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SITE CHARACTERIZATION ACTIVITIES

PRELIMINARY ATMOSPHERIC ASSESSMENT OF A NUCLEAR WASTE REPOSITORY

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UNITED STATES DEPARTMENT OF ENERGY
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PRELIMINARY ATMOSPHERIC ASSESSMENT OF A NUCLEAR WASTE REPOSITORY

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Abbreviations, Symbols, and Units

Abbreviations and Symbols

CAAA	Clean Air Act Amendments
CO	Carbon Monoxide
DOE	Department of Energy
E_B	Emission rate for concrete batching
E_{BTOT}	Total emissions for concrete batching
E_C	Emission rate for construction of surface facilities
E_{CTOT}	Total emissions for construction of surface facilities
E_{M1}	Emission rate for drilling and blasting waste rock (underground)
E_{M1TOT}	Total emissions for drilling and blasting waste rock (underground)
E_{M2}	Emission rate for loading waste rock (underground)
E_{M2TOT}	Total emissions for loading waste rock (underground)
E_{M3}	Emission rate for dumping waste rock (underground)
E_{M3TOT}	Total emissions for dumping waste rock (underground)
E_G	Emission rate for sand and gravel processing
E_{GTOT}	Total emissions for sand and gravel processing
E_S	Emission rate for drilling and blasting shaft construction
E_{STOT}	Total emissions for drilling and blasting shaft construction
E_W	Emission rate for wind erosion
E_{WTOT}	Total emissions for wind erosion
E_{WR1}	Emission rate for loading waste rock (surface)
E_{WR1TOT}	Total emissions for loading waste rock (surface)
E_{WR2}	Emission rate for hauling waste rock (surface)
E_{WR2TOT}	Total emissions for hauling waste rock (surface)

E_{WR3}	Emission rate for dumping waste rock (surface)
E_{WR3TOT}	Total emissions for dumping waste rock (surface)
EPA	United States Environmental Protection Agency
F_B	Emission factor for concrete batching
F_C	Emission factor for construction of surface facilities
F_D	Emissions factor for dumping waste rock
F_G	Emission factor for sand and gravel processing
F_L	Emission factor for loading waste rock
F_T	Emission ractor for vehicles on dirt roads
F_W	Emission factor for wind erosion
GEIS	Generic environmental impact statement
HC	Hydrocarbon
H_v	Fraction of suspended particles from dirt roads
MSL	Mean sea level
N	Number of days with precipitation 0.01 inches or greater
NAAQS	National ambient air quality standard
NDEP	Nevada Division of Environmental Protection
NNWSI	Nevada Nuclear Waste Storage Investigations
NO_x	Oxides of nitrogen
NTS	Nevada Test Site
PSD	Prevention of significant deterioration
s	Soil silt factor in per cent
S	Vehicle speed in mph
SO_2	Sulfur dioxide
TEF	Test and evaluation facility
T_s	Tire size factor for vehicles on dirt roads
TSP	Total suspended particulate matter
W	Climatic factor for precipitation

Units

g/s	grams per second
ha	hectare ($10^4 m^2$)
kg	kilogram
km	kilometer ($10^3 m$)
m	meter
μm	micrometer ($10^{-6} m$)
mph	miles per hour
tonnes	metric ton (10^3 kg)

NEVADA NUCLEAR WASTE STORAGE INVESTIGATION (NNWSI) SITE CHARACTERIZATION ACTIVITIES: ATMOSPHERIC ASPECTS FOR ENVIRONMENTAL ASSESSMENT OF NUCLEAR WASTE REPOSITORY

I. INTRODUCTION

The southwestern part of the Nevada Test Site (NTS) has been designated as a prospective location for a high level nuclear waste repository. Before this site can be selected for a repository, an assessment of environmental effects must be made. This report covers atmospheric aspects of the project called Nevada Nuclear Waste Storage Investigation (NNWSI).

Present plans call for two steps: an exploratory shaft to determine geologic suitability and the potential repository. Effects of the exploratory shaft have been discussed in a draft letter report to Sandia National Laboratory dated August 18, 1982 (Bowen and Egami, 1982).

This assessment covers a construction phase of seven years and an operation phase of twenty years for the repository. Since the repository would consist of a series of mined chambers accessed by shafts and tunnels, the construction activities would be similar to deep mine construction. Operations would be mainly movement of nuclear wastes to the location and their placement in the repository. The repository would ultimately be decommissioned by backfilling and sealing the access shafts with mined materials.

II. NUCLEAR WASTE REPOSITORY

The prospective site for the high level nuclear waste repository is Yucca Mountain at the southwestern edge of NTS. Yucca Mountain consists of a north-south ridge of approximately 10km in length. It has a steep slope to the west and a more gradual slope with numerous canyons to the east. The ridge height is near 1500m above mean sea level (MSL) or about 500m above Jackass Flats to the east.

The repository would consist of mined chambers some two thousand feet underground accessed by shafts and tunnels. The host rock for the repository is tuff which is composed of fused volcanic ash.

Repository designs at NTS have not been completed. For purposes of this report, estimates of design characteristics can be obtained from the generic environmental impact statement (DOE, 1980) covering the management of commercially generated radioactive waste. This document, hereafter referred to as the GEIS, contains information on repositories in salt, shale, basalt, and granite. A repository in tuff at NTS would be most similar to one in granite. The GEIS considers both spent fuel and reprocessing waste repositories. Spent fuel wastes are those wastes from light water reactors that have been contaminated with fission products such that the fission process is no longer efficient. Reprocessing wastes result from the extraction of useable uranium and plutonium from the spent fuel wastes. Only the repository for spent fuel wastes will be considered here. This one would have the greater impact from both resource commitment and environmental points of view.

The standard repository consists of surface facilities for waste receiving and handling and for mining and operations support and of subsurface facilities for waste handling emplacement. Table 1 shows the areal extent of a repository in tuff as estimated from one in granite. It is referred to as an 800 hectare repository which would be the approximate underground areal extent.

The construction of the repository would include construction of surface support facilities and excavation of subsurface areas. Subsurface mining would be by conventional room-and-pillar methods with mined rock brought to the surface for storage. Some of the stored rock would eventually be used as backfill upon decommissioning the repository. Table 2 describes the amounts of rock moved and stored.

Environmental effects can be estimated from resource commitments necessary for construction and operation of a repository. The GEIS has these commitments summed for a total construction period of seven years and a total operation period of twenty years. Those commitments of particular interest to atmospheric emissions are given in Table 3. These are the total commitments and do not reflect peak years. A better understanding of the schedule for construction and operation is necessary to determine peak commitments and thus peak emissions. Those categories under operation without entries either have low requirements or are not given in the GEIS. The GEIS does assume that a coal-fired power plant would be built near the repository to supply the electricity. This would not occur at NTS, and the electricity would have to be obtained from commercial sources. Emissions caused by this generation of electricity are not considered here.

TABLE 1. LAND USE FOR REPOSITORY IN TUFF

Land Use	Area ha
Surface Total	280
Support Facilities	115
Waste Rock Storage	165
Subsurface Total	800
Storage Area	730
Support	70

TABLE 2. MINING AND ROCK HANDLING REQUIREMENTS

Operation	Amount of Rock (tonnes x 10^6)
Mined Quantity	77
Room Backfill	29
Total Backfill	38
Permanent Onsite Surface Storage	39

TABLE 3. RESOURCE COMMITMENTS FOR CONSTRUCTION AND OPERATION OF SPENT FUEL REPOSITORY IN TUFF

Resource	Construction 7 Year Total	Operation 20 Year Total
Concrete, m^3	3.0×10^5	-
Propane, m^3	6.4×10^3	2.7×10^4 (1)
Diesel Fuel, m^3	6.4×10^4	3.2×10^5
Gasoline, m^3	4.7×10^4	3.1×10^4 (2)
Electricity,		
Peak kW	1.1×10^4	
Total Consumption kWh	4.3×10^7	3.2×10^9
Manpower, man-year	3.0×10^4	2.0×10^4

(1) Estimate based on commitment for construction assuming same use per year.

(2) Estimate based on commitment for construction assuming same use per man-year.

III. EMISSIONS INVENTORY

Emissions of atmospheric pollutants will occur during the construction and operation of the proposed nuclear waste repository. In lieu of better information these emission estimates will have to be determined from design information in the GEIS such as quantities of rock moved and various resource commitments.

A. EMISSIONS FROM CONSTRUCTION ACTIVITIES

Repository construction would require approximately seven years and would be similar to that of mine construction without any ore processing. Emissions would occur during surface site preparation and movement of subsurface mined rock to storage piles. The storage piles would also have some emissions caused by wind erosion. Commuter traffic to and from the site would emit air pollutants. Emissions would consist mainly of suspended soil particles from dirt handling activities and gases and particles from gasoline and diesel internal combustion engines. Airborne particles are referred to as total suspended particulate (TSP) matter which is the amount of particulate matter in the air that would be collected by the high volume (hivol) method. This method collects all particles with diameters less than approximately 30 μm. The emission factors used here have been determined for this size range. The present standard for TSP is under investigation by the U.S. Environmental Protection Agency (EPA), and a new standard which is dependent on particle size is being developed. Present indications are that the standard will be for inhalable particles of diameters less than 10 μm and for fine particles of diameters less than 2.5 μm. In most cases suspended soil particles will comprise a lesser part of the smaller size fractions than of the TSP samples. Future emission factors will have to reflect the new size categories.

In this report the movement of mined rock in Table 2 and the resources used in Table 3 will be considered to be evenly spaced over the seven year construction period. This probably underestimates the maximum emissions for a particular time. The calculated emissions could be adjusted to reflect an actual schedule. There would also be surface preparation and construction of surface support facilities. These activities would probably be completed during the early part of the project. It is assumed that these would require one year for considerations of fugitive dust. For purposes of computing emission rates, all construction activities are taken to occur in two 8-hour shifts, 5 days a week which gives a total of work or emission times of 1.50×10^7 sec/year.

A summary of estimated emissions and average emission rates of airborne particles from construction activities is given in Table 4. Each source is discussed separately.

1. Surface Facilities Construction

Emissions from construction activities in cities of the Southwest have been measured by Cowherd et al., (1974). These were typical of moderate activities in an arid location with some watering for control. The emission factor for suspended particulate matter is

$$F_C = 2.7 \text{ tonnes/ha/month} \quad (1.2 \text{ tons/acre/month}).$$

The surface facilities of the repository would cover an area of 115ha. If construction required one year, the total emisisons would be

$$E_{CTOT} = 3726 \text{ tonnes}.$$

TABLE 4

FUGITIVE DUST EMISSIONS DURING 7-YEAR CONSTRUCTION PERIOD[1]

Source	Total tonnes	Rate g/s
Surface Facilities	3726	250[2]
Mine Construction		
Shaft		
Drilling/Blasting	58	0.55
Subsurface (with controls)		
Drilling/blasting	4.4	0.04
Rock moving subsurface		
Loading	13	0.12
Dump	0.68	0.006
Surface Rock Transport to Storage		
Loading	1500	14.3
Hauling	2700	25.7
Dumping	77	0.73
Wind Erosion	1100	4.5
Concrete		
Batching	36	0.34
Sand and Gravel Processing	30	0.29

(1) Without controls except where noted.
(2) Emission rate for 1 year of construction.

This is probably an overestimate, since the entire area would not be disturbed at all times during the year. The emission rate of suspended soil particles from surface support facility construction would be

$$E_C = 250 \text{ g/s.}$$

2. Mine Construction

Mining construction would involve digging of shafts from the surface to the level of the repository, removing waste rock at repository depth to the surface, and moving waste rock to storage piles. These operations would result in airborne soil particles.

a. Shaft Construction

Shaft construction would probably be accomplished by conventional drill/blast and muck removal techniques, all of which would have some particulate emissions. The amount of the emissions would be dependent on the number and size of the shafts. Table 2 shows the amounts of total backfilled material and room backfilled material, the difference of which would be the material in the shafts (9×10^6 tonnes). The letter report on the Exploratory Shaft estimated the emissions for a mined shaft in which 3.6×10^4 tonnes of rock was removed. For drilling and blasting, the emissions were 230kg. Transport of waste rock from the shafts will be included in figures for waste rock from the entire repository below. Total emissions of suspended soil particles from drilling and blasting repository shafts based on scaling from the exploratory shaft emissions are

$$E_{STOT} = 5.8 \times 10^4 \text{kg.}$$

The emission rates when spread over 7 years would be

$$E_S = 0.55 \text{ g/s}$$

for drilling and blasting.

b. Removing Subsurface Waste Rock

In mining the subsurface rooms where the nuclear waste would be placed, there would be suspended soil particles underground. The conceptual design of the repository in the GEIS refers to a subsurface ventilation system which circulates the air and removes particles generated by subsurface activities. The air would probably be filtered through highly efficient filters although all the particles would not be removed and some would be emitted to the atmosphere. The removal efficiency of a highly efficient baghouse is greater than 99% (Seinfeld, 1975).

There would be dust generated from drilling and blasting and from moving waste rock. There would be a total of 6.8×10^6 tonnes of waste rock removed from underground. If drilling and blasting of the shafts is scaled up for subsurface rooms, the total suspended soil particle mass would be

$$E_{M1TOT} = 4.4 \times 10^5 \text{kg}$$

before controls and with 99% removal would be

$$E_{M1TOT} = 4.4 \times 10^3 \text{kg}$$

the emission rate to the atmosphere over 7 years would be

$$E_{M1} = 0.042 \text{ g/s.}$$

Airborne dust would also be generated from loading, moving, and dumping waste rock underground. Emission factors for loading and dumping mined material have been determined by PEDCo (1978) as

$$F_L = 0.019 \text{kg/tonnes}$$

for loading and dumping

$$F_D = 0.001 \text{ kg/tonnes.}$$

The waste rock would also have to be transported some distance underground. While it is not known how this would be done, it is anticipated that there would be controls on dust suspension such that the transport would have low emissions. These will not be considered here.

The subsurface emissions of suspended soil particles from loading and dumping waste rock before controls with 99% removal

$$E_{M2TOT} = 1.3 \times 10^6 \text{kg}$$

for loading and

$$E_{M3TOT} = 6.8 \times 10^4 \text{ kg}$$

for dumping. The total emissions to the atmosphere would be

$$E_{M2TOT} = 1.3 \times 10^4 \text{kg}$$

for loading and

$$E_{M3TOT} = 6.8 \times 10^2 kg$$

which have emission rates over 7 years of

$$E_{M2} = 0.12 \text{ g/s}$$

for loading and

$$E_{M3} = 0.006 \text{ g/s}$$

for dumping.

c. Moving Waste Rock to Storage

The total amount of mined material would have to be loaded on to trucks, moved to storage areas, and dumped. Loading and dumping would have the same emission factors as above. Emissions from transportation can be determined from an emission factor given by EPA (1981):

$$F_T = 0.23\ H_v\ T_s\ s\ (\frac{S}{30})^2 W$$

where F_T is in kg/km,

H_v = 0.6, the fraction of particles with diameter less than 30 μm,

T_s = 2.5, the tire size factor for large trucks,

s = 10%, the silt content for 200 mesh sieve,

S = 15 mph, the vehicle speed

W = climatic factor = $\frac{365 - N}{365}$

N = Number of days/year with precipitation of 0.01 in. or more. For Yucca Flat (NOAA, 1972) N is 30 which would be similar to that for Yucca Mountain. Then W = 0.92 and the emission factor for trucks hauling waste rock is

F_T = 0.79 kg/km.

The total amount of waste rock moved would be 77 x 10^6 tonnes. This would require 8.5 x 10^5 trips with 91 tonnes (100 ton) trucks. The average length of each trip would be about 4 km for a total truck distance of 3.4 x 10^6 km in 7 years.

The total emissions of suspended soil particles would be

$$E_{WR1TOT} = 1.5 \times 10^6 \text{ kg}$$

for loading,

$$E_{WR2TOT} = 2.7 \times 10^6 \text{ kg}$$

for hauling, and

$$E_{WR3TOT} = 7.7 \times 10^4 \text{ kg}$$

for dumping. The emission rates for waste rock movement over 7 years would be

$$E_{WR1} = 14.3 \text{ g/s}$$

for loading,

$$E_{WR2} = 25.7 \text{ g/s}$$

for hauling, and

$$E_{WR3} = 0.73 \text{ g/s}$$

for dumping.

3. Wind Erosion

Wind blowing over disturbed land and storage piles causes resuspension of soil particles. The emission factor for wind erosion has been determined by PEDCo (1976) to be

$$F_W = 0.56 \text{ tonnes/ha/year} \quad (0.25 \text{ ton/acre/year}).$$

The surface facilities and storage piles would have an area of 280 ha so that emissions of soil particles during the 7-year construction period would be

$$E_{WTOT} = 1100 \text{ tonnes}.$$

An average emission rate for wind erosion can be determined for the entire 7 year period as

$$E_W = 4.5 \text{ g/s}.$$

It might be expected that emissions caused by wind erosion would not be constant but would depend on wind speed and precipitation. Higher wind speeds should resuspend more soil than lower ones; higher precipitation events should suppress soil resuspension. Effects of precipitation can be included by using the climatic factor introduced above. Effects of wind speed, however, are not clear cut. Studies by PEDCo (1975) failed to show a wind speed dependence for resuspension from aggregate storage piles, probably because sampling was done over 24-hour periods. Actual instantaneous emission rates during high wind conditions should be higher than the average given above. The actual rate cannot determined at present from available literature.

4. Concrete Batching

A major source of suspended particulate matter would be concrete batching. Table 3 contains the amount of concrete that would be used in 7 years. Batching could be done at the repository. The emission factor for concrete batching from EPA (1981) is

$$F_C = 0.12kg/m^3.$$

There would also be sand and gravel processing which would probably not be at the repository. For emission purposes this will be included here. The emission factor for sand and gravel processing from EPA (1981) is

$$F_G = 0.05kg/tonnes.$$

An average batch of concrete with a volume of $1m^3$ weights 2.4 tonnes of which 0.4 tonnes is cement and 2 tonnes is sand and gravel. The total emissions of soil particles would be

$$E_{BTOT} = 36 \text{ tonnes}$$

for concrete batching and

$$E_{GTOT} = 30 \text{ tonnes}$$

for sand and gravel processing.

Emission rates over the 7-year period would be

$$E_C = 0.34 \text{ g/s}$$

for concrete batching and

$$E_G = 0.29 \text{ g/s}$$

for sand and gravel processing.

5. Emissions From Internal Combustion Engines

There would be gaseous and particulate emissions from the burning of fossil fuels in internal combustion engines. Table 3 contains the amounts of propane, diesel fuel, and gasoline that would be used during the seven year construction period.

Emission factors that have been determined by URS (1977) from EPA (1975) for various gases from fuel usage are listed in Table 5. The gases of interest are carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), and sulfur dioxide (SO_2). Particulate emissions are also listed.

TABLE 5. EMISSION FACTORS FOR FUEL USE

Pollutant	Propane kg/m^3	Diesel Fuel kg/m^3	Gasoline $kg/^3$
CO	0.23	11.4	475.0
HC	0.084	4.16	16.6
NO_x	1.3	59.2	14.1
NO_2	0.005S[(1)]	3.74	0.633
Particles	0.22	3.61	0.387

(1) S is sulfur content $\simeq$ 0.366g/100 m^3.

Total emissions and average emission rates for the 7-year construction period are given in Table 6. Emissions are assumed to occur during the same time period as fugitive dust emissions above.

TABLE 6. GASEOUS AND PARTICULATE EMISSIONS FROM FOSSIL FUEL USAGE FOR CONSTRUCTION

Pollutant	Propane Total tonnes	Propane Rate g/s	Diesel Fuel Total tonnes	Diesel Fuel Rate g/s	Gasoline Total tonnes	Gasoline Rate g/s
CO	1.5	1.4×10^{-2}	730	7.0	22,325	212.6
HC	0.54	5.1×10^{-3}	266	2.5	780	7.4
NO_x	8.3	7.9×10^{-2}	3790	36.1	663	6.3
SO_2	1.2×10^{-4}	1.1×10^{-6}	240	2.3	30	0.3
Particles	1.4	1.3×10^{-2}	231	2.2	42	0.4

These emissions would occur over most of the construction site with certain perferred locations. The GEIS does not differentiate between gasoline used on the site and used during commuting. Commuting emissions would be more diffuse than those on site except near roadways.

Some of the gaseous emissions would be at repository depth. These emissions would be mainly diesel exhaust from equipment operating underground. There would probably be some control on the pollutants before they were emitted to the atmosphere which would result in lower emission rates for diesel fuel than indicated in Table 6.

B. EMISSIONS FROM OPERATIONS

Emissions for air pollutants during operations would be mainly caused by the burning of fossil fuels. Vehicles transporting nuclear waste would be using diesel fuel. Commuter traffic would use gasoline. Space heating of surface facilities would possibly be provided by propane or oil burning furnaces. Diesel generators would be used for emergency power in case of electrical power failures. The resource commitments of Table 3 help determine the amount of emissions. The GEIS, however, does not have gasoline or propane usage estimates for repository operation. Gasoline usage would be proportional to manpower commitments because it would be associated with commuter traffic. Propane usage would be proportional to the number of years since it would be mainly used for heating for which requirements would be similar from year to year.

Operational emissions can be considered at the same time without separating them into categories of how they would be generated. Emission factors from Table 5 are used to determine gaseous and particulate emissions from fossil fuel usage. Table 7 contains the total emissions and emission rates during operation of the proposed repository. Rates are determined for the 20-year period assuming the same daily operation schedule as during construction.

TABLE 7. GASEOUS AND PARTICULATE EMISSIONS FROM FOSSIL FUEL USAGE FOR OPERATION

Pollutant	Propane Total tonnes	Propane Rate g/s	Diesel Fuel Total tonnes	Diesel Fuel Rate g/s	Gasoline Total tonnes	Gasoline Rate g/s
CO	6.2	2.1×10^{-2}	3,650	12.2	14,725	49.1
HC	2.3	7.8×10^{-3}	1,330	4.4	515	1.7
NO_x	22.4	7.5×10^{-2}	18,950	63.2	440	1.5
SO_2	5×10^{-4}	1.7×10^{-6}	1,200	4.0	20	0.07
Particles	5.9	2.0×10^{-2}	1,160	3.9	28	0.09

Part of the diesel emissions would be underground and partially treated before release to the atmosphere resulting in a lower emission than Table 7 indicates. Emissions from both diesel fuel gasoline burning vehicles would be dispersed during emission because the vehicles would be in motion and in fact much of their travel would not be at the repository site itself but would be on roads leading to the site.

There would still be storage piles for waste rock during operations. Wind erosion would cause resuspension of soil particles from these piles in a similar manner as during construction. Comments pertaining to wind speed dependence of emission rate above would be applicable.

C. EMISSIONS FROM DECOMMISSIONING

The decommissioning procedure would consist of backfilling the empty underground volume and shafts with material from the storage piles and restoring the surface to something similar to its original condition. There would be fugitive dust emissions from loading, hauling, and dumping. There would be gaseous and particulate emissions from equipment and commuter traffic.

Table 2 gives total amount of backfill as 33×10^6 tonnes. The total amount of emissions would be proportional to those similar emissions during construction in the ratio of the backfill to total waste rock. Total emissions in Table 4 for surface rock transport and in Table 6 for all fossil fuel burning would be reduced by a factor of two. Emission rates are more difficult to determine, since the length of time required is not given in the GEIS. Less time should be required for decommissioning than construction; but since it has not been stated, emission rates cannot be determined.

D. EMISSION CONTROLS

Most particulate emission would be in the form of soil particles and unavoidable due to the nature of the source, although there are controls that can be placed on these emissions. During site preparation and road building water trucks can be used to wet roads so that other traffic on those roads generates less dust. Jutze et al. (1974) have estimated that twice daily watering with complete coverage will reduce dust emissions by up to 50 percent. There are also chemical stabilizers such as magnesium chloride which are effective on completed construction areas but not on active construction areas. In general, construction emissions could be reduced by a factor of two with the proper techniques.

Emissions from completed dirt roads can be controlled in several ways, paving (85% control), surface treating with penetration chemicals (50%), working of soil stabilization chemicals into road bed (50%), and traffic control. The access road to the repository would probably be paved and have low dust emissions. Other roads on the repository would probably also have some controls such as paving.

Storage piles of waste rock can be treated with chemicals to lower resuspension. Under some conditions they could be revegetated so that they would act like the natural surrounding soil. Again emissions could be reduced by a factor of two.

Internal combustion engines have required controls which were already figured into the emisson estimates above. Future vehicles may be required to have more stringent controls, but those are difficult to estimate. Since vehicular emissions are not likely to have decreased controls, the above emissions are a good estimate of the worst possible emissions.

IV. ESTIMATED AMBIENT CONCENTRATIONS

Ambient concentrations of air pollutants from the repository can be estimated by air quality simulation models. In general these models require input data as to emission rates, wind fields, atmospheric stability, and mixing heights. Since actual site-specific data are not available at Yucca Mountain, only the initial screening process for environmental effects can be done. This process uses standard EPA-approved models under conservative circumstances to obtain worst-case concentrations (EPA, 1980). Modeling results are highly speculative because of the dependence on details of topography, source geometry, and model algorithm inter-relationships.

At present, there is only one model which has been approved for use in complex terrain, the Valley model (Burt, 1977). There are some other models which can be used if site-specifc data were available. The Valley model was originally intended to simulate the impact of an isolated, elevated point source of sulfur dioxide in complex terrain for 24-hour periods. Worst case conditions are defined as very stable atmosphere (F stability in the Pasquill-Gifford scheme (Turner, 1970)) and a wind speed of 2.5 m/s in one of 16 compass directions for six of 24 hours.

Valley model is not entirely suitable for application to the repository in which emissions occur relatively near the surface. Valley was intended for elevated sources which impact elevated terrain, while near surface emission would tend to follow the terrain.

The actual location of the repository has not been determined. Two possible locations for the exploratory shaft were investigated for the letter report: one on the ridge of Yucca Mountain and the other in a valley on the eastern slope of the mountain. These two locations will also be used for modeling the repository.

The repository would act as an area source having emissions over much of the 280 ha of surface area although there would be some parts which would have more emissions than others. For this study the source will be considered to be spread evenly over the square area. The large area itself poses some problems in the complex terrain situation of Yucca Mountain. As the mountain is now, a 280 ha repository would be larger than some of the complex terrain features. Some of the features themselves would probably be changed during the construction phase. The square area does not lend itself to realistic placement on Yucca Mountain, although it is can be used for screening purposes.

With all emissions spread over the entire area, the estimated concentrations are proportional to the emission rates. Table 8 gives circumstances under which maximum emission rates would occur for both particulate and gaseous emissions. The maximum rate for any one pollutant occurs for total suspended particulate matter from construction of the surface support facilities. At any one particular time, the emission rate for soil particles would be about 280 g/s. For the gaseous emissions, most of those from propane and diesel fuel would be emitted at the repository. Those from gasoline would be emitted along the road to the repository and except near the roadway, would be dispersed. The effects would be over estimated by putting all the emissions at the repository.

TABLE 8. MAXIMUM EMISSION CIRCUMSTANCES

Pollutant	Activity/Source	Emission Rate g/s
TSP	Construction of Surface Facilities	280
CO	Fossil Fuel Usage During Construction	220
HC	Fossil Fuel Usage During Construction	10
NO_x	Fossil Fuel Usage During Operations	65
SO_2	Fossil Fuel Usage During Operations	4

TABLE 9. ESTIMATED MAXIMUM 24-HOUR AMBIENT CONCENTRATIONS OF AIR POLLUTANTS FROM HIGH LEVEL NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN[1]

Pollutant	Emission Rate g/s	Ridge Location Distance[2] km	Ridge Location Direction	Ridge Location Concentration $\mu g/m^3$	Valley Location Distance km	Valley Location Direction	Valley Location Concentration $\mu g/m^3$
Suspended Particles	280	1.5	SSW	271	1.0	ENE	276
CO	220	1.5	SSW	213	1.0	ENE	217
HC	10	1.5	SSW	10	1.0	ENE	10
NO_x	65	1.5	SSW	63	1.0	ENE	64
SO_2	4	1.5	SSW	4	1.0	ENE	4

(1) All cases use "F" stability and wind speed of 2.5 m/s.
(2) Distance from center of 1.7 km x 1.7 km repository. Point of highest concentration outside surface boundaries.

TABLE 10

AMBIENT AIR QUALITY STANDARDS

Figures without ( ) are in micrograms per cubic meter
Figures with ( ) are in parts per billion

Parameter	Time Period	Nevada[2]	Federal Primary	Federal Secondary
SO_2	3 Hour	1300	*	1300 (500)
	24 Hour	365 (140)	365 (140)	*
	Annual Arithmetic Mean	80 (30)	80 (30)	80 (30)
TSP	24 Hour	150	260	150
	Annual Geometric Mean[1]	75	75	60
Oxidant (ozone)	1 Hour	235 (120)	235 (120)	235 (120)
NO_2	Annual Arithmetic Mean	100 (50)	100 (50)	100 (50)
CO	1 Hour	40,000 (35,000)	40,000 (35,000)	40,000 (35,000)
	8 Hour	10,000 (9,000)	10,000 (9,000)	10,000 (9,000)

[1] The geometric mean (GM) of a group of numbers is the 'nth' root of the product of 'n' numbers in the group, i.e., GM = $(X_1 \cdot X_2 \cdots X_n)^{1/n}$. This figure is a more representative average of a group of numbers which are distributed lognormally than the arithmetic mean, as the GM is the average of the logarithms of the numbers. Federal and State total suspended particulate (TSP) standards are defined using the geometric mean rather than the arithmetic mean for data because, in many parts of the country, TSP data are distributed lognormally. However, this assumption is not always valid in the type of environment surrounding the Yucca Mountain vicinity.

[2] The air quality standards for the State of Nevada during 1982 appear in the Nevada Air Pollution Control Law, Chapter 445, Nevada Air Quality Regulations, Article 12 -Ambient Air Quality Standards.

Results of application of the Valley model to a repository of Yucca Mountain are shown in Table 9. In all cases a stable (F stability) atmosphere and wind speed of 2.5 m/s were used. The locations in Table 9 are those at the points of highest concentration outside the 280 ha repository. There are points within the boundaries which could have higher concentrations.

Federal primary and secondary and Nevada air quality standards are given in Table 10 to be compared to the estimated concentrations of Table 9. Also, Table 11 contains the allowable incremental increases for SO_2 and particulate matter from Prevention of Significant Deterioration (PSD) regulations for the three classes of allowable degradation. The next section will discuss PSD in more detail. Several of the standards do not have averaging periods of 24-hours and cannot be compared to the Valley model concentrations directly.

TABLE 11. INCREMENTS OF MAXIMUM ALLOWABLE INCREASES FOR PREVENTION OF SIGNIFICANT DETERIORATION

		Increments[1]		
Pollutant	Time Period	Class I $\mu g/m^3$	Class II $\mu g/m^3$	Class III $\mu g/m^3$
SO_2	3 hour	25	512	700
	24 hour	5	91	182
	1 year	2	20	40
Particles	24 hour	5	19	37
	1 year	10	37	75

(1) For any period other than annual, increase may be exceeded not more than 1 day per year at any one location.

Tables 9, 10, and 11 show that TSP standards and increments could be exceeded during construction. The concentrations from the Valley model for worst-case conditions, however, are misleading and probably too high. Six hours of very stable atmosphere are assumed to occur during a 24-hour period which would happen in most cases during late evening and early morning hours before sunrise. This may not correspond to actual working hours at the repository, and in fact there may be no emissions during the most stable period. The application of hourly emission rates and meteorological data would give more realistic ambient concentrations. These would require further definition of construction and operation plans and site-specific meteorological data.

V. REGULATORY REQUIREMENTS

Regulatory requirements on the construction and operation of new sources have been promulgated by both federal and State of Nevada agencies. Appendix A lists the various agencies that have requirements for mining operations and pertinent information about them. The two agencies for air quality are the United States Environmental Protection Agency (EPA) and the Nevada Division of Environmental Protection (NDEP). Clark County, where much of the impact of increased population would be, has not been included in the Appendix but would have an interest in the extent of the project. Of most concern for the NNWSI are the federal regulations for the prevention of significant deterioration (PSD) and the State regulations for permits to construct and operate a new source.

A. PREVENTION OF SIGNIFICANT DETERIORATION

The Clean Air Act Amendments of 1977 (CAAA, 1977) has required the prevention of significant deterioration (PSD) of air quality in areas which were in attainment of the national ambient air quality standards (NAAQS). Air pollutant concentrations in attainment areas are not to be allowed to reach the NAAQS. This is to be accomplished by requiring new stationary sources and major modification of sources to limit their emission increases to increments less than the NAAQS. The allowable incremental concentrations are dependent on location of source and its impacts. Regions have been put into three classes for PSD considerations: Class I in which there is to be minimal deterioration such as national parks and some wilderness areas, Class II in which moderate deterioration is allowed such as areas with low ambient concentrations but removed from Class I areas, and Class III in which NAAQS are allowed to reached such as urban attainment areas.

If PSD regulations are applicable to a new source or major modification, the source is subject to preconstruction review which includes ambient air quality analysis (monitoring and modeling) and possibly postconstruction monitoring. The permitting authority will make decisions concerning pre- and postconstruction requirements on a case-by-case basis. The applicability of PSD is determined by the source's potential to emit criteria pollutants in excess of certain threshold values. A source with emissions in excess of the thresholds are considered as major emitting facilities. Stationary sources in 28 categories have been defined in CAAA (1977), Section 169 (1) as having threshold values of 100 tons/year (91 tonnes/year) for the criteria pollutants. Other stationary sources are considered major emitting facilities if they emit 250 tons/year (227 tonnes/year) or more.

The computation of the emission potential is extremely important in determining if PSD is applicable. At present emission potentials are determined after application of air pollution controls (EPA, 1980). This lowers the emission potential for most sources by at least a factor of two and usually more. Emissions are considered to be either point source emissions from stacks or vents or fugitive emissions from diverse parts of a plant. Point source emissions are obviously included in the sources potential to emit; fugitive emissions are not as well defined. The Federal Register (45 FR 52690) has spelled out EPA's position on PSD and fugitive emissions. The EPA administrator has made rules that 27 categories of stationary sources (these include all the 28 categories in CAAA (1977), Section 169 (1)) would include fugitive emissions in the threshold calculations of major emitting facility status. If a source is not in one of the 27 categories for this rulemaking, it does not include fugitive emissions in its threshold calculations. This does not preclude the EPA administrator from future rulemaking to include other sources which would have fugitive emissions included in the threshold calculations. Fugitive emissions must always be taken into account when determining if NAAQS or allowable increments will be violated.

Fugitive emissions are those that would occur during some industrial process which could not be passed through a stack or vent. These are different from fugitive dust emissions which would consist of soil particles. The 1978 PSD regulations (43 FR 26380) exempted fugitive dust from air quality impact assessment. This exemption has been deleted (45 FR 52693) and EPA has deferred further action pending review of a size-dependent particle standard.

A further development concerning fugitive emissions has recently occurred (Environmental Reporter, 1982). EPA has drafted rules in which fugitive emissions would not be considered in determining if a stationary source would be a major source. The requirement that fugitive emissions be included in threshold applicability determinations for construction of new sources and major modifications would be deleted from PSD regulations.

A high level nuclear waste repository does not fall into either one of the 28 categories of CAAA (1977) or one of the 27 categories of the fugitive emission rulemaking. Its major emissions are fugitive dust from heavy equipment and gaseous pollutants from mobile sources. There are some underground emissions that would be vented to the atmosphere. These are difficult to separate from the surface emissions given lack of design information. It is not clear if the repository would come under PSD regulations. This determination will have to be made by the appropriate regulatory agency. At present that agency is EPA Region IX, although the State of Nevada is in the process of acquiring control over PSD regulations. In any event both EPA and the state should be contacted as to plans and possible impacts.

B. STATE OF NEVADA PERMITS

The NDEP issues Air Quality Permits to Construct, called a registration certificate, and to Operate, called an operating permit. These permits are required for new sources which, among other things, disturb more than 8 ha of surface area.

Registration certificates and operating permits are issued on a case-by-case basis and can have specified requirements such as air quality and meteorological monitoring before, during, and after construction. While the extent of possible required monitoring is difficult to determine at present, it seems reasonable to expect at least a requirement for meteorological monitoring and for measurement of TSP because of the lack of anti-specific data. Measurements of other criteria and non-criteria pollutants might also be necessary because of the large size and sensitive nature of the proposed repository. The actual requirements will be made by the NDEP based upon information presented to them concerning the repository plans and impacts.

VI. CONCLUSIONS

This report is a preliminary assessment of nonradiological air pollution caused by a high level nuclear waste repository in the southwest part of NTS. Basic assumptions about repository design are made from information concerning a repository for spent nuclear fuel in granite.

Emissions and emission rates are determined for construction and operations while decommissioning is also discussed. Emissions include suspended soil particles from surface facility construction waste rock transport, and wind erosion and gaseous and particulate emissions from the burning of fossil fuel.

The maximum 24-hour concentrations are estimated using the Valley model because of the complex terrain features surrounding the repository. These concentrations show high values for fugitive dust near the site exceeding NAAQS and PSD increments during contruction.

Regulatory requirements by federal and State of Nevada agencies are presented. PSD is described and some attempt to determine its applicability is made, although the actual determination has to be made by the proper regulatory agency. State permits and their possible requirements for meteorological and air quality monitoring are briefly discussed. It is expected that at least meteorological and TSP measurements would be required. Again the actual requirements have to be made by the regulatory agency.

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APPENDIX A

NEVADA BUREAU OF MINES AND GEOLOGY
Special Publication L-6
(revised to May 1981)

STATE AND FEDERAL PERMITS REQUIRED IN NEVADA BEFORE MINING OR MILLING CAN BEGIN

compiled by
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This is a list of State and Federal permits and actions required during development, planning, construction, and before operation of Nevada mines and mills. We hope it will help both individuals and companies through the complex, often confusing regulatory maze—please understand that inclusion in this list does not indicate approval of these regulations.

Remember that in addition to State and Federal permits, County and City permits may be required. We have attempted to include a general description of County and City permits necessary. As these may vary, it is suggested you contact the local County Planning Commission for specific requirements.

This list will be revised periodically, however, the user should be aware that there may be additional, new, or revised regulations issued after this list was compiled. We welcome any additions, and/or corrections, as well as any suggestions on how to improve this list. For more information about permitting, contact: Nevada Division of Mineral Resources, 201 S. Fall St., Carson City, NV 89710; (702) 885-4368.

John Schilling
Director/State Geologist
Nevada Bureau of Mines and Geology

STATE REQUIREMENTS

PERMIT TO CONSTRUCT CAMPSITE

Granting agency ....Nevada Division of Health/Bureau of Consumer Health Protection Services, 505 E. King St., Carson City, NV 89710; (702) 885-4750
When required ....Prior to construction
Maximum time to obtain.....30 days
Minimum time to obtain .....5 days
Cost of permit ....None
Public Notice required.......No
Information required........Complete plans are required for the following permits: Labor camp (NRS 444), Public bathing place (NRS 444), Mobile Home park (NRS 439.200), Camp kitchen & dining room (NRS 446), Drinking water supply (NRS 445), Recreational vehicle park (NRS 439.200), Sewage system (NRS 444), Sub-division (NRS 278).

ENDANGERING WILDLIFE

Agency to contact ....Nevada Department of Wildlife, 1100 Valley Rd., Reno, NV 89510; (702) 784-6214
When required ....Prior to construction and operation
Required action ....Ascertain whether or not the mining operation would endanger fish and game habitat, etc.

STATE REQUIREMENTS (continued)

AIR QUALITY PERMIT TO CONSTRUCT

Granting agency............Nevada Division of Environmental Protection, 201 S. Fall St., Carson City, NV 89710; (702) 885-4670
When required.............Prior to construction
Maximum time to obtain.....90 days
Minimum time to obtain.....30 days
Cost of permit.............$10.00
Public Notice required.......Yes
Information required........Location of source; specifications and design of source; type and quantity of air emissions; basis of data; materials used in process; air contaminant control equipment; type of combustion unit; hourly fuel consumption operating schedule; process products; flow diagram; baseline data.
Governing statute...........NRS Chapter 445

PERMIT TO APPROPRIATE THE PUBLIC WATERS

Granting agency............Nevada Division of Water Resources, 201 S. Fall St., Carson City, NV 89710; (702) 885-4380
When required.............Prior to construction
Maximum time to obtain.....180 days
Minimum time to obtain.....90 days
Cost of permit.............$35.00 (statutory filing fee)
Public Notice required.......Yes
Information required........Location of point of diversion and place of use; use to which water will be applied; annual consumption of water.
Governing statute...........NRS Chapter 533 and 534

PERMIT TO CONSTRUCT TAILINGS DAM

Granting agency............Nevada Division of Water Resources, 201 S. Fall St., Carson City, NV 89710; (702) 885-4380
When required.............Prior to construction
Maximum time to obtain.....90 days
Minimum time to obtain.....45 days
Cost of permit.............None
Public Notice required.......No
Information required........Plans and specifications must be filed with application for any tailings dam which will be higher than 10 feet or impound more than 10 acre feet; supportive engineering study.
Governing statute...........NRS Chapter 535

NEVADA WATER POLLUTION CONTROL PERMIT

Granting agency............Nevada Division of Environmental Protection, 201 S. Fall St., Carson City, NV 89710; (702) 885-4670
When required.............Prior to operation
Maximum time to obtain.....120 days
Minimum time to obtain.....60 days
Cost of permit.............$100.00 ($25.00 for each additional permit)
Public Notice required.......Yes
Information required........Site plan; water or treatment works to which discharge will be released.
Governing statute...........NRS Chapter 445

AUTHORIZATION FOR DISPOSAL OF SOLID WASTES

Granting agency............Nevada Division of Environmental Protection, 201 S. Fall St., Carson City, NV 89710; (702) 885-4670
When required.............Prior to disposal of construction wastes and/or disposal of workers' solid wastes
Maximum time to obtain.....3 months
Minimum time to obtain.....2 weeks
Cost of Authorization.......None
Public Notice required.......No
Information required........Site location, design and operational plan as specified in Nevada regulations governing solid waste management.

OPENING AND CLOSING MINES

Agency to contact ....State Inspector of Mines, 515 E. Musser St. (mailing), 504 E. Musser St. (location), Carson City, NV 89710; (702) 885-5243

When required ....Before opening and upon closing mine operations

Required action ....Operators shall notify the inspector of mines; the notice must include the name and location of the mine(s); the name and address of the operator, the name of the person in charge of the operation, a statement of whether the operation will be continuous or intermittent, and upon closing, a statement of whether the closing is temporary or permanent.

Governing statute...........NRS Chapter 512.160

HISTORIC PRESERVATION

Agency to contact ....Nevada Division of Historic Preservation & Archaeology, 201 S. Fall St., Carson City, NV 89710; (702) 885-5138

When required ....Prior to actual mining

Required action ....Submit a legal description of the area to be disturbed so NDHPA can determine if it is within any particular state historic preservation area.

AIR QUALITY PERMIT TO OPERATE

Granting agency............Nevada Division of Environmental Protection, 201 S. Fall St., Carson City, NV 89710; (702) 885-4670

When required ....Prior to permanent operation

Maximum time to obtain.....6 months after start-up

Minimum time to obtain .....30 days

Cost of permit ....$50.00 (five-year permit)

Public Notice required.......No

Information required........Date of approval of Air Quality Permit to Construct; changes to previous applications, if any; projected date of start-up; actual date of start-up; construction drawings.

Governing statute...........NRS Chapter 445

HAZARDOUS WASTE

Agency to contact ....Nevada Division of Environmental Protection, 201 S. Fall St., Carson City, NV 89710; (702) 885-4670

Required action ....This agency does not have any regulations in effect regarding the generation, transportation, treatment, storage, or disposal of waste from the extraction, benefication and processing of ores and minerals. It would be advisable, however, to contact this office for a possible change or update of state or federal regulations.

FEDERAL REQUIREMENTS

USE OF BLM-ADMINISTERED LAND

Granting agency............Bureau of Land Management (BLM), District Offices:

Reno - 300 Booth St., P.O. Box 1200, Reno, NV 89520, (702) 784-5751;
Winnemucca - 705 E. 4th St., Winnemucca, NV 89445, (702) 623-3676;
Carson City - 1050 E. Williams St., Suite 335, Carson City, NV 89701, (702) 882-1631;
Elko - 2002 Idaho St., P.O. Box 831, Elko, NV 89801, (702) 738-4071
Ely - Star Route 5, Box 1, Ely, NV 89301, (702) 289-4856;
Las Vegas - 4765 W. Vegas Dr., P.O. Box 5400, Las Vegas, NV 89102, (702) 385-6403;
Battle Mountain - Box 194, Battle Mountain, NV 89820, (702) 635-5181.

When required ....Affects lands open to mining and administered by BLM (except lands under wilderness review.) The regulations incorporate three levels of operation: 1) Casual use—no notice or plan required. Designed for the part-time miner or weekend prospector who does negligible disturbance. Need not contact BLM. No use of mechanized earth-moving equipment or explosives; 2) surface disturbance less than 5 acres per year—a written letter or notice must be submitted to BLM 15 days prior to starting operations. Notice must describe the operation, location and must contain a statement that the lands will be reclaimed to the standards spelled out in the regulations Operator must notify BLM when reclamation is completed so an inspection can be made. No approval or bonding necessary; 3) disturbance of more than 5 acres or if operations are proposed in Wild & Scenic River areas, areas of critical environmental control, National Wilderness Preservation System, off-road vehicle "closures", or "limited" areas (valid existing rights in areas withdrawn from mining)—plan of operation required which must describe the entire operation, equipment to be used, location of access, support facilities, drill sites, measures to prevent undue degradation and reclamation plans. BLM acknowledges receipt of plan; 30 days to act; 60-day extension if necessary; reclamation required for all operations. Bonding may be required. Appeals to Nevada State Director, BLM; Interior Board of Land Appeals, Office of the Secretary, Dept. of the Interior, 4015 Wilson Blvd., Arlington, VA 22203.

USE OF BLM-ADMINISTERED LAND UNDER WILDERNESS REVIEW

Granting agency .... Bureau of Land Management, 300 Booth St., P.O. Box 1200, Reno, NV 89520;(702) 784-5751

When required .... A plan of operations shall include appropriate environmental protection and reclamation measures selected by the authorized officer. An approved plan of operations within lands under wilderness review is required prior to commencing: 1) mining operations which involve construction of means of access, or improving or maintaining such access facilities in a way that alters the alignment, size and character of such facilities; 3) mining operations using mechanized earth-moving equipment; 4) mining operations mining operations using mechanized earth-moving equipment; 4) mining operations using motorized vehicles over other than open use areas and trails, unless the use of a motorized vehicle can be covered by a temporary use permit; 5) construction or placing of any mobile, portable or fixed structure on public land for more than 30 days; 6) mining operations requiring the use of explosives; 7) any operation which may cause changes in a water course. [Not required when: 1) searching for and occassionally removing mineral samples or specimens; 2) operating motorized vehicles over open use areas and trails; 3) maintaining or making minor improvements to existing access routes or other facilities; 4) making geological, radiometric, geochemical, geophysical or other tests using instruments, devices or drilling equipment which are transported without using mechanized earth-moving equipment or vehicles.]

TEMPORARY USE OF BLM-ADMINISTERED LAND

Granting agency .... Bureau of Land Mangement, 300 Booth St., P.O. Box 1200, Reno, NV 89520; (702) 784-5751

When required .... Prior to use

Maximum time to obtain..... 90 days

Minimum time to obtain ..... 15 days

Cost of permit .... Varied. Consult district BLM offices

Public Notice required....... No

Information required........ Location of use area; proposed use; cost of use development; archaeological and historical clearances.

PREVENTION OF SIGNIFICANT DETERIORATION

Granting agency .... Environmental Protection Agency, 215 Fremont St., San Francisco, CA 94105; (415) 556-3450

When required .... Prior to construction

Maximum time to obtain..... 1 to 1½ years

Minimum time to obtain ..... 6 months

Cost of permit .... None

Public Notice required....... None

Information required........ SO_2 and particulate emission from project; projected maximum ground level SO_2 and particulate concentration; baseline air quality and meteorology data (1 per year); emissions of hazardous pollutants; frequency of increment violations during baseline.

RIGHT OF WAY FOR TRANSMISSION CORRIDOR

Granting agency	Bureau of Land Management, 300 Booth St., P.O. Box 1200, Reno, NV 89520; (702) 784-5751
When required	Prior to construction
Maximum time to obtain	Approximately 6 months
Minimum time to obtain	Approximately 20 days
Cost of permit	$50.00 per mile up to 5; 5 to 20 miles, $500.00
Public Notice required	Yes
Information required	Corridor route; archaeological and historical clearances; methods of construction; notice of completion (within 90 days).

ROAD ACCESS (ROW)

Granting agency	Bureau of Land Management, 300 Booth St., P.O. Box 1200, Reno, NV 89520; (702) 784-5751
When required	Prior to construction
Maximum time to obtain	Approximately 6 months
Minimum time to obtain	Approximately 30 days
Cost of permit	$50.00 per mile up to 5; 5 to 20 miles, $500.00
Public Notice required	Yes
Information required	Corridor route; archaeological and historical clearances; methods of construction; notice of completion (within 90 days).

PURCHASE, TRANSPORT, OR STORAGE OF EXPLOSIVES

Agency to contact	Bureau of Alcohol, Tobacco and Firearms (BATF), 350 S. Center St., Reno, NV 89501; (702) 784-5251
When required	Before purchasing explosives outside state of residence and/or transporting them interstate
Required action	Obtain permit (information concerning purchase, transport, and storage of explosives can be obtained from BATF).

FLORA AND FAUNA

Agency to contact	U.S. Forest Service (USFS), 111 N. Virginia, Reno, NV 89501; (702) 784-5331 or Bureau of Land Management (BLM), 300 Booth St., P.O. Box 1200, Reno, NV 89520; (702) 784-5452
When required	Before beginning operations
Required action	Find out the types of flora and fauna which exist in the area of operations which of those, if any, are on the endangered species list.

NOTIFICATION OF COMMENCEMENT OF OPERATION

Granting agency	Mine Safety & Health Administration, 1605 Evans Ave., Reno, NV 89507; (702) 784-5443
When required	Prior to start-up
Maximum time to obtain	None
Minimum time to obtain	None
Cost of permit	None
Public Notice required	No
Information required	Location; estimated commencement date; safety training; dam specifications.

PATENTING MINING CLAIMS

Granting agency	Bureau of Land Management, 300 Booth St., P.O. Box 1200, Reno, NV 89520; (702) 784-5751
When required	When desired by claim holder
Maximum time to obtain	2 years
Minimum time to obtain	15 months
Cost of permit	$25.00 filing fee and proof that not less than $500.00 has been expended for development of each claim. Purchase Price: Lode Claim - $5.00 per acre; Placer Claim - $2.50 per acre.
Public Notice required	Yes, posted on claim and in newspapers
Information required	Mineral survey plat, two copies of field notes, two copies of survey, proof of posting on claim, evidence of title, proof of citizenship, proof of publication.

CITY/COUNTY REQUIREMENTS

General Plan: Many counties are governed by a general plan and have adopted special land use ordinances with regard to this general plan. Mining in some areas may be allowable by right, where in others, such as urbanized areas and agricultural and housing districts, it may be prohibited.

Building Permit: Prior to construction of any structure, many counties require the issuance of a building permit. Cost of the permit may vary depending on extent and type of construction. There must be prior approval for construction from the Nevada State Health Division.

Special Use Permit: Various counties require special use permits in relation to mining activities. A full description of all phases of the proposed operation is required. Cost of the permit may vary among counties. Public notice is generally required.

Zoning Change: A description of the proposed mining operation is required for a zoning change for industrial use. Often in open use zones, a special use permit may be required. Public notice is generally required.

Business License: Various city/county governments require a license prior to any firm, person, association or corporation engaging in any business activities.

NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS

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