TECHNICAL REVIEW AND EVALUATION

OF APPLICATION FOR

AIR QUALITY PERMIT NO. 52522

I. INTRODUCTION

This Class II air quality control permit is for the operation of an underground uranium mine located on the Coconino Plateau in Coconino County, Arizona approximately 6.5 miles southeast of Tusayan. The facility is owned and operated by Denison Mines (USA) Corp. The facility will have an anticipated maximum annual production of approximately 109,500 tons of uranium ore.

Coconino County is an attainment or unclassified area for the National Ambient Air Quality Standards (NAAQS).

Company Information

Company Name:	Denison Mines (USA) Corp.
Facility Name:	Canyon Mine
Facility Location:	35° 52' 58"/112° 05' 46", 6,500 ft
Mailing Address:	1050 17th Street, Suite 950 Denver, Colorado, 80265

Background

This source is an underground uranium mine, located approximately 6.5 miles southeast of Tusayan, Arizona. This is a previously developed facility that is being reactivated.

II. PROCESS DESCRIPTION

A. Underground Uranium Mining

The proposed mine production rate is 109,500 tons per year (tpy) of uranium ore. No ore processing will be conducted on-site. The ore will be shipped to an off-site processing mill. If the ore cannot be shipped immediately to the mill, it will be placed on-site in stock piles within the Ore Stockpile Area (OSA). The OSA will encompass approximately 0.7 acre and can accommodate up to 13,100 tons of stockpile ore. The company also proposes to install an existing 400 kilowatt (kW) standby diesel-powered generator for use as backup power.

Rock from the mining operations with less than 0.03 percent uranium will be stored on the surface in the Development Rock Area (DRA) and in mined-out areas of the underground workings. The DRA will encompass approximately 1.54 acres.

III. RADIATION BACKGROUND[1]

Denison Mines is a uranium mining operation and as such the potential radiation from the mine must be understood.

Radiation refers to energy emitted in the form of waves or particles. There are two main types of radiation which must be considered: Non-ionizing radiation and ionizing radiation.

Non-ionizing radiation occurs at the low frequency end of the electromagnetic spectrum. Examples of non-ionizing radiation include: microwaves, radio waves, radar, infrared and some ultraviolet radiation. This type of radiation in sufficient concentration can produce undesirable effects on humans through heating.

As the frequency increases through the ultraviolet region, the energy from the electromagnetic radiation becomes sufficient to release orbiting electrons from the surrounding matter. This form of radiation is ionizing radiation. Examples of ionizing radiation are x-rays, gamma rays, and cosmic rays. In addition to wave or frequency type radiation emissions, several particles are also included in this form of radiation. These particles are alpha particles and beta particles.

The form of radiation of concern at the Canyon Mine is ionizing radiation.

The negative health effects attributed to this type of radiation depend on many parameters including the amount of radiation received (dose), the rate at which the radiation is delivered (dose rate), and the type of ionizing radiation (alpha, beta, x-ray, gamma).

The ionizing radiation which will be present at the Canyon Mine site will include x-rays, gamma rays, alpha particles and beta particles. These types of radiation are emitted from the radioactive material found in and around the uranium ore body.

X-rays and gamma radiation have no mass or charge. They may be produced by x-ray machines, by ionization of atoms or molecules, or by the decay of radioactive atoms.

Beta particles have a very small mass and a negative charge. Basically, beta particles are electrons which have been released from inside an atom as that atom decays and seeks a more stable configuration.

Some radioactive materials may decay by releasing an alpha particle from its nucleus. The alpha particle has two positive charges and is identical to an ionized helium atom. Alpha particles are about 2,000 times larger and are ejected with about 10 times more kinetic energy than beta particles.

Now that the types of radiation have been identified it is helpful also to understand the natural radiation environment. The natural radiation environment consists of cosmic radiation and many radioactive elements including Hydrogen-3, Carbon-14, Potassium-40, Rubidium-87, Uranium-235, Uranium-238 and Thorium-232. Both Uranium-238 and Thorium-232 are ubiquitous in soil with average concentrations of a few parts per million. Each are parent elements of a radioactive decay series. The parents decay to daughters which are also radioactive. Natural uranium is about 99.3% U-238.

Radioactive materials are present in air, water and soil. Their concentrations are expressed in units of radioactivity per volume or mass. Typical concentrations of naturally occurring uranium and Radium-226 in normal soil are on the order of 1 pico-Curie per gram. A pico-Curie (pCi) is equivalent to 2.22

[1] Radiological Assessment of the Arizona 1 Project Prepared for EFNI by Dr. John W. McKlveen January 25, 1988

atoms of the radionuclide decaying each minute. These values may vary considerably depending on the extent of uranium mineralization in the area being examined.

When ionizing radiation deposits energy in living matter it produces a physical and biological effect which may be quantified in terms of dose. The dose to a particular receptor of radiation is expressed in radiological units, known as **rems** (roentgen equivalent man). However, because this unit is so large it is often useful to divide the value by 1,000 and call it **millirem** (mrem).

A progeny of U-238 is Radon-222. Radon is a colorless, odorless and inert gas which diffuses into the atmosphere from rocks, soil and building materials. All the radon progeny are particulates and many decay by emitting alpha particles. It is the alpha particle emitting progeny of Radon-222 that have been linked to negative effects on humans.

Airborne Radioactivity

Radon gas emanates from earthen materials containing uranium such as natural soil and the ore stockpiles. Once airborne, the gas will be transported by prevailing winds and will decay to its progeny. Uranium and its progeny will be present in dust from the mining operations.

The natural background radon gas concentration in the vicinity of the Canyon mine is on the order of 0.2 picocuries per liter (pCi/l) or 125 mrem/yr. Based upon previous evaluations of the Arizona I Mine project (McKleveen, 1988) the highest potential exposure projected from radon would be on the order of 106 mrem/year. The mine shaft vent emissions are subject to limitations set forth of 40 Code of Federal Regulations (CFR) part 61 subpart B at 10 mrem/year. Radiation exposure from dust associated with the mining operation is dependent on the concentrations of dust in the air and the activity of the compounds in the dust. Since these values are variable, it is not feasible to estimate the radiation impact from the dust.

Direct radiation from haul trucks will be about 2 mrem/hr at the truck bed, about 0.3 mrem/hr on the shoulder of the roadbed, and normal background at about 96 feet from the trailer. As a truck passes, individuals standing on the shoulder of the road would receive a dose of radiation too small to quantify.

These radiation concentrations can be put in perspective by comparing them to what naturally occurs in various locations. For example, naturally occurring radiation levels for a person living in the Colorado Plateau will receive 400-500 mrem/year based on EPA estimates. Thus, the estimated radiation exposure at the Canyon Mine site does not present a significant risk to human health.

IV. EMISSIONS

A. Emissions of criteria pollutants are produced from the standby generator. This engine is limited to 120 hours of operation per year until May 3, 2013. Beginning on this date the engine is limited to 50 hours per year, except for maintenance and testing purposes which is limited to 100 hours per year. At 120 hours of operation, the engine has the potential to emit 0.21 tpy of carbon monoxide (CO) and 1.0 tpy of nitrogen oxides (NO_X).

B. The facility has a potential to emit 0.082 tpy of volatile organic compounds (VOCs) from the diesel tanks.

C. The $PM_{10/2.5}$ emissions listed in Table 1 below account only for generator, vent shaft and ore/development rock unloading. Fugitive emissions are not included in calculations for determining major source status since this facility is not a listed category source as defined under A.A.C. R18-2-101.64.c. The fugitive emissions were, however, included in the air dispersion modeling analysis.

Table 1: Facility Emissions

Pollutant	Facility Potential to Emit (tons/year)
PM_{10}	3.31
$PM_{2.5}$	3.31
NO_X	1.0
CO	0.21
SO_2	0.066
VOC	0.082
HAPs	0.0075
Radionuclides	0.007

*PM_{10} is assumed to be all $PM_{2.5}$

V. APPLICABLE REGULATIONS

The applicable regulations were identified by the company as part of the application packet. If necessary, the source is required to list any additional regulations that may be applicable. Table 2 displays the applicable requirements for each piece of equipment under this proposed permit.

Table 2: Verification of Applicable Regulations

Unit	Control Device	Rule	Verification
Mine Vents	N/A	A.A.C. R18-2, Article 11 40 CFR 61 Subpart B	NESHAPs requirements for radon monitoring apply to the mine vents.
Internal Combustion Engine	None	A.A.C. R18-2-719 40 CFR 63 Subpart ZZZZ	This standard applies to all stationary rotating machinery This standard applies since the engine is an existing emergency CI engine located at an area source of HAPS
Fugitive dust sources	Water and other reasonable precautions.	A.A.C. R18-2, Article 6	These standards are applicable to all fugitive dust sources.
Mobile sources	Water Sprays/Water Truck for dust control	A.A.C. R18-2, Article 8	Opacity requirements for smoke and dust for mobile sources (construction equipment, etc.).

VI. LEARNING SITES POLICY

In accordance with ADEQ's Environmental Permits and Approvals near Learning Sites Policy, the Department conducted an evaluation to determine if any nearby learning sites would be adversely impacted by the facility. Learning sites consist of all existing public schools, charter schools and private schools at the K-12 level, and all planned sites for schools approved by the Arizona School Facilities Board. The learning sites policy was established to ensure that the protection of children at learning sites is considered before a permit approval is issued by ADEQ.

The Department did not identify any learning sites within two miles of the facility.

VII. MONITORING AND RECORDKEEPING REQUIREMENTS

A. Opacity Requirements

The permit specifies opacity limitations for the various emission sources found within the facility, including mine vents, and fugitive dust sources. The permit requires the source to perform bi-weekly (once every two weeks) observations (quarterly for the emergency generator) of the various point sources and non-point sources, and if emissions appears to exceed the opacity standard, a Method 9 observation is to be conducted.

The Permittee is to keep records of the date, time, and results of all visible surveys made, as well as the name of the observer who conducted the survey.

B. Particulate Matter Requirements

The permit specifies particulate matter limits for the fuel-burning equipment, mine vent emissions, and work practice standards for fugitive dust sources. The Permittee is required to keep records of all activities that may produce fugitive dust emissions of particulate matter. In addition, the Permittee must use water or equivalent control to minimize fugitive dust emissions from storage piles and development rock areas.

C. Radiation Survey Plan

The Permittee is required to submit a radiation survey plan within 90 of permit issuance. This plan requires the facility to survey the area around the mine and measure radiation levels. The frequency of these surveys is annually at minimum. If elevated levels of radiation are detected, the facility must take the appropriate action as specified in the plan.

D. Radon NESHAPs Requirements

The permit specifies Radon (Rn-222) testing requirements. The permit specifies that Rn-222 concentration and flow rate measurements will be used to calculate the effective dose equivalent resulting from mine emissions. The permit specifies that compliance modeling will be reported each year to EPA and the Department by March 31st of the following year.

E. Internal Combustion Engines

The Permittee is required to keep records of the fuel supplier certification to demonstrate compliance with the sulfur limit.

This generator is subject to 40 CFR 60 Subpart ZZZZ which requires the facility to maintain the generator by conducting routine maintenance including scheduled oil changes.

VIII. Insignificant Activities

Table 3, below, lists the insignificant activities at the Denison Mines (USA) Corp. Canyon Mine.

Table 3: Insignificant Activities

Equipment Description	Number of Equipment Items	Maximum Size or Capacity	Verification of Insignificance
Diesel Storage Tanks	1	6,000 gallons	Size limitation for Diesel Fuel Storage Tanks (A.A.C. R18-2-101.57.c)

IX. Ambient Air Impact Analysis

A. Introduction

Denison Mines (USA) Corp. conducted an Ambient Air Impact Analysis to demonstrate protection of the National Ambient Air Quality Standards (NAAQS) and visibility criteria. Modeling was completed using AERMOD for dispersion modeling of PM_{10} and CALPUFF refined for the visibility analysis. Vent shaft emissions, road dust emissions from haul trucks traveling on unpaved roads, and neighboring source emissions were addressed in the modeling analysis.

B. Haul Truck Dust Emissions

Particulate matter emissions from vehicle traffic within the mine site and along the access road as well as fugitive emissions from haul trucks traveling from forest road 305A and forest road 305 to highway 64 were included in the modeling analysis. Fugitive emissions from off-site roads were modeled using the protocols developed by the Texas Commission on Environmental Quality, with ADEQ modifications. Haul road emissions will be controlled by limiting vehicle speeds to 25 miles per hour (mph).

C. Neighboring Source Emissions

A cumulative source analysis was evaluated as part of the permit application. The objective of the cumulative analysis was to determine if any nearby sources should be included in the modeling analysis. Based upon review of available data, no nearby sources were identified.

D. Regional Haze Analysis

To conduct a visibility analysis for the mine including impacts from haul road dust emissions a refined CALPUFF model was run. The visibility modeling was completed to evaluate potential visibility impacts at the Grand Canyon National Park resulting from the Canyon Mine operations. The closest part of the Grand Canyon Nation Park to the Canyon Mine is 7.5 miles away. Model receptors at the Grand Canyon have been developed by the National Park Service for use in CALPUFF analysis.

CALPUFF is an advanced, integrated Gaussian puff modeling system for the simulation of atmospheric pollution dispersion. CALPUFF is designed to use comprehensive 3-dimensional windfield meteorological data to address complicated airflow patterns in the atmosphere. Calpuff was run in the refined model using the regulatory default options and CALMET wind field meteorological input data. The CALMET windfield data were developed by the Western Regional Air Partnership (WRAP).

E. NAAQS Dispersion Modeling Results

Dispersion modeling for the NAAQS was done using SCREEN3 for gaseous pollutants (CO, NO_2, and SO_2) and AERMOD dispersion modeling for PM_{10}. The results demonstrate that the Canyon Mine project is not expected to exceed the Ambient Standards in Article 2 of the Arizona Administrative Code. Table 4 on the following page presents the results of the modeling analysis, in addition to applicable background concentrations for comparison to the NAAQS.

TABLE 4:
DENISON MINES (USA) CORP. – CANYON MINE
NAAQS DISPERSION MODELING RESULTS

Pollutant	Averaging Period	Year	Highest Modeled Cumulative Concentration[a] ($\mu g/m^3$)[b]	Background Concentration ($\mu g/m^3$)[b]	Total Cumulative Concentration ($\mu g/m^3$)[b]	NAAQS[c] ($\mu g/m^3$)[b]
[1]SO_2	3-Hour	N/A	17.3	73	90.3	1300
	24-Hour	N/A	7.7	16	23.7	365
	Annual	N/A	1.5	3	4.5	80
[1]NO_2	Annual	N/A	23.2	4	27.2	100
[1]CO	1-Hour	N/A	62.5	582	644.5	40,000
	8-Hour	N/A	43.8	582	625.8	10,000
[2]PM_{10}	24-Hour	2003	78.1	46	124.1	150
	Annual	2001	16.1	19	35.1	50

[a]High-first-high modeled concentrations are presented for both short-term and annual averaging periods, per ADEQ request (ADEQ 2007).
[b]Micrograms per cubic meter
[1]Modeled Using SCREEN3
[2]Modeled Using AERMOD

F. CALPUFF Modeling Results

Output from the CALPUFF was compared to the 5 percent change in light extinction (Δb_{ext}) screening level. A change in Δb_{ext} from new sources that is less than 5 percent is generally considered acceptable.

Modeling results indicate that the predicted visibility impairment is below the 5 percent screening criteria for all days in the 3-year meteorological period modeled. The maximum predicted change in visibility impairment over the 3-year period was 0.63 percent.

TABLE 5:
GRAND CANYON CUMULATIVE VISIBILITY IMPACT MODELING RESULTS

Visibility Impacts (% degradation)					
Visibility Parameter	Averaging Period	Denison Mines Canyon Mine and Haul Road Traffic			Screening Threshold
Modeled Year:		2001	2002	2003	
Grand Canyon National Park					
Max ΔB_{ext} (%)	24-Hour	0.54	0.63	0.38	5%
# days > 5%	N/A	0	0	0	N/A
# days > 10%	N/A	0	0	0	N/A

The FLMs have identified a new approach to calculating modeled visibility impairment in their revised FLAG document (USFS, NPS, and USFWS 2008). This new approach uses a modified visibility algorithm, uses monthly relative humidity values rather than hourly values, and takes the 98th percentile value to screen out seven days of haze-type visibility impairment per year (USFS, NPS, and USFWS 2008). This new approach was also applied to the Canyon Mine for comparison purposes with the old Method 2 approach. The results of the new visibility impairment calculation approach are presented in Table 6. The highest value using the new

FLAG approach is 0.45 percent. This high value visibility impairment value occurred along the northern Grand Canyon NP boundary, approximately 7.5 miles from the mine site.

TABLE 6:
GRAND CANYON CUMULATIVE VISIBILITY IMPACT MODELING RESULTS
NEW FLAG APPROACH

Visibility Impacts 98th Percentile Values (% degradation)					
Visibility Parameter	**Averaging Period**	**Denison Mines Canyon Mine and Haul Road Traffic**			**Screening Threshold**
Modeled Year:		**2001**	**2002**	**2003**	
Grand Canyon National Park					
Max ΔB_{ext} (%)	24-Hour	0.45	0.42	0.32	5%
# days > 5%	N/A	0	0	0	N/A
# days > 10%	N/A	0	0	0	N/A

These model results indicate that operation of the Canyon Mine will not adversely impact visibility in the Grand Canyon National Park.

X. LIST OF ABBREVIATIONS

A.A.C. .... Arizona Administrative Code
CFR. .... Code of Federal Regulations
CI.......... Compression Ignition
CO. .... Carbon Monoxide
DRSP.......... Development Rock Storage Pad
DRA. .... Development Rock Area
EPA. .... Environmental Protection Agency
HAPs .... Hazardous Air Pollutants
Lb/hr.......... Pound per Hour
m.......... meters
mph.......... Miles per Hour
mrem. .... Millirem
NAAQS. .... National Ambient Air Quality Standards
NESHAP. .... National Emission Standards for Hazardous Air Pollutants
NPS. .... National Park Service
OSA.......... Ore Stockpile Area
pCi.......... pico-Curie
PM_{10}. .... Particulate Matter with an Aerodynamic Diameter less than 10 Microns
NO_x .... Nitrogen Oxide
SO_2. .... Sulfur Dioxide
TPY .... Tons per Year
$\mu g/m^3$.......... Microgram per Cubic Meter
USFS. .... United States Forest Service
VOC .... Volatile Organic Compound
WRAP .... Western Regional Air Partnership