1. INTRODUCTION

Development of the synthetic fuels industry has raised concerns relating to the risks involved in the potential release of toxic or hazardous substances in the production and utilization of synthetic fuels. The Environmental Sciences Division, Oak Ridge National Laboratory (ORNL) is currently performing both health and environmental risk assessments associated with three synthetic fuels technologies, namely, direct liquefaction, indirect liquefaction and oil shale processing. Synfuels processes evaluated in this effort are as follows:

- Direct coal liquefaction processes - H-Coal, SRC-I, SRC-II, and Exxon Donor Solvent (EDS)
- Indirect coal liquefaction processes - Fischer-Tropsch (F-T) synthetis via Lurgi and Koppers-Totzek (K-T) gasification processes
- Oil shale extraction processes - TOSCO II and Paraho.

One key element of risk assessment is the characterization of streams of concern. Thus, ORNL has sponsored two tasks in order to (1) estimate the source terms for liquid synthetic fuel technologies, and (2) analyze the various aspects associated with utilization of synfuel products. Source term estimates are estimates of pollutant-specific emission rates associated with each waste stream (source). Pollutants are categorized according to pollutant/compound groupings, herein referred to as risk analysis units (RAUs) associated with specific health and environmental risks. The 38 RAUs of interest in this study are summarized in Table 1-1.

The objectives of Task 1 were to prepare source term estimates for waste streams generated by commercial-scale facilities employing the eight selected synfuels processes and estimate product/by-product generation rates. Because these synfuels processes are not generally operating at commercial scale,

TABLE 1-1. SUMMARY OF RISK ANALYSIS UNITS

RAU Number	RAU Category	Description
1	Carbon monoxide	CO
2	Sulfur oxides	SO_x
3	Nitrogen oxides	NO_x
4	Acid gases	H_2S, HCN
5	Alkaline gases	NH_3
6	Hydrocarbon gases	Methane through butanes, acetylene, ethene through butenes; C_1-C_4 alkanes, alkynes and cyclo compounds; bp <20°C
7	Formaldehyde	HCHO
8	Volatile organochlorines	To bp ~120°C; CH_2Cl_2, $CHCl_3$, CCl_4
9	Volatile carboxylic acids	To bp ~120°C; formic and acetic acids only
10	Volatile O&S heterocyclics	To bp ~120°C; furan, THF, thiophene
11	Volatile N-heterocyclics	To bp ~120°C; pyridine, piperidine, pyrrolidine, alkyl pyridines
12	Benzene	
13	Aliphatic/alicyclic	C_5 (bp ~40°C) and greater; paraffins, olefins, cyclocompounds, terpenoids, waxes, hydroaromatics
14	Mono/Diaromatic hydrocarbons (excluding benzene)	Toluene, xylenes, naphthalenes, biphenyls, alkyl derivatives
15	Polycyclic aromatic hydrocarbons	Three rings and greater; anthracene, BaA, BaP, alkyl derivatives
16	Aliphatic amines (excluding N-heterocyclics)	Primary, secondary and tertiary non-heterocyclic nitrogen, $MeNH_2$, DiMeNH, TriMeN
17	Aromatic amines (excluding N-heterocyclics)	Anilines, naphtylamines, amino pyrenes; nonheterocyclic nitrogen
18	Alkaline nitrogen heterocyclics ["azaarenes"] (excluding "volatiles")	Quinolines, acridines, benzacridins; excluding pyridines
19	Neutral N, O, S heterocyclics (excluding "volatiles")	Indoles, carbazoles, benzofurans, dibenzothiophenes
20	Carboxylic acids (excluding "volatiles)	Butyric, benzoic, phthalic, stearic
21	Phenols	Phenol, cresols, catechol, resorcinol
22	Aldehydes and ketones ["carbonyls"] (excluding formaldehyde)	Acetaldehyde, acrolein, acetone
23	Nonheterocyclic organo sulfur	Mercaptans, sulfides, disulfides, thiophenols, CS_2
24	Alcohols	Methanol, ethanol
25	Nitroaromatics	Nitrobenzenes, nitropyrenes
26	Esters	Acetates, phthalates, formates
27	Amides	Acetamide, formamide, benzamides
28	Nitriles	Acrylonitrile, acetonitrile
29	Tars	
30	Respirable particles	
31	Arsenic	As, all forms
32	Mercury	Hg, all forms
33	Nickel	Ni, all forms
34	Cadmium	Cd, all forms
35	Lead	Pb, all forms
36	Other trace elements	Be,Be,B,Ag,Cr,Cu,F,Se,V,Zn, all forms
37	Radioactive materials	Ra-226
38	Other remaining materials	