Energy Fuels Resources (USA) Inc.
225 Union Blvd. Suite 600
Lakewood, CO, US, 80228
303 974 2140
www.energyfuels.com

April 12, 2021

Via Electronic Mail and Express Delivery

Ms. Valerie Thorsen
Air Permits Unit Manager
Air Quality Division
1110 W. Washington St.
Phoenix, AZ 85007

Re: Class II Permit Renewal Application for the EZ Mine, Permit No. 62878

Dear Ms. Thorsen:

Energy Fuels Resources (USA) Inc. ("EFRI") operates the EZ Mine (the "Mine") located approximately 36 miles south of Fredonia, Arizona. The Mine's Class II Air Quality Permit #62878 (the "Permit") is scheduled to expire on October 13, 2021. EFRI is submitting the attached permit application to renew the Permit in accordance with A.A.C. R18-2-304.C.2.

Operation of the Mine will remain consistent with the current permit. Please refer to the original Permit application submitted in June 2010 for detailed project description, applicable requirements, facility flow diagram, and dispersion modeling analyses.

Potential to Emit emissions have not changed from those included in Permit #62878 but have been provided for reference. Additionally, an electronic emissions calculations file has been included with the electronic version submitted via e-mail.

Please contact me at 303-389-4132 or sbakken@energyfuels.com if you have any questions or need additional information.

Sincerely,

Scott Bakken Digitally signed by Scott Bakken
Date: 2021.04.12 16:39:21 -06'00'

ENERGY FUELS RESOURCES (USA) INC.
Scott A. Bakken
Vice President, Regulatory Affairs

Enc. ADEQ Class II Renewal Application

cc: D. Frydenlund, Kathy Weinel, D. Kolkman (EFRI), E. Farstad (CTEH)

ATTACHMENT A

CLASS II PERMIT RENEWAL APPLICATION FOR THE EZ MINE

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Energy Fuels Resources (USA) Inc.

CLASS II PERMIT RENEWAL APPLICATION FOR THE EZ MINE

Submitted to:

Arizona Department of Environmental Quality
Air Quality Division
1110 West Washington Street
Phoenix, Arizona 85007

Submitted by:

Energy Fuels Resources (USA) Inc.
225 Union Blvd., Suite 600
Lakewood, CO 80228

Prepared by:

CTEH, LLC
1114 Washington Ave., Suite 201
Golden, CO 80401

April 9, 2021

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1.0 INTRODUCTION

Energy Fuels Resources (USA) Inc. (EFRI) is submitting this permit application to renew Class II Air Quality Permit #62878 for the EZ Mine located approximately 36 miles south of Fredonia, Arizona. Operation of the mine will remain consistent with the current permit. Please refer to the original Class II permit application submitted in June 2010 for detailed project description, applicable requirements, facility flow diagram, and dispersion modeling analyses.

Potential to Emit (PTE) emissions have not changed from the values included in Permit #62878 but have been provided in Attachment B for reference. The electronic emission calculations file is also attached with this application package.

Appendices to this document complete the necessary information required as part of the permit renewal application and include:

Appendix A: Permit Application Form and Equipment List

Appendix B: Emission Calculations

2.0 FACILITY DESCRIPTION

The EZ Mine is located at Universal Transverse Mercator (UTM) coordinates 329,000 meters east and 4,054,300 meters north (North American Datum [NAD] 83, Zone 12). The maximum annual production rate is 146,000 tons per year [tpy]) of uranium ore. Access to the ore deposit will be provided by a conventional, three-compartment vertical shaft located centrally among the three deposits.

Mined ore will be hauled to the surface where it is loaded, using a front-end loader, into over-the-road haul trucks for transportation to the off-site processing mill. If the ore cannot be shipped immediately to the mill, it will be stored in the Ore Stockpile Area (OSA). Rock from the mining operations with less than 0.03 percent uranium will be stored on the surface in the Development Rock Stockpile (DRS) or in mined-out areas of the underground workings. The DRS encompasses approximately 6 acres. A topsoil stockpile will also be present on the site which is seeded and produces only minor emissions from wind erosion.

Power for the EZ Mine will be supplied via overhead electric lines. One diesel generator will be used as a source of backup power in the event of power failure. Various vehicles will travel within the permit area boundary and access ore stockpiles, the DRS, and maintenance facilities. Surface equipment that travels over on-site roads includes:

- Front-End Loaders
- Backhoe/Skid Loader
- Dump Truck
- Highway Haul Trucks
- Water Truck
- Fuel Truck
- Passenger Vehicles

Diesel fuel may be stored on site in an aboveground storage tank (AST), drums, and smaller containers. The fueling station will be located in the western portion of the site and contain one 15,000-gallon diesel fuel tank. Potential emissions from the diesel storage fuel tank are included in the emission inventory (Table B-12).

3.0 SUMMARY OF FACILITY EMISSIONS

Sources of air emissions associated with the EZ Mine include mine vent shaft emissions, one standby diesel generator, a diesel storage tank, ore and development rock storage and handling, and other fugitive emissions. A summary of facility-wide annual PTE emissions for criteria air pollutants and greenhouse gases (GHGs) is given in Table 2-1. A summary of facility-wide PTE emissions for hazardous air pollutants (HAPs) is given in Table 2-2. There are no changes to PTE from the current air permit #62878.

Table 2-1 EZ Mine Facility-Wide Annual Criteria Pollutant and GHG Emissions

Pollutant	Generator	Vent Shafts	Material Handling Sources	Storage Piles	On-Site Road Fugitives	Storage Tank	Total
	(tons per year)						
Criteria Pollutants							
CO	0.22	---	---	---	---	---	0.22
NO_X	1.0	---	---	---	---	---	1.04
$PM_{2.5}$	0.07	4.68	0.40	0.08	0.45	---	5.68
PM_{10}	0.07	4.68	3.43	0.56	4.52	---	13.25
VOC	0.08	---	---	---	---	0.003	0.09
SO2	0.07	---	---	---	---	---	0.07
Lead	---	6.08E-05	3.45E-05	8.28E-10	---	---	9.53E-05
Greenhouse Gases							
CO_2e	151.7	---	---	---	---	---	151.7

--- Emissions of the compound are either not present or were not reported in the literature reviewed.

Table 2-2 EZ Mine Facility-Wide Annual HAPs Emissions

Pollutant	Generator	Vent Shafts	Material Handling Sources	Storage Piles	Storage Tank	Total
(tons per year)						
Hazardous Air Pollutants						
Naphthalene	7.23E-06	---	---	---	---	7.23E-06
Acetaldehyde	6.54E-05	---	---	---	---	6.54E-05
Acrolein	7.89E-06	---	---	---	---	7.89E-06
Benzene	7.96E-05	---	---	---	6.78E-05	1.47E-04
1,3-Butadiene	3.33E-06	---	---	---	---	3.33E-06
Ethyl benzene	---	---	---	---	8.45E-06	8.45E-06
Formaldehyde	1.01E-04	---	---	---	---	1.01E-04
Hexane	---	---	---	---	1.48E-04	1.48E-04
Toluene	3.49E-05	---	---	---	5.44E-05	8.93E-05
Xylenes	2.43E-05	---	---	---	3.43E-06	2.77E-05
Arsenic	---	2.15E-04	1.22E-04	2.57E-05	--	3.63E-04
Lead	---	6.08E-05	3.45E-05	7.25E-06	--	1.03E-04
Nickel	---	7.01E-05	3.99E-05	8.37E-06	--	1.18E-04
Selenium	---	1.40E-05	7.97E-06	1.67E-06	--	2.37E-05
Radionuclides	---	1.47E-02	6.97E-03	9.08E-04	--	2.26E-02
TOTAL HAPs	**3.23E-04**	**1.51E-02**	**7.17E-03**	**9.51E-04**	**2.82E-04**	**2.38E-02**

--- Emissions of the compound are either not present or were not reported in the literature reviewed.

APPENDIX A

Permit Application Form and Equipment List

SECTION 3.1

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Air Quality Division

1110 West Washington • Phoenix, AZ 85007 • Phone: (602) 771-2338

STANDARD CLASS II PERMIT APPLICATION FORM

(As required by A.R.S. § 49-426, and Chapter 2, Article 3, Arizona Administrative Code)

1. Permit to be issued to (Business license name of organization that is to receive permit):
   Energy Fuels Resources (USA) Inc.

2. Mailing Address: 225 Union Blvd. Suite 600
   City: Lakewood State: Colorado ZIP: 80228

3. Name (or names) of Responsible Official: Scott Bakken
   Phone: 303-389-4132 Fax: 303-389-4125 Email: sbakken@energyfuels.com

4. Facility Manager/Contact Person and Title: Steve Hancock; Director, Arizona Strip Operations
   Phone: 928-643-6185 ext. 206 Fax: Email: shancock@energyfuels.com

5. Facility Name: EZ Mines
   Facility Location/Address (Current/Proposed): 36 miles south of Fredonia, AZ
   City: South of Fredonia County: Mohave ZIP: 86022
   Indian Reservation (if applicable, which one): N/A
   Latitude/Longitude, Elevation: 36.629 deg N / 112.921 deg W, 1566 m (5138 ft)

6. General Nature of Business: Underground Uranium Mine

7. Type of Organization:
   ☑ Corporation ☐ Individual Owner ☐ Partnership ☐ Government Entity ☐ LLC
   ☐ Other

8. Permit Application Basis: ☐ New Source ☐ Revision ☑ Renewal of Existing Permit
   For renewal or modification, include existing permit number (and exp. date): 62878, expires 10-13-2021
   Date of Commencement of Construction or Modification: N/A
   Primary Standard Industrial Classification Code: 1094

9. I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by ADEQ as public record. I also attest that I am in compliance with the applicable requirements of the Permit and will continue to comply with such requirements and any future requirements that become effective during the life of the Permit. I will present a certification of compliance to ADEQ no less than annually and more frequently if specified by ADEQ. I further state that

I will assume responsibility for the construction, modification, or operation of the source in accordance with Arizona Administrative Code, Title 18, Chapter 2 and any permit issued thereof.

Signature of Responsible Official: _____

Printed Name of Signer/Official Title: Scott Bakken

Date: 4/12/21 Telephone Number: 303-389-4132

Section 3.5 - Equipment List

Type of Equipment	Maximum Rated Capacity	Make	Model	Serial Number	Date of Manufacture	Equipment ID Number
Emergency Generator	500 kW	TBD	TBD	TBD	TBD	TBD
Diesel Storage Tank	15,000 gallons	N/A	N/A	N/A	N/A	N/A

All relevant equipment utilized at the facility should be included in the equipment list. Please complete all fields.
The date of manufacture must be included in order to determine applicability of regulations.
Indicate the units (tons/hour, horsepower, etc.) when recording the maximum rated capacity.
Make additional copies of this form if necessary.

SECTION 3.6 - EMISSION SOURCE FORM

					USE THIS SECTION FOR MODIFICATIONS ONLY		
Emission Point		Regulated Air Pollutant Name	PTE		PTE AFTER MODIFICATION		CHANGE IN PTE
Number	Name		lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
1	Emergency Generator	CO	4.48	0.22			
		NOx	20.79	1.04			
		$PM_{10}/PM_{2.5}$	1.48	0.07			
		VOC	1.69	0.08			
		SO_2	1.37	0.07			
		CO_2e	N/A	151.7			
		HAPs	6.47E-3	3.23E-4			
2	Diesel Storage Tank	VOC	6.04E-4	0.003			
		HAPs	6.44E-5	2.82E-4			
3	Vents	$PM_{10}/PM_{2.5}$	1.07	4.68			
		Lead	1.39E-5	6.08E-5			
		HAPs	0.015	3.45E-3			
4	Front End Loaders	PM_{10}	0.25	1.08			
		$PM_{2.5}$	0.04	0.16			
		Lead	3.20E-6	1.40E-5			

SECTION 3.6 - EMISSION SOURCE FORM (Page 2)

Emission Point		Regulated Air Pollutant Name	PTE		USE THIS SECTION FOR MODIFICATIONS ONLY PTE AFTER MODIFICATION		CHANGE IN PTE
Number	Name		lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
	Front End Loaders (cont.)	HAPs	7.97E-4	3.49E-3			
5	Backhoe	PM_{10}	0.11	0.49			
		PM_{25}	0.02	0.07			
		Lead	1.5E-6	6.5E-6			
		HAPs	1.86E-4	1.86E-4			
6	Dump Truck	PM_{10}	0.25	1.08			
		PM_{25}	0.04	0.16			
		Lead	3.2E-6	1.4E-5			
		HAPs	7.97E-4	3.49E-3			
7	Vehicle Traffic	PM_{10}	1.03	4.52			
		$PM_{2.5}$	0.10	0.45			
8	Storage Piles	PM_{10}	0.13	0.56			
		$PM_{2.5}$	0.02	0.08			
		Lead	1.66E-6	8.28E-10			
		HAPs	2.17E-4	9.51E-4			

SECTION 5.0 -APPLICATION ADMINISTRATIVE COMPLETENESS CHECKLIST

	REQUIREMENT	MEETS REQUIREMENTS			COMMENT
		YES	NO	N/A	
1	Has the standard application form been completed?	X			
2	Has the responsible official signed the standard application form?	X			
3	Has a process description been provided?	X			
4	Are the facility's emissions documented with all appropriate supporting information?	X			
5	Is the facility subject to Minor NSR requirements? If the answer is "YES" , answer 6a, 6b and 6c as applicable. If the answer is "NO", skip to 7.		X		
6.a	If the facility chooses to implement RACT, is the RACT determination included for the affected pollutants for all affected emission units?				
6.b	If the facility chooses to demonstrate compliance with NAAQS by screen modeling, is the modeling analysis included?				
6.c	If refined modeling has been conducted, is a comprehensive modeling report along with all modeling files included?				
7	Does the application include an equipment list with the type, name, make, model, serial number, maximum rated capacity, and date of manufacture?	X			
8	Does the application include an identification and description of Pollution Controls? (if applicable)	X			
9	For any application component claimed as confidential, are the requirements of AR.S. 49-432 and A.A.C. R18-2-305 addressed?			X	
10	For any current non-compliance issue, is a compliance schedule attached?			X	
11	For minor permit revision that will make a modification upon submittal of application, has a suggested draft permit been attached?			X	

APPENDIX B

Emission Calculations

TABLE B-1
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
FACILITY-WIDE ANNUAL EMISSIONS (TONS PER YEAR)

EMISSIONS	Generator	Vent Shafts	Material Handling Sources	Storage Pile Fugitive Sources	On-Site Road Fugitive Sources	Storage Tank	Total (tons/yr)
Criteria Pollutants							
CO	0.22	--	--	--	--	--	**0.22**
NOx	1.04	--	--	--	--	--	**1.04**
$PM_{2.5}$	0.07	4.68	0.40	0.08	0.45	--	**5.68**
PM_{10}	0.07	4.68	3.43	0.56	4.52	--	**13.25**
VOC	0.08	--	--	--	--	0.003	**0.09**
SO_2	0.07	--	--	--	--	--	**0.07**
Lead	--	6.08E-05	3.45E-05	8.28E-10	--	--	**9.53E-05**
Greenhouse Gases							
CO_2e	151.7	--	--	--	--	--	**151.7**

'--' Emissions of compound are either not present or were not reported in the literature reviewed.

TABLE B-2
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
FACILITY-WIDE SHORT TERM EMISSIONS (POUNDS PER HOUR)

EMISSIONS	Generators	Vent Shafts	Material Handling Sources	Storage Pile Fugitive Sources	On-Site Road Fugitive Sources	Storage Tank	Totals
Criteria Pollutants							
CO	4.48	--	--	--	--	--	**4.48**
NOx	20.79	--	--	--	--	--	**20.79**
$PM_{2.5}$	1.48	1.07	0.09	0.02	0.10	--	**2.76**
PM_{10}	1.48	1.07	0.78	0.13	1.03	--	**4.48**
VOC	1.69	--	--	--	--	0.0006	**1.69**
SO_2	1.37	--	--	--	--	--	**1.37**
Lead	--	1.39E-05	7.89E-06	1.66E-06	--	--	**2.34E-05**

'--' Emissions of compound are either not present or were not reported in the literature reviewed.

TABLE B-3
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
FACILITY-WIDE ANNUAL HAZARDOUS AIR POLLUTANT EMISSIONS
(TONS PER YEAR)

EMISSIONS	Generator	Material Handling Sources	Storage Pile Fugitive Sources	Storage Tank	Vent Holes	Total Controlled Emissions
Naphthalene	7.23E-06	--	--	--	--	**7.23E-06**
Acetaldehyde	6.54E-05	--	--	--	--	**6.54E-05**
Acrolein	7.89E-06	--	--	--	--	**7.89E-06**
Benzene	7.96E-05	--	--	6.78E-05	--	**1.47E-04**
1,3-Butadiene	3.33E-06	--	--	--	--	**3.33E-06**
Ethyl benzene	--	--	--	8.45E-06	--	**8.45E-06**
Formaldehyde	1.01E-04	--	--	--	--	**1.01E-04**
Hexane	--	--	--	1.48E-04	--	**1.48E-04**
Toluene	3.49E-05	--	--	5.44E-05	--	**8.93E-05**
Xylenes	2.43E-05	--	--	3.43E-06	--	**2.77E-05**
Arsenic	--	1.22E-04	2.57E-05	--	2.15E-04	**3.63E-04**
Lead	--	3.45E-05	7.25E-06	--	6.08E-05	**1.03E-04**
Nickel	--	3.99E-05	8.37E-06	--	7.01E-05	**1.18E-04**
Selenium	--	7.97E-06	1.67E-06	--	1.40E-05	**2.37E-05**
Radionuclides	--	6.97E-03	9.08E-04	--	1.47E-02	**2.26E-02**
Total HAPs	**3.23E-04**	**7.17E-03**	**9.51E-04**	**2.82E-04**	**1.51E-02**	**2.38E-02**

TABLE B-4
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
PILES AND PRODUCTION RATES[1]

Material Produced	Maximum Amount Produced Annually (tons/year)	Storage Pile Name	Pile ID	Total Pile Volume (ft^3)	Pile Base Area (acres)	Pile Length (L) (ft)	Pile Width (W) or Radius (R) (ft)	Pile Height (H) (ft)	Shape[3]	Exposed Surface Area (ft^2)
Ore	73,000	Ore Stockpile	OSP1	290,400	1.00	NA	118	20	Cone	44,200
	73,000	Ore Stockpile	OSP2	290,400	1.00	NA	118	20	Cone	44,200
Development Rock	146,000	Development Rock Stockpile	DRS	3,049,200	6.00	NA	288	35	Cone	263,300
Topsoil[2]	43,560	Topsoil Stockpile	TS	871,200	3.00	NA	204	20	Cone	131,300

1 Pile dimensions listed are approximate and are based on estimated pile heights and base areas given by the facility.
2 The amount of topsoil listed in the table is the amount produced over the lifetime of the mine.
3 The surface area is calculated as the exposed area of the cone ($\pi * R * \sqrt{(R^2 + H^2)}$).

TABLE B-5
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
GENERATOR EMISSIONS - CRITERIA POLLUTANTS

Explanation: The EZ Mines receive prime power from overhead electrical lines. One generator is used as a backup in the event of power outage or generator maintenance. The emission estimates are based on one 500-kW backup generator using No. 2 fuel oil. The calculations are based on specifications from the generator manufacturer and AP-42 emission factors as noted.

Emission Equations:

Hourly Emissions (lbs/hr) = PR * (1.341 hp/kW) * E (lb/hp-hr)

24-Hour emissions (lb/hr) = Hourly Emissions (lbs/hr) * D/24hours

Annual emissions (tons/yr) = Hourly Emissions (lbs/hr) * OH * (ton/2000 lbs)

Where:
PR = generator power rating (kW)
E = emission factor
OH = annual operating hours (hours/year)
D = daily operating hours (hours/day)

Data:

PR (500 kW) =	500	kW
OH (500 kW) =	100	hours/year
D (500 kW) =	12	hours/day

Generator Emissions Estimate

Generator Size	Pollutant	Emission Factor per Unit	Units	Emission Factor Source	Hourly Emissions[3] (lb/hr)	24-Hour Emissions[3] (lb/hr)	Annual Emissions (tons/yr)
Standby Generator (500-kW) [1]	CO	6.68E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1	4.5	NA	0.22
	NO_X	0.031	lb/hp-hr	AP-42 (10/96) Table 3.3-1	20.8	NA	1.0
	$PM_{10}/PM_{2.5}$	2.20E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1	1.48	0.7	0.07
	VOC	2.51E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1 [2]	1.69	NA	0.08
	SO_2	2.05E-03	lb/hp-hr	AP-42 (10/96) Table 3.3-1	1.37	NA	0.07

[1] All emission factors are all taken from AP-42, Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines. (Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines).

[2] The VOC emission factor is equal to 100% of the AP-42 Total Organic Compounds emission factor.

[3] All short-term emissions were calculated based on hourly emission averages, except for $PM_{10}/PM_{2.5}$, which was calculated based on a 24-hour average.

TABLE B-6
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
FRONT-END LOADER MATERIAL HANDLING EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **FRONT-END LOADER - LOADING**
Pollutants: **PM_{10}, $PM_{2.5}$**

Emission Factor From: **AP-42, Section 13.2.4**
"Aggregate Handling and Storage Piles"

Emission Factor Rating: **A**

Explanation: A front-end loader is used to move ore from the ore storage bins into haul trucks or the ore stockpile area if the ore cannot be shipped immediately. Most of the ore will be shipped immediately.

Emission Equations: $E = k*0.0032*[((U/5)^{1.3})/((M/2)^{1.4})]$

Where:
E = emission factor (lbs/ton)
k = Aerodynamic Particle Size Multiplier (unitless)
U = mean wind speed (mph)
M = material moisture content (%)

Data:

k_{PM10} =	0.35		[Areodynamic Particle Size Multiplier for particles < 10 µm (AP-42 13.2.4)]
$k_{PM2.5}$ =	0.053		[Areodynamic Particle Size Multiplier for particles < 2.5 µm (AP-42 13.2.4)]
U =	6.32	mph	[2006 mean wind speed from Grand Canyon National Park meteorological station]
M_{ore} =	5.4	%	[mean moisture content for lump ore from iron and steel production (AP-42, Table 13.2.4-1)]
$M_{dev\ rock}$ =	0.4	%	[mean moisture content for tailings from taconite mining and processing (AP-42, Table 13.2.4-1)]

E_{ore} =	**0.0003778**	**lbs PM_{10}/ton ore**
$E_{waste\ rock}$ =	**0.0144471**	**lbs PM_{10}/ton rock**
E_{ore} =	**0.0000572**	**lbs $PM_{2.5}$/ton ore**
E_{DR} =	**0.0021877**	**lbs $PM_{2.5}$/ton rock**

Annual PM_{10} emissions (tons/yr) = E * P * (ton/2000 lbs)
Short-term PM_{10} emissions (lbs/hr) = E * P / H

Where:
P = Annual production rate (tpy)
H = Working hours per year (hrs/yr)
= 8760 hours/year [assumes mine will be operational 365 days/year, 24 hours/day]

Material Handling	P (tpy)	H (hrs/yr)	PM_{10} Emissions (lbs/hr)	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (lbs/hr)	$PM_{2.5}$ Emissions (tons/yr)
Ore Loading	146,000	8,760	0.0063	0.028	0.0010	0.004
Development Rock Loading	146,000	8,760	0.2408	1.055	0.0365	0.160
		Total Emissions	**0.25**	**1.08**	**0.04**	**0.16**

TABLE B-7
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
STOCKPILE EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **Wind Erosion of Stockpiles (Topsoil, Development Rock, and Ore)**
Pollutants: **PM_{10}, $PM_{2.5}$**

Emission Factor From: **AP-42, Section 13.2.5**
Industrial Wind Erosion

Explanation: Emissions of PM_{10} from wind erosion of stockpiles are calculated as a function of mean area wind speed, threshold velocity, the number of disturbances per year, the erosion potential, and particle size.
The topsoil pile will be seeded to mitigate fugitive dust. Ore and development rock pieces will likely range from 1 to 6 inches in size.

Emission Equations:

$$E_{uc} = P * A * k * N \quad \text{grams/year}$$
$$P = 58(u'-u_t)^2 + 25(u'-u_t)$$
$$u' = 0.1*u10*(u_s/u_r)$$
$$u10 = u*(\ln(10/0.005)/\ln(h/0.005))$$
$$E_c = E_{uc} * (100-C)/100$$

Where:

E_{uc} = uncontrolled particle emissions (grams/year)
P = pile erosion potential (grams/m^2-disturbance)
A = pile surface area (m^2)
k = Aerodynamic Particle Size Multiplier (dimensionless)
N = number of pile disturbances in one year (disturbances/year)
u' = friction velocity (m/s)
u_t = threshold velocity (m/s) found in AP-42, Table 13.2.5-2
$u10$ = corrected fastest mile wind speed (m/s)
u_s/u_r = ratio of surface wind speed to approach wind speed (unitless)
u = fastest wind speed for the periods between disturbances (m/s)
h = anemometer height (m)
E_c = controlled particle emissions (grams/year)
C = control efficiency (%)

Data:

k_{PM10} =	0.5	unitless	[Areodynamic Particle Size Multiplier for particles < 10 µm (AP-42 13.2.5)]
$k_{PM2.5}$ =	0.075	unitless	[Areodynamic Particle Size Multiplier for particles < 2.5 µm (AP-42 13.2.5)]
N =	1	disturbances/year	[assumed total surface area of the piles are disturbed once per year on average]
u_t =	1.33	m/s for ore and DRSP	[assumed threshold friction velocity for scoria, AP-4 13.2.5]
	1.02	m/s for top soil	[assumed threshold friction velocity for overburden, AP-4 13.2.5]
u_s/u_r=	0.9		[assumed maximum value, taken from AP-42, Section 13.2.5; maximum value will produce maximum emissions]
u =	46.0	miles per hour	[Fastest Mile for Flagstaff, AZ, measured May 1975, from Climate Data Summary]
h =	10	m	[assumed anemometer height for Flagstaff, AZ]
C =	90	%	[assumed control efficiency for seeding topsoil piles]

Annual PM Emissions:

Pile	Pile Volume (cubic ft.)	Annual Disturbed Area (sq.ft.)	Uncontrolled PM_{10} Emissions		Controlled PM_{10} Emissions		Controlled $PM_{2.5}$ Emissions	
			(tons/yr)	(lb/hr)	(tons/yr)	(lb/hr)	(tons/yr)	(lb/hr)
Ore Stockpile	290,000	44,200	6.50E-02	1.48E-02	6.50E-02	1.48E-02	0.010	0.002
Ore Stockpile	290,000	44,200	6.50E-02	1.48E-02	6.50E-02	1.48E-02	0.010	0.002
Development Rock Stockpile	3,049,000	263,300	3.87E-01	8.84E-02	3.87E-01	8.84E-02	0.058	0.013
Topsoil Stockpile	871,000	131,300	4.08E-01	9.33E-02	4.08E-02	9.33E-03	0.006	0.001
		Total Pile Emissions	**0.9**	**0.2**	**0.56**	**0.127**	**0.084**	**0.019**

Note: It was assumed the entire surface area of a pile will be available for disturbance at any given time.

TABLE B-8
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
BACKHOE/SKID LOADER MATERIAL HANDLING EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **BACKHOE/SKID LOADER - TOPSOIL STRIPPING**
Pollutants: **PM_{10}, $PM_{2.5}$**

Emission Factor From: **AP-42, TABLE 11.9-4**
"Uncontrolled Particulate Emission Factors for Open Dust Sources at Western Surface Coal Mines"

Emission Factor Rating: **E**

Explanation: A backhoe/skid loader may be used to strip areas of topsoil and mound the topsoil into piles. A total material handling value is calculated by determining the amount of soil to be stripped.

Emission Equations:

Annual PM_{10} emissions (tons/yr) = E * P * (ton/2000 lbs)
Short-term PM_{10} emissions (lbs/hr) = E * P / H
$E_c = E_{uc}$ * (100-C)/100

Where:
E is the emission factor (lbs/ton)
P is the amount of topsoil produced annually (tons/year)
H is the number of working hours per year (hrs/year)
E_{uc} is uncontrolled particle emissions (lbs/ton)
E_c is controlled particle emissions (lbs/ton)
C is control efficiency (%)

Data:

E =	0.058	lb PM_{10}/ton topsoil (PM_{10} assumed to be equal to PM)	
P =	43560	tons/year	
H =	8760	hours/year	[assumes mine will be operational 365 days/year, 24 hours/day]
C =	61	%	[WRAP 2006, Chapter 3, Apply water at 3.2 hour intervals to disturbed areas]

Material Handling	P (tpy)	H (hrs/yr)	Uncontrolled PM_{10} Emissions		Controlled PM_{10} Emissions		Controlled $PM_{2.5}$ Emissions[1]	
			Hourly (lbs/hr)	Annual (tons/year)	Hourly (lbs/hr)	Annual (tons/year)	Hourly (lbs/hr)	Annual (tons/year)
Topsoil	43,560	8,760	0.29	1.26	0.11	0.49	0.02	0.07

[1] $PM_{2.5}$ emissions were calculated assuming the ratio of $PM_{2.5}/PM_{10}$ is 0.105/0.75 from AP-42 Section 11.9, Table 11.9-1.

TABLE B-9
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
TEN WHEEL DUMP TRUCK MATERIAL HANDLING EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **TEN WHEEL DUMP TRUCK - UNLOADING**
Pollutants: **PM_{10}, $PM_{2.5}$**

Emission Factor From: **AP-42, Section 13.2.4**
"Aggregate Handling and Storage Piles"

Emission Factor Rating: **A**

Explanation: A ten wheel dump truck will be used to move ore and development rock from the mine shaft to the stockpile areas. A total material handling value is calculated by determining the amount of ore and development rock produced. It was assumed that the dump truck will be moving all ore produced in a year.

Emission Equations: $E = k*0.0032*[((U/5)^{1.3})/((M/2)^{1.4})]$

Where:
E = emission factor (lbs/ton)
k = Aerodynamic Particle Size Multiplier (unitless)
U = mean wind speed (mph)
M = material moisture content (%)

Data:

k_{PM10} =	0.35		[Areodynamic Particle Size Multiplier for particles < 10 µm (AP-42 13.2.4)]
$k_{PM2.5}$ =	0.053		[Areodynamic Particle Size Multiplier for particles < 2.5 µm (AP-42 13.2.4)]
U =	6.32	mph	[2006 mean wind speed from Grand Canyon National Park meteorological station]
M_{ore} =	5.4	%	[mean moisture content for lump ore from iron and steel production (AP-42, Table 13.2.4-1)]
M_{DR} =	0.4	%	[mean moisture content for tailings from taconite mining and processing (AP-42, Table 13.2.4-1)]

E_{ore} = 0.0003778 lbs PM_{10}/ton ore
$E_{waste\ rock}$ = 0.0144471 lbs PM_{10}/ton rock
E_{ore} = 0.0000572 lbs $PM_{2.5}$/ton ore
E_{DR} = 0.0021877 lbs $PM_{2.5}$/ton rock

Annual PM_{10} emissions (tons/yr) = E * P * (ton/2000 lbs)
Short-term PM_{10} emissions (lbs/hr) = E * P / H

Where:
P = Annual production rate (tpy)
H = Working hours per year (hrs/yr)
= 8760 hours/year [assumes mine will be operational 365 days/year, 24 hours/day]

Material Handling	P (tpy)	H (hrs/yr)	PM_{10} Emissions (lbs/hr)	PM_{10} Emissions (tons/yr)	$PM_{2.5}$ Emissions (lbs/hr)	$PM_{2.5}$ Emissions (tons/yr)
Ore Unloading	146,000	8,760	0.0063	0.028	0.0010	0.004
Development Rock Unloading	146,000	8,760	0.2408	1.055	0.0365	0.160
		Total Emissions	**0.25**	**1.08**	**0.04**	**0.16**

TABLE B-10
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
FUGITIVE UNPAVED ROAD EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **FUGITIVE DUST EMISSIONS FROM VEHICLE TRAFFIC**

Pollutants: **PM_{10}, $PM_{2.5}$**

Emission Factor Reference: **AP-42, Section 13.2.2**
"Unpaved Roads"

Emission Factor Rating: **B**

Explanation: PM emissions for on-site vehicle traffic are calculated by using the emission factor equation for unpaved roads in AP-42, Section 13.2.2. Emissions are calculated by first calculating an emission factor for each vehicle type, which is then multiplied by the calculated vehicle miles traveled (VMT) for each vehicle. To calculate VMT, an examination of the on-site roads is necessary. All roads within the facility boundary are unpaved. Nonroad vehicles, such as front-end loaders, will travel only on site in the portal area. In most cases, the VMT is calculated by taking the frequency of use and multiplying by the quantity of the amount of material hauled divided by the capacity of the vehicle. The product is then multiplied by the haul road distance times two, to accommodate round-trips. When the VMT is not dependant on the amount of material being hauled (such as a pickup truck), the annual VMT is determined by multiplying the distance traveled per trip by an average number of trips per year. Dust suppression methods including watering and limiting travel speeds are applied to all traveled on-site roadways. Dust suppression methods of limiting travel speeds are applied to off-site haul roads.

Emission Equations:

$$E_{uc} = k * (s/12)^a * (W/3)^b$$

$$E_c = E_{uc} * [(100 - C) / 100]$$

Where:
E_{uc} = uncontrolled emission factor (lbs/VMT)
E_c = controlled emission factor (lbs/VMT)
k = Aerodynamic Particle Size Multiplier (unitless)
s = surface material silt content (%)
a = particle size multiplier constant (unitless)
W = mean vehicle weight (tons)
b = particle size multiplier constant (unitless)
C = control efficiency of surfactant used to mitigate fugitive dust emissions from roads (%)

Hourly Uncontrolled PM_{10} emissions (lbs/hr) = E_{uc} * (hourly VMT)
Annual Uncontrolled PM_{10} emissions (tons/yr) = E_{uc} * (Annual VMT) * (ton/2000 lbs)
Hourly Controlled PM_{10} emissions (lbs/hr) = E_c * (hourly VMT)
Annual Controlled PM_{10} emissions (tons/yr) = E_c * (Annual VMT) * (ton/2000 lbs)

Constants:

k_{PM10} =	1.5	[AP-42 13.2.2, Table 2]
$k_{PM2.5}$ =	0.15	[AP-42 13.2.2, Table 2]
s =	5.8 %	[average silt content for a haul road (to/from pit) at a taconite ore mining and processing facility (AP-42, 13.2.2)]
$a_{PM10,PM2.5}$ =	0.9	[AP-42 13.2.2, Table 2]
$b_{PM10,PM2.5}$ =	0.45	[AP-42 13.2.2, Table 2]
C_{OSR} =	74.8 **%**	[Onsite roads: emission control for low travel speeds and watering (44% + 55%); WRAP Fugitive Dust Handbook]
C_{HR} =	44.0 **%**	[Haul roads: emission control for low travel speeds; WRAP Fugitive Dust Handbook]

L_{hr} = Amount of material hauled per hour (tph)
L_{yr} = Amount of material hauled per year (tpy)
Annual VMT = Vehicle round-trips/year * D_{rt}
D_{rt} = On-Site Round-Trip Hauling Distance (miles)

TABLE B-10 (cont.)
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
FUGITIVE UNPAVED ROAD EMISSIONS - CRITERIA POLLUTANTS

Calculations for onsite roads:

Vehicle Type	Load Type	W (tons)	E_{uc} (lbs/VMT)	E_c (lbs/VMT)	L_{yr} (tons/year or gallons/year)[1]	L_{hr} (tons per hour or gallons/hour)[1]	Vehicle Capacity (tons/vehicle)	D_{rt}[2] (miles)	Annual VMT (VMT/yr)	Uncontrolled PM_{10} Emissions		Controlled PM_{10} Emissions		Controlled $PM_{2.5}$ Emissions	
										Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)
Haul Truck	Ore	28	2.1	0.53	146,000	17	25	0.26	1500	1.58	0.36	0.40	0.09	0.04	0.01
Front-End Loader	Ore	7	1.1	0.29	146,000	17	4	0.07	2469	1.41	0.32	0.36	0.08	0.04	0.01
	Development Rock	7	1.1	0.29	146,000	17	4	0.07	2469	1.41	0.32	0.36	0.08	0.04	0.01
Backhoe/Skid Loader	Topsoil	10	1.3	0.34	43,560	4.97	1.35	0.380	12265	8.22	1.88	2.07	0.47	0.21	0.05
Dump Truck	Ore	28	2.1	0.53	146,000	17	25	0.39	2296	2.43	0.55	0.61	0.14	0.06	0.01
	Development Rock	28	2.1	0.53	146,000	17	25	0.25	1433	1.51	0.35	0.38	0.09	0.04	0.01
Fork-Lift	Various	5	1.0	0.25	N/A	N/A	N/A	0.16	591	0.29	0.07	0.07	0.017	0.01	0.00
Passenger Vehicles	Various	3	0.78	0.20	N/A	N/A	N/A	0.38	1401	0.55	0.12	0.14	0.031	0.01	0.00
Water Truck	Dust Suppressant	19	1.8	0.45	N/A	N/A	8	1.59	582	0.52	0.12	0.13	0.030	0.01	0.00
Tanker Truck	Fuel	24	2.0	0.50	140,000	N/A	18	0.23	6.6	0.01	0.00	0.00	0.00	0.00	0.00
									TOTAL EMISSIONS FOR ALL ROAD TRAFFIC	**17.93**	**4.09**	**4.52**	**1.03**	**0.45**	**0.10**

N/A = not applicable

1 The Tanker Truck Vehicle Capacity is in units of gallons/vehicle

2 On-Site Round-Trip Hauling Distance is estimated for each vehicle type, based on the following routes:

Haul Truck	2*(Road A + Road E/2 + Road F)
Front-End Loader (Ore)	2*(Road H)
Front-End Loader (Development)	2*(Road H)
Backhoe/Skid Loader	2*(Road H + Road I + Road J + Road K)
Dump Truck (Ore)	2*(Road H + Road G + Road E/2 + Road F)
Dump Truck (Development)	2*(Road H + Road I + Road J)
Fork-Lift	2*(Road C)
Passenger Vehicles	2*(Road A + Road B + Road C)
Water Truck	2*(Road A + Road B + Road C + Road D + Road E + Road Ea + Road F + Road G + Road H + Road I + Road J+ Road K)
Tanker Truck	2*(Road A + Road D)

Calculations for offsite haul roads:

Vehicle Type	Load Type	W (tons)	E_{uc} (lbs/VMT)	E_c (lbs/VMT)	L_{yr} (tons/year or gallons/year)[1]	L_{hr} (tons per hour or gallons/hour)[1]	Vehicle Capacity (tons/vehicle)	D_{rt}[2] (miles)	Annual VMT (VMT/yr)	Uncontrolled PM_{10} Emissions		Controlled PM_{10} Emissions		Controlled $PM_{2.5}$ Emissions	
										Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)	Annual (tpy)	Hourly (lbs/hr)
Haul Truck	Ore	28	2.1	1.18	146,000	16.7	25	52.88	308826	326.28	74.49	182.72	41.72	18.27	4.17
Front-End Loader	Ore	7	1.1	0.64	146,000	17	4	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
	Development Rock	7	1.1	0.64	146,000	17	4	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
Backhoe/Skid Loader	Topsoil	10	1.3	0.75	140,000	15.98	18	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
Passenger Vehicles	Various	3	0.78	0.44	N/A	N/A	N/A	52.88	193016	75.24	17.18	42.14	9.62	4.21	0.96
Water Truck	Dust Suppressant	19	1.8	1.01	N/A	N/A	8	52.88	19302	17.34	3.96	9.71	2.22	0.97	0.222
Tanker Truck	Fuel	24	2.0	1.11	140,000	N/A	18	52.88	1481	1.47	0.34	0.82	0.19	0.08	0.0188
									TOTAL EMISSIONS FOR ALL ROAD TRAFFIC	**420.33**	**95.97**	**235.39**	**53.74**	**23.54**	**5.37**

N/A = not applicable

1 The Tanker Truck Vehicle Capacity is in units of gallons/vehicle

2 Haul Road Round-Trip Hauling Distance is estimated for each vehicle type, based on the following routes:

Haul Truck	2*(Haul Roads A-C + Haul Road C-F)
Front-End Loader (Ore)	Passenger Vehicles 2*(Haul Roads A-C + Haul Road C-F)
Front-End Loader (Development)	Water Truck 2*(Haul Roads A-C + Haul Road C-F)
Backhoe/Skid Loader	Tanker Truck 2*(Haul Roads A-C + Haul Road C-F)

TABLE B-11
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
FUGITIVE UNPAVED ROAD EMISSIONS - MODELING PARAMETERS

Emission Source: **FUGITIVE DUST EMISSIONS FROM VEHICLE TRAFFIC**
Pollutants: **PM_{10}, $PM_{2.5}$**

Modeling Parameter Estimate From: **ADEQ Air Dispersion Modeling Guidelines for Arizona Air Quality Permits**
Road Emission Source Modeling Technique

Explanation: To represent road emissions as volume sources, the following eight steps were followed:

1. Determine the adjusted width of the road. The adjusted width is the actual width of the road plus 6 meters. The additional width represents turbulence caused by the vehicle as it moves along the road. This width will represent a side of the base of the volume.
2. Determine the number of volume sources, N. Divide the length of the road by the adjusted width. The result is the maximum number of volume sources that could be used to represent the road.
3. Determine the volume height. The height will be equal to twice the height of the vehicle generating the emissions – rounded to the nearest meter.
4. Determine the initial horizontal sigma for each volume.

a. If the road is represented by a single volume, divide the adjusted width by 4.3.
b. If the road is represented by adjacent volumes, divide the adjusted width by 2.15.
c. If the road is represented by alternating volumes, divide by 2x the adjusted width (measured from the center point of the first volume to the center point of the next represented volume) by 2.15. Start with the volume nearest to the property line. This representation is often used for long roads.

5. Determine the initial vertical sigma. Divide the height of the volume determined in Step 3 by 2.15.
6. Determine the release point. Divide the height of the volume by two. This point is the center of the volume.
7. Determine the emission rate for each volume used to calculate the initial horizontal sigma in Step 4. Divide the total emission rate equally among the individual volumes used to represent the road, unless there is a known spatial variation in emissions.
8. Determine the UTM coordinate for the release point. The release point location is in the center of the base of the volume. This location must be at least one meter from the nearest receptor.

Road ID	Road Length (m)	Road Thickness (ft)	Road Thickness (m)	Road Adjusted Width (m)	Max Number of volume sources - N	Number of volume sources modeled[(a)]	Volume source spacing (m)	source height[(b)] (m)	sigma (y0)	sigma (z0)	Release Height (m)
Haul A-B	13565.8	32.00	9.75	15.75	861	437	31.0	9	14.7	4.25	4.572
Haul B-C	18788.1	32.00	9.75	15.75	1193	591	31.8	9	14.7	4.25	4.572
Haul C-F	10188.9	32.00	9.75	15.75	647	315	32.3	9	14.7	4.25	4.572
A	26.52	14.00	4.27	10.27	3	3	10	9	4.78	4.25	4.572
B	151.92	14.00	4.27	10.27	15	17	10	9	4.78	4.25	4.572
C	130.29	14.00	4.27	10.27	13	15	10	9	4.78	4.25	4.572
D	162.52	14.00	4.27	10.27	16	18	10	9	4.78	4.25	4.572
E	243.72	14.00	4.27	10.27	24	27	10	9	4.78	4.25	4.572
Ea	122.13	14.00	4.27	10.27	12	14	10	9	4.78	4.25	4.572
F	58.26	14.00	4.27	10.27	6	7	10	9	4.78	4.25	4.572
G	81.06	14.00	4.27	10.27	8	9	10	9	4.78	4.25	4.572
H	55.09	14.00	4.27	10.27	5	6	10	9	4.78	4.25	4.572
I	91.30	14.00	4.27	10.27	9	10	10	9	4.78	4.25	4.572
J	50.99	14.00	4.27	10.27	5	6	10	9	4.78	4.25	4.572
K	108.09	14.00	4.27	10.27	11	13	10	9	4.78	4.25	4.572

(a) The number of volume sources was determined following EPA guidance using the separated volume source representation method. Thus, the line source is approximated by representing two source lengths as a single volume source. The number of volume sources was adjusted in some cases according to site layout restrictions.
(b) Truck height assumed to be 15 ft.

TABLE B-12
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
FUGITIVE FUEL STORAGE TANK EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **Fugitive Emissions from Fuel Storage Tanks**
Pollutants: **VOCs**

Emission Estimate From: **EPA TANKS 4.0.9D Storage Tank Emissions Calculation Software (2005)**

Explanation: TANKS 4.0.9D is a Windows-based computer software program that estimates volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from fixed- and floating-roof storage tanks. Storage tank specifications as input into the EPA TANKS model.

Annual VOC Emissions:

Storage Tank	Contents	Tank Volume (gallons)	Tank Orientation	Tank Length (ft)	Tank Diameter (ft)	Tank Height (ft)	Equivalent Diameter (ft)	Average Liquid Height (ft)	Turnovers per Year per Tank	Annual VOC Emissions		
										(lbs/year)	(tons/year)	(lbs/hr)
AST #1	Diesel	15,000	H	28.0	11.00	11.00	11.0	5.5	10	5	2.64E-03	6.03E-04
Total										5	2.64E-03	6.03E-04

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	EZDiesel
City:	
State:	Arizona
Company:	Energy Fuels Resources (USA) Inc.
Type of Tank:	Horizontal Tank
Description:	15000 gal Diesel Tank

Tank Dimensions

Shell Length (ft):	28.00
Diameter (ft):	11.00
Volume (gallons):	15,000.00
Turnovers:	10.00
Net Throughput(gal/yr):	150,000.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Flagstaff, Arizona (Avg Atmospheric Pressure = 11.43 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

EZDiesel - Horizontal Tank

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Distillate fuel oil no. 2	All	47.94	40.49	55.38	45.76	0.0042	0.0032	0.0056	130.0000			188.00	Option 1: VP40 = .0031 VP50 = .0045

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

EZDiesel - Horizontal Tank

Annual Emission Calcaulations	
Standing Losses (lb):	3.3293
Vapor Space Volume (cu ft):	1,694.8592
Vapor Density (lb/cu ft):	0.0001
Vapor Space Expansion Factor:	0.0536
Vented Vapor Saturation Factor:	0.9988
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	1,694.8592
Tank Diameter (ft):	11.0000
Effective Diameter (ft):	19.8080
Vapor Space Outage (ft):	5.5000
Tank Shell Length (ft):	28.0000
Vapor Density	
Vapor Density (lb/cu ft):	0.0001
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0042
Daily Avg. Liquid Surface Temp. (deg. R):	507.6080
Daily Average Ambient Temp. (deg. F):	45.7375
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	505.4275
Tank Paint Solar Absorptance (Shell):	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	1,630.1861
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0536
Daily Vapor Temperature Range (deg. R):	29.7737
Daily Vapor Pressure Range (psia):	0.0024
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0042
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0032
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0056
Daily Avg. Liquid Surface Temp. (deg R):	507.6080
Daily Min. Liquid Surface Temp. (deg R):	500.1646
Daily Max. Liquid Surface Temp. (deg R):	515.0515
Daily Ambient Temp. Range (deg. R):	30.5750
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9988
Vapor Pressure at Daily Average Liquid: Surface Temperature (psia):	0.0042
Vapor Space Outage (ft):	5.5000
Working Losses (lb):	1.9553
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0042
Annual Net Throughput (gal/yr.):	150,000.0000
Annual Turnovers:	10.0000
Turnover Factor:	1.0000
Tank Diameter (ft):	11.0000
Working Loss Product Factor:	1.000
Total Losses (lb):	5.2846

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

EZDiesel - Horizontal Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	1.96	3.33	5.28

TABLE B-13
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
VENT SHAFT EMISSIONS - CRITERIA POLLUTANTS

Emission Source: **VENT SHAFT**
Pollutants: **PM_{10}, $PM_{2.5}$**

Emission Factor From: **MSHA**

Explanation:

Vent shafts will be used at the EZ Mine for mine aeration and air circulation. The vent shafts may have particulate emissions due to underground activities. The vent shafts have y-shaped vent shaft diffusers that split the shafts into two surface openings. Emissions from each opening are calculated separately. A total particulate emission value is calculated by multiplying the ventilation rate from each vent opening by an emission factor for particulate emissions. Watering in the mine will be implemented to reduce particulate emissions.

Emission Equations:

Hourly Emissions (lbs/hr) = VR * E * (%UC/100) * $(0.3048 m/ft)^3$ * (g/1000 mg) * (lb/453.56 g) * (60 min/hr)

Annual Emissions (tons/yr) = Hourly Emissions (lbs/hr) * OH * (ton/2000 lbs)

Where:
VR = ventilation rate (actual ft^3/min)
E = particulate emission factor (mg/m^3)
%UC = percentage of time in up cast mode (%)
OH = annual operating hours (hrs/yr)
C = control efficiency (%)

Data:
OH = 8760 hrs/yr
E = 1 mg/m^3 $PM_{10}/PM_{2.5}$
C = 62 % (assumed for material handling water application, based on Table 4-2 of the Western Regional Air Partnership (WRAP) Fugitive Dust Handbook)

Vent Shaft Emissions Estimate:

Mine	Vent Hole ID	VR	Fan Type	%UC[1]	Hourly Uncontrolled $PM_{10}/PM_{2.5}$ Emissions per Vent[2]	Annual Uncontrolled $PM_{10}/PM_{2.5}$ Emissions per Vent[2]	Hourly Controlled $PM_{10}/PM_{2.5}$ Emissions per Vent[2]	Annual Controlled $PM_{10}/PM_{2.5}$ Emissions per Vent[2]
	--	(ft^3/min)	--	(%)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)
EZ-1	EZ1V	250,000	Up Cast	100%	0.94	4.10	0.36	1.56
EZ-2	EZ2V	250,000	Up Cast	100%	0.94	4.10	0.36	1.56
WHAT	WHATV	250,000	Up Cast	100%	0.94	4.10	0.36	1.56
Total EZ Mine Vent Hole Emissions					*2.81*	*12.31*	*1.07*	*4.68*

1 Fans in the down cast mode predominantly pull air from ambient air into the vent shaft; no particulates will be released to ambient air during down cast operation.
2 It was assumed in this analysis that 100% of the PM_{10} is $PM_{2.5}$.

TABLE B-14
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
GENERATOR EMISSIONS - HAZARDOUS AIR POLLUTANTS

Explanation: The EZ Mine will receive its prime power from overhead electrical lines. One generator may be used as a backup in the event of power outage or generator maintenance. The emission estimates are based on one 500-kW backup generator using No. 2 fuel oil. The calculations are based on manufacturer specifications and AP-42 emission factors.

Emission Equations: **Hourly (lbs/hr) = PR * (1.341 hp/kW)*(2544 BTU/hr/hp)*(mmBTU/10^6 BTU)*E (lb/mmBTU)**
Annual (tons/yr) = Hourly Emissions (lbs/hr) * OH * (ton/2000 lbs)

Total Emissions = Emissions per Unit * Number of Units

Where:
PR = generator power rating (kW)
E = emission factor (lb/mmBTU)
OH = annual operating hours (hours/year)

Data:
PR (500 kW) = 500 kW
OH (500 kW) = 100 hours/year

Generator Emissions Estimate

Pollutant	Emission Factor	Units	Source	Hourly Emissions (lb/hr)	Annual Emissions (lb/yr)	Annual Emissions (ton/yr)	Chemical Abstract Services (CAS) Number
Naphthalene	8.48E-05	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.45E-04	1.45E-02	7.23E-06	91-20-3
Acetaldehyde	7.67E-04	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.31E-03	1.31E-01	6.54E-05	75-07-0
Acrolein	9.25E-05	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.58E-04	1.58E-02	7.89E-06	107-02-8
Benzene	9.33E-04	lb/mmBtu	AP-42 (10/96) Table 3.3-2	1.59E-03	1.59E-01	7.96E-05	71-43-2
1,3-Butadiene	3.91E-05	lb/mmBtu	AP-42 (10/96) Table 3.3-2	6.67E-05	6.67E-03	3.33E-06	106-99-0
Formaldehyde	1.18E-03	lb/mmBtu	AP-42 (10/96) Table 3.3-2	2.01E-03	2.01E-01	1.01E-04	50-00-0
Toluene	4.09E-04	lb/mmBtu	AP-42 (10/96) Table 3.3-2	6.98E-04	6.98E-02	3.49E-05	108-88-3
Xylenes	2.85E-04	lb/mmBtu	AP-42 (10/96) Table 3.3-2	4.86E-04	4.86E-02	2.43E-05	1330-20-7
Total HAPs	**3.79E-03**	**lb/mmBtu**	**AP-42 (10/96) Table 3.3-2**	**6.47E-03**	**6.47E-01**	**3.23E-04**	--

Note:
No Inorganic HAPs emission factors provided in AP-42, Section 3.3

TABLE B-15
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
ORE AND DEVELOPMENT ROCK EMISSIONS - HAZARDOUS AIR POLLUTANTS

Controlled Emissions

Development Rock Composition[1] / Ore Sampling Composition[2]	PM_{10}		Arsenic 46.0 ppm		Lead 13.0 ppm		Nickel 15 ppm		Selenium 3.0 ppm		Uranium 300 ppm / 6000 ppm		Total HAPs	
Emissions Source Description[3]	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**	**lb/ hour**	**lb/ year**
Vent Holes	1.07	9352.13	4.9E-05	4.3E-01	1.4E-05	1.2E-01	1.6E-05	1.4E-01	3.2E-06	2.8E-02	3.4E-03	2.9E+01	3.45E-03	3.02E+01
Front-End Loader Loading	0.25	2164.44	1.1E-05	1.0E-01	3.2E-06	2.8E-02	3.7E-06	3.2E-02	7.4E-07	6.5E-03	7.8E-04	6.8E+00	7.97E-04	6.98E+00
Backhoe Material Handling	0.11	985.33	5.2E-06	4.5E-02	1.5E-06	1.3E-02	1.7E-06	1.5E-02	3.4E-07	3.0E-03	3.4E-05	3.0E-01	4.24E-05	3.71E-01
Dump Truck Material Handling	0.25	2164.44	1.1E-05	1.0E-01	3.2E-06	2.8E-02	3.7E-06	3.2E-02	7.4E-07	6.5E-03	7.8E-04	6.8E+00	7.97E-04	6.98E+00
Ore Storage Piles	0.03	260.0	1.4E-06	1.2E-02	3.9E-07	3.4E-03	4.5E-07	3.9E-03	8.9E-08	7.8E-04	1.8E-04	1.6E+00	1.80E-04	1.58E+00
Development Rock Stockpiles	0.09	774.3	4.1E-06	3.6E-02	1.1E-06	1.0E-02	1.3E-06	1.2E-02	2.7E-07	2.3E-03	2.7E-05	2.3E-01	3.33E-05	2.92E-01
Top Soil Storage Piles	0.01	81.70	4.3E-07	3.8E-03	1.2E-07	1.1E-03	1.4E-07	1.2E-03	2.8E-08	2.5E-04	2.8E-06	2.5E-02	3.52E-06	3.08E-02
Total Rock HAP Emissions	**1.80**	**15,782**	**8.3E-05**	**0.73**	**2.3E-05**	**0.21**	**2.7E-05**	**0.24**	**5.4E-06**	**0.05**	**0.005**	**45.21**	**5.3E-03**	**46.42**

1 Chemical composition of HAPs in development rock is from 11 development rock samples from Arizona strip.
2 Uranium composition in ore is based on uranium ore sample data for the Arizona strip. It has been assumed that composition of other metals in ore is similar to the composition in development rock.
3 It was assumed for the purposes of these calculations that top soil storage piles have the same mineral composition as development rock. It was also assumed that HAP emissions for other operations are based on percentage of ore and development rock associated with these operations. For the vent holes, it was assumed 67% of the PM makeup was ore and 33% was development rock, which is the same as the expected percentages of rock mined.

TABLE B-16
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
DIESEL TANK EMISSIONS - TOXIC POLLUTANTS

Pollutant	Emission Factor	Units	Source	Hourly Emissions (lb/hr)	Annual Emissions (ton/yr)	Chemical Abstract Services (CAS) Number
Benzene	2.57	Percent of VOC Vapor	SPECIATE 3.2 Profile	1.55E-05	6.78E-05	71-43-2
Ethyl benzene	0.32	Percent of VOC Vapor	SPECIATE 3.2 Profile	1.93E-06	8.45E-06	100-41-4
Hexane	5.61	Percent of VOC Vapor	SPECIATE 3.2 Profile	3.38E-05	1.48E-04	110-54-3
Toluene	2.06	Percent of VOC Vapor	SPECIATE 3.2 Profile	1.24E-05	5.44E-05	108-88-3
Xylenes	0.13	Percent of VOC Vapor	SPECIATE 3.2 Profile	7.84E-07	3.43E-06	1330-20-7
Total Organic HAPs	**-**	**Percent of VOC Vapor**	**SPECIATE 3.2 Profile**	**6.44E-05**	**2.82E-04**	-

Note:
Emission estimates based on emission factors provided in the US EPA SPECIATE 3.2 database for "Composite of 9 Emission Profiles from Distillate Oil Storage Tanks - 1993" (Profile 2488).

TABLE B-17
ENERGY FUELS RESOURCES (USA) INC. - EZ MINES
GENERATOR EMISSIONS - GREENHOUSE GAS POLLUTANTS

Emission Source: **GENERATORS; 40 CFR Part 98, Table C-1**
Calculation Notes: Calculations are based on specifications from the generator manufacturer and the EPA GHG Reporting Rule.

Emission Equations: **Annual emissions (metric tons/yr) = 1 x 10^{-3} * Fuel * HHV * EF**
Total Emissions = Emissions per Unit * Number of Units

Where:
1 x 10^{-3} = Conversion from kg to metric tons
Fuel = Mass or volume of fuel combusted per year
HHV = Default high heat value of fuel
EF = Fuel emission factor

Data:	HHV (#2 Fuel Oil) =	0.138	mmBTU/gallon	
	CO_2 EF =	73.96	kg/mmBTU	
	CH_4 EF =	3.00E-03	kg/mmBTU	
	N_2O EF =	6.00E-04	kg/mmBTU	
Power Rating (PR):	PR (400) =	500	kW	
Fuel Usage (F):	F (400) =	112	gal/hr	
Operation hours (OH):	OH (400) =	120	hrs/yr	

Global Warming Potential (GWP)

CO_2 =	1
CH_4 =	21
N_2O =	310

Emissions Estimate:

Generator	Generator Rating (kW)	Pollutant	Emission Factor per Unit	Units	Emission Factor Source	Annual Emissions (kg/year)	Annual Emissions (metric tons/yr)	Annual Emissions (short tons/yr)
500	500	CO_2	73.96	kg/mmBTU	40 CFR Part 98, Table C-1	137,175	137	151
		CH_4	3.00E-03	kg/mmBTU	40 CFR Part 98, Table C-1	5.6	0.006	0.006
		N_2O	6.00E-04	kg/mmBTU	40 CFR Part 98, Table C-1	1.1	0.001	0.001
					CO_2e	**137,637**	**138**	**152**