is necessary for an agricultural scenario pertaining to Dow-UC. During an EPA tour of nearby facilities, grazing cattle were seen in fenced stretches along the levee of the Mississippi River/River Road, and LDEQ personnel acknowledges the presence of cattle as common in these areas. 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 Dow-UC facility include universal soil loss constants, delineation of water body and effective watershed areas potentially impacted by facility sources, water body

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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 Dow-UC 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 Dow-UC 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 Dow-UC facility, chronic excess cancer risk estimates attributed to both *direct exposure pathways* and *indirect exposure pathways* are below EPA's 1×10^{-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 Dow-UC Boiler 31.

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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 Dow-UC 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 Dow-UC 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 µg/m³, respectively. This means that concentrations of lead predicted to occur in soils and ambient air from RCRA combustion emissions at the Dow-Union Carbide 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

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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 Dow-UC 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 Dow-UC 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

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In completing the evaluation of risk estimates for the Dow-UC facility, EPA has noted that biotransfer factors are primarily responsible for artificially high risk estimates for certain compounds. Specifically, one phthalate compound was identified for further evaluation when resulting risk estimates seemed disproportionate for the low level emission rates used in the Dow-UC risk assessment:

di-n-octylphthalate

Although di-n-octylphthalate was detected in two of three runs, and the emission rate was similar to that of other phthalate compounds measured during the risk burn, excessive hazard quotients resulted for both adult and child farmer receptors.

The farmer 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. Di-n-octylphthalate falls 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 acknowledge that phthalates (ATSDR, 1987; U.S. EPA, 1995) 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 di-n-octylphthalate may be biased high. In fact, the EPA Office of Research and Development has currently estimated that the metabolism factor for di-n-octylphthalate may be overestimated by at least a factor of 100. With this consideration, the risk estimates attributable to this compound are consequently overestimated by a factor of 100. In other words, EPA believes that the potential risk from exposure to this compound is not of concern since it tends 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**

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Data Usability in Risk Assessment (Publication 9285.7-090A; April 1992).

All compounds which were retained in the Dow-UC risk assessment resulted in risk estimates well below EPA levels of concern, with the exception of one phthalate compound. Risk estimates for this compound are biased high due to use of biotransfer factors which do not account for metabolism. Therefore, EPA believes that this phthalate compound does not actually pose adverse health impacts—even at the detected values.

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:

trichlorofluoroethane, xylenes (total)

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 trichlorofluoroethane does not have a benchmark value, it is similar in chemical structure to trichlorofluoromethane, 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

Dow-UC 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 Dow-UC 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 unit (Boiler 31) at the Dow-UC Taft facility should not adversely impact human health. Additionally, EPA’s risk assessment results for emissions from the Dow-UC hazardous waste combustion unit (Boiler 31) indicate that the regulatory maximum permit limits (Adjusted Tier 1 Feed Rate Limits) for several key metals should be augmented with lower annual average permit limits (risk-based limits) in order for emissions to be protective of human health. EPA Region 6 recommends that LDEQ incorporate the annual average metal feed rate limits listed below into the RCRA permit.

<i>Boiler No. 31 Waste Feed Rates</i> (g/s)			
Table 1 <i>Metals of Concern</i>	Adjusted Tier I Regulatory Permit Limit Maximum Allowable	Recommended Risk-Based¹ Permit Limit Annual Average	“Normal Operations” Demonstrated via the Risk Burn¹ (3 Runs Evaluated)
Antimony	1.17E+00	1.17E-03	ND² = 3.60E-05
Arsenic	4.50E-04	4.50E-04	ND² = 4.11E-06
Barium	1.95E+01	9.75E-02	2.40E-03
Beryllium	3.94E-04	3.94E-04	ND² = 2.57E-06
Cadmium	5.47E-04	5.47E-04	ND² = 1.03E-06
Chromium, Total	2.92E-03	1.17E-03⁴	9.21E-04
Lead	3.51E-01	3.51E-01	ND² = 2.57E-05
Mercury, Total	3.12E-01	7.08E-05	2.36E-05⁵
Nickel³	Not Established	5.37E-03	1.79E-03
Selenium³	Not Established	6.12E-04	2.04E-04
Silver	1.17E+00	1.17E-03	ND² = 1.03E-05
Thallium	1.95E+00	9.75E-04	ND² = 1.54E-05
Zinc³	Not Established	2.37E-03	7.90E-04

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NOTES:

1. Recommended RCRA Permit Limits are based upon the annual average stack gas temperature of 402 K and an annual average stack gas flow rate of 34.7 m³/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. Not having regulatory maximum limits specified by the regulations, EPA calculated risk-based limits for this constituent from the available risk burn data, allowing three times the detected value for variance in waste feed.
4. 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.
5. Detection of Total Mercury very close to detection limit of 1.94E-05 g/s. Recommended RCRA Permit Limit is based upon toxic effects of Methyl Mercury.

As the above comparison shows, Dow-UC demonstrated during the risk burn that feed rate limits during “normal operations” fall below the recommended permit feed rate limits. *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 Dow-UC 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 Dow-Union Carbide-Taft Plant; St Charles Operations** (June 1998).
4. **“Fugitive Emission Information”** Report for Dow-Union Carbide Corporation (May 4, 2001).
5. **Certificates Of Compliance** for the Dow-Union Carbide facility (August 1995, August 1998).
6. *External Peer Review Meeting, HHRAP and Errata.* (TechLaw, Inc.; Dallas, Texas; May 2000).
7. **Louisiana Chemical Association (LCA) Letter Report on Upset Factors** (October 27, 1999).
8. **Region 6 Risk Management Addendum - Draft Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities** (EPA-R6-98-002, July 1998).
9. **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).
10. **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).
11. **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).
12. **EPA Region 6 Human Health Medium Specific Screening Levels** (EPA November 1999).
13. **Guidance for Data Useability in Risk Assessment (Part A) Final** (EPA 9285.7-09A, April 1992).
14. **Biotransfer and Bioaccumulation of Dioxins and Furans from Soil: Chickens as a Model for**

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Foraging Animals (Stephens, Petreas, and Hayward, 1995).

15. **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 Medicine, Karolinska Institute, Stockholm, Sweden. Draft Report dated July 30, 1997.*
16. **Draft Toxicological Profile for Di(2-ethylhexyl) Phthalate** (Agency for Toxic Substances and Disease Registry (ATSDR), Oak Ridge National Laboratory; December 1987).