2019 RMP Modeling Final Report

Toxic Worst-Case Release Scenarios

US Ecology, Inc.

Prepared for

PACSCON GeoEnvironmental, Inc.

Tampa, Florida

April 5, 2019
Prepared by:

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Project No. 863_19_01

KOOGLER & ASSOCIATES, INC.
ENVIRONMENTAL SERVICES

Certification

I certify that, based upon information and belief formed after reasonable inquiry, the statements and information in the attached documents are true, accurate and complete.

Signature

Max Lee, Ph.D., P.E.
President of Koogler & Associates Inc.

Name / Title

1. Offsite Consequence Analysis (OCA)

a. OCA Process Overview

PACSCON GeoEnvironmental, Inc. (PACSCON) contracted Koogler and Associates, Inc. (Koogler) to conduct modeling for worst-case release OCA of potential chemical releases from the US Ecology Inc. (USE) Tampa, Florida facility (see Attachment 1, Building Layout). The modeling is provided for environmental permitting requirements and is conducted per the requirements of Environmental Protection Agency's (EPA) Risk Management Program (RMP) (40 CFR Part 68, Subpart G). EPA guidelines[1] for RMP OCA modeling provide descriptions of the modeling requirements for worst-case releases. The scenarios modeled in this project involve 'worst case' releases of the compounds listed in Table 1 from their respective largest vessel containers. The location of the releases is shown in Attachment 1 at the southern side of the waste processing building (see Attachment 1, Building Layout, red highlighted area). The modeling was conducted in a two-step modeling sequence to first assess using the conservative modeling of RMPCOMP provided by EPA. For those compounds that RMPCOMP estimated over the distance of 1000 feet, a more accurate model, HGSYSTEM was applied. A distance of 1250 ft. is the distance from the source of this hypothetical release to the closest sensitive population, which is a prison. Therefore, RMP toxic endpoints at distances of less than 1250 ft. are considered for this modeling effort to be acceptable.

Table 1. Modeled toxic chemicals

Toxic Chemicals	Weight Fraction	Volume (gal)	Modeling	Case 1 Toxic Endpoint (ft)	Case 2 Toxic Endpoint (ft)	Case 3 Toxic Endpoint (ft)
Ammonia (aqueous)	20%	55	RMPCOMP	528	--	--
Hydrofluoric acid	12%	55	HGSYSTEM	262	262	66
Hydrochloric acid	30%	275	HGSYSTEM	787	787	525
Nitric acid	30%	275	HGSYSTEM	1050	1050	918

These chemicals were modeled to determine the distance to the RMP toxic endpoint for each chemical, after a "worst-case" release into the interior of the storage building. Consistent with the 2016 modeling for offsite consequence analysis, ammonia, hydrofluoric acid, hydrochloric acid and nitric acid are considered the most toxic chemical compounds (i.e., have the lowest "toxic endpoint" concentration threshold, highest vapor pressure, and greater storage volume) managed (treated) at the USE facility. These compounds would result in the greatest potential offsite impact from the waste processing building to the closest offsite sensitive receptor, the Orient Road jail/prison, if a worst-case release were to occur and thus are appropriate for the modeling completed.

Similar modeling was performed for this facility in 2016. Additional modeling for hydrofluoric acid, hydrochloric acid, and nitric acid is now performed for different scenarios since the facility is planning to install a new sump. Note that even though USE is requesting for approval to store a larger total quantity of material, the EPA RMP program requires worst-case release modeling to be conducted for a single largest storage vessel or pipe. EPA states:

> *40 CFR 68.25(b) Determination of worst-case release quantity. The worst-case release quantity shall be the greater of the following:*
>
> *(1) For substances in a vessel, the greatest amount held in a single vessel, taking into account administrative controls that limit the maximum quantity; or*
>
> *(2) For substances in pipes, the greatest amount in a pipe, taking into account administrative controls that limit the maximum quantity.*

The models were ran using three different case scenarios:
Case 1: scenario of spill without new sump
Case 2: scenario of spill near new sump (spill volume of two of 2 gallons captured in sump)
Case 3: scenario assuming the new sump is entirely filled with chemical mix from spill (spill volume of 54-56 gallons capture in sump)

b. RMPCOMP model

EPA offers an online version on its website for modeling of RMP chemicals by a simplistic model RMPCOMP. The model is based on conservative assumptions described in RMP program modeling guidance.[2] The model makes a number of conservative assumptions, while not highly accurate, that provide a reasonable measure of conservatism to assure the modeling result includes the toxic endpoint for the above chemicals. Ammonia was modeled by RMPCOMP to have an end point of only 0.1 miles (RMPCOMP only provides results in increments of 0.1 miles) or 528 ft. which is conservative and does not extend to sensitive population areas in the vicinity to the facility. The input parameters included a total tank volume of 55 gallons, ammonia weight fraction of 20%, reservoir temperature of 97 ^{o}F and does not consider an interior release.

c. HGSYSTEM Model[3]

HGSYSTEM is short-range distance (less than 50 km) model developed specifically for accidental releases approved and recommended by EPA that can simulate a release of toxic liquid and then disperse the resulting gaseous cloud of the pollutant of concern into the atmosphere and downwind after the accidental release. The model contains a number of submodules that one uses in sequence for each step in the initial release to the final toxic endpoint determination.

The initial release was reduced to account for an interior release (see Section i.) based on EPA guidance. The release forms a pool and evaporates based on the chemical properties of the pollutant and the remaining mixture (water). The submodule LPOOL was used to model the pool and its evaporation. The results of the model (file ending in *.*LPR*) are provided in Attachment 2.

The dispersion modeling was determined using the submodule, HEGADAST. This module provides time-interval dispersion of the plume and its concentration at downwind (centerline) concentrations from the evaporating pool. HEGADAST was set to provide results of the instantaneous cloud concentration data (in units of percent of volume) along the centerline of the cloud plume at 20-meter intervals away from the release. The cloud concentration data at 20-meter distance intervals is calculated for each 200-second time interval following the release. Given the high evaporation properties and the relatively smaller volumes of the modeled chemical releases, the dispersion cloud reaches a maximum distance as the chemicals, without containment, evaporate quickly such that the farthest hourly average toxic endpoint occurs within the first couple of hours.

After HGSYSTEM modeling produces these 200-second interval data, the data are used to calculate the hourly-average concentration of the cloud. Hourly-average concentration data are corrected for the fractional amount of the regulated toxic compound within the cloud at each time interval using data from the LPOOL submodule (file ending in *.LPC* Attachment 2). Hourly-average concentration data sheets are tabled and provided near the end of Attachment 2 and indicate the resulting farthest distance of the toxic endpoint over 200 second intervals. EPA guidance[4] states:

> *"The averaging time is specified as 1 hour to make the model-predicted concentrations comparable to the ERPG (Emergency Response Planning Guideline) concentrations."*

The toxic endpoint distances were determined as the greatest distance that the toxic endpoint (concentration of chemical in units of μg/m3) or greater was observed in the cloud plume.

d. EPA MODELING PARAMETERS

Certain specified input parameters are provided in EPA RMP modeling guidance for worst-case scenarios as required input for RMP modeling. Some modeling input parameters not specified by EPA have been obtained through literature review, calculated through literature review, or chosen by engineering judgment. These are provided in Attachment 2.

Atmospheric conditions required for modeling are determined using EPA guidance. For example, the worst-case release ambient temperature and humidity applied to the model are determined as highest daily maximum temperature (36 ºC / 97 ºF) and average humidity (70 percent) for the site (Tampa, FL) during the past three years, per 40 CFR 68.22(c). This same temperature was conservatively applied to the containers of liquid tank. Wind speed is set at 1.5 m/s and atmospheric stability at F class. Surface roughness was determined to be "obstructed terrain" (urban). It is stated in 40 CFR 68.22(e):

> *"The owner or operator shall use either urban or rural topography, as appropriate. Urban means that there are many obstacles in the immediate area; obstacles include buildings or trees. Rural means there are no buildings in the immediate area and the terrain is generally flat and unobstructed."*

i. Interior Building Release

These releases occur inside the USE facility building as shown in the Attachment 1 figure. The release of a toxic liquid and the subsequent dispersion plume are impeded by the building for which EPA specifically addresses in guidance.[5] For this modeling, the EPA factor for building mitigation of 0.1 is applied to the release amount. Note that EPA describes the impact of interior releases as more restrictive and therefore use of this factor is considered a conservatively high value resulting in a farther endpoint than suggested by EPA.

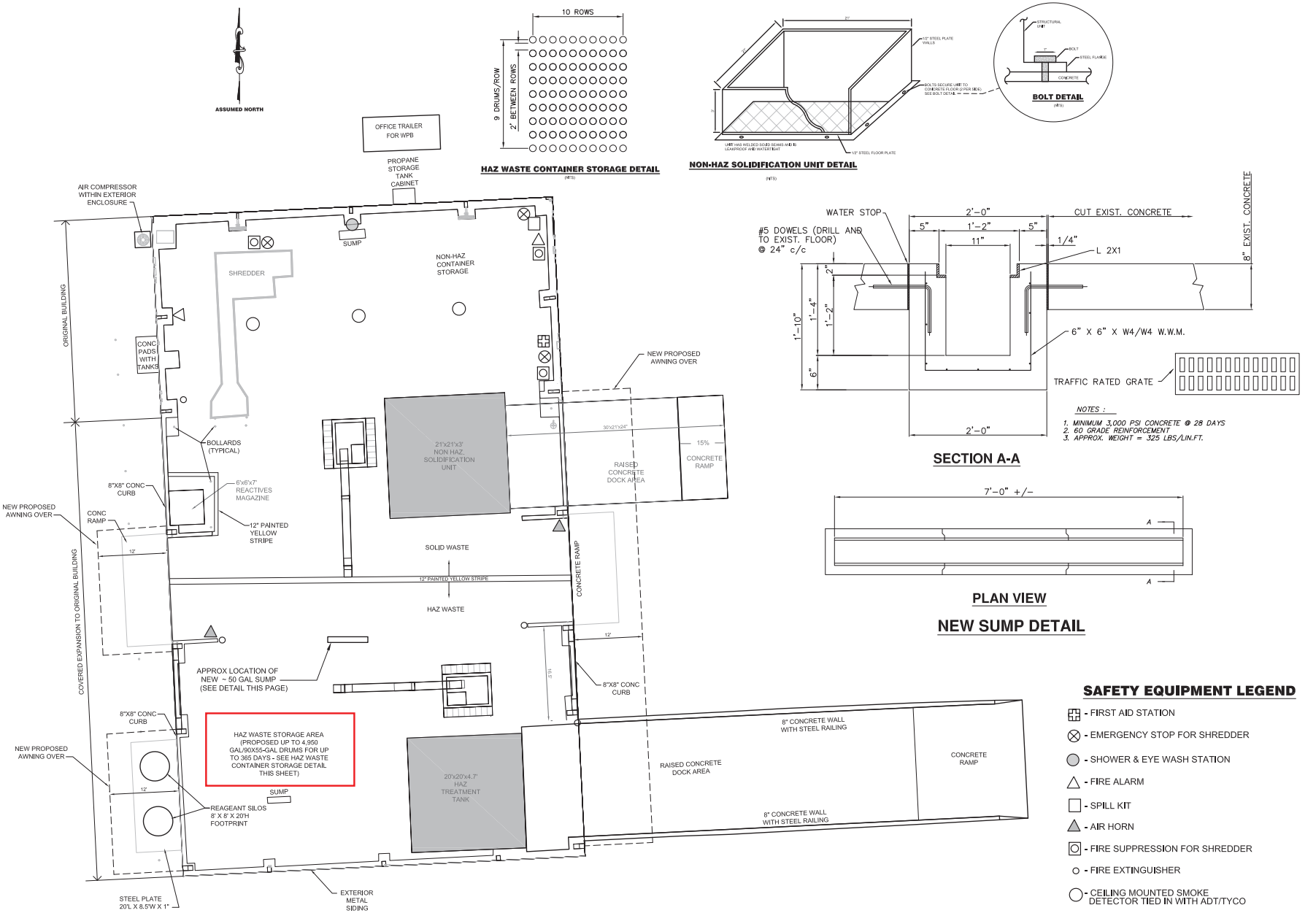
2. Conclusion

Based on the model results, the toxic endpoints incorporating the new sump did not increase the endpoints of the release of regulated pollutants without the new sump. Based on these results, additional modeling for ammonia was not performed since it would not increase the toxic endpoint. The results of RMP worst-case release modeling for the USE facility demonstrate that the toxic endpoint of any potential release of an RMP chemical, as defined by EPA RMP Program, does not extend beyond a maximum distance of 1050 feet from the location of a chemical release at the facility hazardous waste storage area with the addition of a new sump. This maximum distance does not reach sensitive populations in the vicinity of the facility. Additional refinement of the modeling parameters would likely reduce toxic endpoints.

3. References

1. "Risk Management Program Guide for Offsite Consequence Analysis," EPA Doc. No. EPA-550-B-99-009.
2. https://www.epa.gov/rmp/guidance-facilities-risk-management-programs-rmp
3. "HGSYSTEM User Manual," Shell Internationale Research Maatschappij BV. The Hague, TNER.94.058, 1994.
4. EPA Doc. No EPA-454/R-93-002, section 5.8.16.
5. https://www.epa.gov/sites/production/files/2013-11/documents/oca-apds.pdf, Section 3.2.3

ATTACHMENT 1: BUILDING LAYOUT



SAFETY EQUIPMENT LEGEND

- FIRST AID STATION
- EMERGENCY STOP FOR SHREDDER
- SHOWER & EYE WASH STATION
- FIRE ALARM
- SPILL KIT
- AIR HORN
- FIRE SUPPRESSION FOR SHREDDER
- FIRE EXTINGUISHER
- CEILING MOUNTED SMOKE DETECTOR TIED IN WITH ADT/TYCO

PACSCON
Client Centric | Geo-Environmentally Focused

LAST REVISION: 3/27/2019
LAST PLOTTED: 3/27/2019
PLOT SCALE: 1:1

SCALE VERIFICATION
THIS BAR REPRESENTS ONE INCH ON ORIGINAL DRAWING
0 1"
USE TO VERIFY FIGURE

REV.	DATE	DESCRIPTION
01	03/19	REVISIONS PER FDEP COMMENTS

CAD FILE: 180312015 | SCALE: 1/8"=1' | DATE: 10/2018
DRAWN BY: T.N. | DATE: 10/2018
CHECKED BY: C.P. | DATE:
APPROVED BY: | DATE:

PACSCON GEOENVIRONMENTAL, INC.
2019 OSPREY LANE
LUTZ, FL 33549
FLORIDA CERTIFICATION OF AUTHORIZATION: 32142
PACSCON GEOENVIRONMENTAL, INC. - ALL RIGHTS RESERVED

WASTE PROCESSING BUILDING
(EXISTING & PROPOSED LAYOUT)
US ECOLOGY TAMPA, INC.
7202 EAST EIGHTH AVENUE
TAMPA, FL 33619

PROJECT No. 2018-1133
FIGURE 15 of 18

ATTACHMENT 2: MODELING RESULTS

2019-USE, RMP Modeling
Koogler Project: 863_19_01
RISK MANAGEMENT PLANNING, OFF-SITE CONSEQUENCE ANALYSIS

SUMMARY OF RELEASE ENDPOINTS

Case 1: Worst case scenario - without new sump (current)
Case 2: Worst case scenario - with new sump
Case 3: Alternative case scenario - sump is entirely filled with pollutant from spill

HF

	AMOUNT RELEASE		endpoint	
	gallons	kg	meters	feet
Case 1	55	225	**80**	**262**
Case 2	53	217	**80**	**262**
Case 3	1	4	**20**	**66**

filename: hf

HCl

	RELEASE		endpoint	
	gallons	kg	meters	feet
Case 1	275	1227	**240**	**787**
Case 2	273	1218	**240**	**787**
Case 3	219	977	**160**	**525**

filename: hcl

HNO3

	RELEASE		endpoint	
	gallons	kg	meters	feet
Case 1	275	1165	**320**	**1050**
Case 2	273	1156	**320**	**1050**
Case 3	219	928	**280**	**918**

filename: nitric

EPA Toxic Endpoints conversions

Chemical	KG/M3	G/M3 = MG/L	MOL. WT.	GMOLE/M3	PPM	%VOL
HF	1.60E-05	0.016	20.01	0.000800	19.550	1.955E-03
HCl	3.00E-05	0.03	36.46	0.000823	20.118	2.012E-03
HNO3	2.60E-05	0.026	63.01	0.000413	10.089	1.009E-03

2019-USE, RMP Modeling
Koogler Project: 863_19_01
RISK MANAGEMENT PLANNING, OFF-SITE CONSEQUENCE ANALYSIS

CHEMICAL PARAMETERS

HYDROFLUORIC ACID (AQUEOUS)
model file surname: 8171602F
HF, balance of water

	Release amount mixture volume	density	weight		volume	containment surf area	building mitigation factor	spill w/ mititation over 60 sec	
	gallons	*lb/gal*	*lb*	*kg*	*m3*	*ft2*		*m3/s*	
Case 1	55	9.02	496.1	225.0	0.2	NA	0.1	0.000347	Case 1
Case 2	53	9.02	478.1	216.8	0.2			0.000334	Case 2
Case 3	1	9.02	9.0	4.1	0.0			0.000006	Case 3

largest tank mixture weight		HF							LPool molar fraction	
		wt.	weight	mol wt.	amount	water weight	water mol wt.	water amount	comp.	water
lb	kg	%	kg	kg/kgmol	mol	kg	kg/kgmol	mol		
496.1	225.0	12.0	27	20.01	1.3	198	18.0	11.0	0.109	0.891

HYDROCHLORIC ACID (AQUEOUS)
model file surname: 8171602C
HCl, balance of water

	Release amount mixture volume	density	weight		volume	containment surf area	building mitigation factor	spill w/ mititation over 60 sec	
	gallons	*lb/gal*	*lb*	*kg*	*m3*	*ft2*		*m3/s*	
Case 1	275	9.84	2706.3	1227.4	1.0	NA	0.1	0.001735	Case 1
Case 2	273	9.84	2686.6	1218.4	1.0			0.001722	Case 2
Case 3	219	9.84	2155.2	977.4	0.8			0.001382	Case 3

largest tank mixture weight		HCL							LPool molar fraction	
		wt.	weight	mol wt.	amount	remaining weight	water mol wt.	water amount	comp.	water
lb	kg	%	kg	kg/kgmol	mol	kg	kg/kgmol	mol		
2706.3	1227.4	30.0	368	36.46	10.1	859	18.0	47.7	0.175	0.825

NITRIC ACID (AQUEOUS) (ASSUME NO2 RELEASED)
model file surname: 8171602B
HNO3, balance of water

	Release amount mixture volume	density	weight		volume	containment surf area	building mitigation factor	spill w/ mititation over 60 sec	
	gallons	*lb/gal*	*lb*	*kg*	*m3*	*ft2*		*m3/s*	
Case 1	275	9.34	2568.7	1165.0	1.0	NA	0.1	0.001735	Case 1
Case 2	273	9.34	2550.0	1156.5	1.0			0.001722	Case 2
Case 3	219	9.34	2045.6	927.7	0.8			0.001382	Case 3

largest tank mixture weight		HNO3							LPool molar fraction	
		wt.	weight	mol wt.	amount	remaining weight	water mol wt.	water amount	comp.	water
lb	kg	%	kg	kg/kgmol	mol	kg	kg/kgmol	mol		
2568.7	1165.0	30.0	349	63.08	5.5	815	18.0	45.3	0.109	0.891

2019-USE, RMP Modeling
Koogler Project: 863_19_01
RISK MANAGEMENT PLANNING, OFF-SITE CONSEQUENCE ANALYSIS

HG system compound input values

	HCL		HF		HNO3		
specific heat of vapour	29.2	1	29.1	2	53.0	3	J/mole-K
specific heat of liquid	90	1	50.2	2	109.6	4	J/mole-K
heat of vaporization	16334	1	25777	2	39000	1	J/mole
critical temperature	325	3	461.1	2	431	1	K
critical pressure	83	3	64	2	101	1	atm
vapor B1	-6.156		-6.156	2	-6.156		
vapor B2	-4.348		-4.348	2	-4.348		
vapor B3	13.13		13.13	2	13.13		
vapor B4	-33.14		-33.14	2	-33.14		
molar mass	36.46	1	20.01	2	63.08	1	kg/kmole
liquid density	1193	1	977.7	2	1510	1	kg/m3
amt boil pt	188	1	293	2	356	1	K
vapour viscosity	1.34E-05	1	0.000108	2	1.3E-10	1	kg/m/s

1 http://encyclopedia.airliquide.com/ (use NO2 for nitric acid gas)
2 provided by Hgsystem
3 http://webbook.nist.gov/ (for nitric acid at 298 K)
4 use heat of vaporization at 298 K

2019-USE, RMP Modeling
Koogler Project: 863_19_01
RISK MANAGEMENT PLANNING, OFF-SITE CONSEQUENCE ANALYSIS

Compound Thermochemical Properties

TOXIC COMPOUND VAPOR PRESSURE - estimator

VAPOR PRESSURE - WAGNER EQUATION — Atm. Pressure @ 298 K

	B1	B2	B3	B4	T	Tc	Tr	Q	Pc	atm	**mm Hg**
HF	-6.156	-4.348	13.130	-33.140	309	461.1	0.670	0.330	64	1.7	**1303**
HCL	-6.156	-4.348	13.130	-33.140	309	325	0.951	0.049	45	31.2	**23693**
HNO3	-6.156	-4.348	13.130	-33.140	309	431	0.717	0.283	101	5.27	**4008**

use trend of HF basis for other gases. Trend line similar other than Tc and Pc