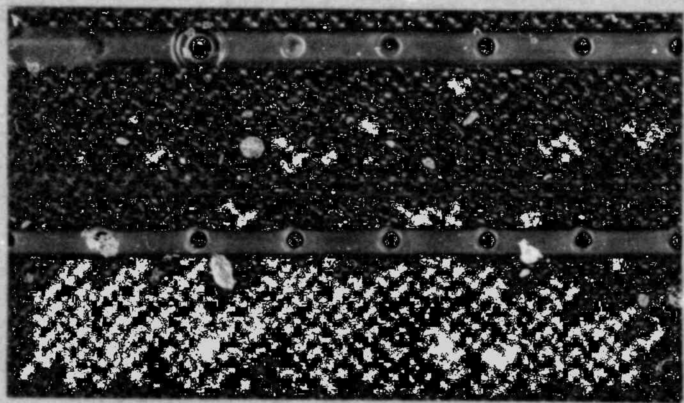

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Amendment to
Final Environmental Statement
U.S. Nuclear Regulatory Commission
White Mesa Uranium Project

Prepared for

Energy Fuels Nuclear, Inc.

Impact Environmental Consultants, Ltd.
1409 Larimer Square
Denver, Colorado 80202

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1. INTRODUCTION

This report was prepared in support of the proposed expansion of the White Mesa Uranium Mill in San Juan County, Utah, operated by Energy Fuels Nuclear, Inc. The format and section numbering conform precisely with that of the U.S Nuclear Regulatory Commission's Final Environmental Statement for the White Mesa Project. All background data and impact assessments judged relevant to the proposed expansion were revised or added to. The following paragraphs are only those which have been modified or replaced.

The proposed expansion involves an increase in annual yellowcake production from the current limit of 1.7 million pounds to 6.3 million pounds yellowcake. This would be accomplished by increasing the daily processing of ore from the current 2,000 tons/day to 3,500 tons/day, and by using ore with an average grade of 0.25% U_3O_8, or approximately twice that of the previous ore grade. A significant portion of this ore will represent toll milling for other uranium projects.

The radiological assessment was performed using the latest NRC dosimetry model, MILDOS. Insofar as was practical, the assumptions used by NRC in their original radiological assessment were followed in this assessment. However, where engineering data or reliable test results were available, these were used in lieu of the old assumptions.

2. THE EXISTING ENVIRONMENT

2.1 CLIMATE

2.1.1 General influences

Table 2.1. (A) presents temperature data collected on-site for the most recent year. This data correlates well with the long-term climatological information for Blanding.

2.1.2 Precipitation

Table 2.2 (A) presents the most recent year of rainfall data collected on-site at the White Mesa Uranium Mill.

2.1.3 Winds

Winds at the project site averaged 3.20 meters/second (7.2 mph) for the period January 1, 1980 - December 31, 1980, with calms recorded 4.6% of the time. Late winter and early spring frontal systems bring strong winds, as do the summer thunderstorms. Daytime winds at the site are from the south, and north- easterly winds prevail at night. Summaries of project site wind speed and direction (and stability classes) are given in Tables D.1 and D.2 of Appendix D.

Table 2.1. (A) Temperature means at White Mesa Project site[a]

Month	Daily maximum		Daily minimum		Monthly	
	°C	°F	°C	°F	°C	°F
January	2.4	36.3	-2.0	28.4	-0.3	31.5
February	6.7	44.1	0.5	32.9	3.2	37.8
March	7.9	46.2	-0.7	33.3	3.4	38.1
April	15.1	59.2	4.0	39.2	9.4	48.9
May	20.6	69.1	9.1	48.4	15.1	59.2
June	29.2	84.6	14.3	57.7	21.3	70.3
July	30.7	87.3	17.2	63.0	24.0	75.2
August	29.6	85.3	16.5	61.7	22.8	73.0
September	29.0	84.2	15.1	59.2	21.5	70.7
October	21.5	70.7	9.2	48.6	15.0	59.0
November	5.4	41.7	-2.6	27.3	0.7	33.3
December	3.1	37.6	-4.8	23.4	-1.6	29.1
Annual	18.1	64.6	7.4	45.3	12.7	54.9

[a] Period of record: June 1979 - May 1980.

Source: Stearns-Roger Corporation, *Annual Report, Meteorological and Air Quality Observations, White Mesa Uranium Project*, Table 9, July 1980.

Table 2.2. (A) Precipitation at White Mesa Project site[a]

Month	Monthly total cm	Monthly total in	Maximum 1 hr cm	Maximum 1 hr in	Maximum 24 hr cm	Maximum 24 hr in
January	4.78	1.88				
February	6.96	2.74				
March	2.62	1.03				
April	1.55	0.61				
May	1.24	0.49				
June	4.80	1.89			3.58 (6/8/79)	1.41
July	2.06	0.81				
August	5.87	2.31	1.40 (0700, 8/16/79)	0.55		
September	0.00	0.00				
October	1.63	.64				
November	1.09	0.43				
December	1.27	0.50				

[a] Period of Record: June 1979 - May 1980.

Source: Stearns-Roger Corporation, *Annual Report, Meteorological and Air Quality Observations, White Mesa Uranium Project*, Table 12, July 1980.

2.2 AIR QUALITY

The White Mesa mill lies within the jurisdiction of the Four Corners Interstate Air Quality Control Region Number 14 which includes parts of Colorado, Arizona, New Mexico and Utah. Under the regulations for Prevention of Significant Deterioration of air quality (PSD), promulgated June 19, 1978, -n area is designated as either Class I, Class II, or Class III. PSD increments or maximum allowable increases above baseline concentrations have been set for these three Classes for two criteria pollutants (Table 2.3 (A)). The increments are smallest for Class I areas and thus the allowable degradation of air quality is minimal. For Class III areas, degradation of air quality up to the National Ambient Air Quality Standards (NAAQS) is allowed.

Table 2.3 (A). Maximum allowable increases in ambient air pollutant concentrations (micrograms per cubic meter)

Pollutant	Average time	Designation of area for PSD: Class I	Class II	Class III
Sulfur dioxide	Annual arithmetic	2	20	40
	24 hr maximum	5	91	182
	3 hr maximum	25	512	700
Particulate matter	Annual geometric	5	19	37
	24 hr maximum	10	37	75

Source: Title 40, Code of Federal Regulations, Part 52.21

Areas are also classified as either attainment or non-attainment with regard to the NAAQS (see Table 4.1). The mill is located in an area which is classified as attainment or unclassified for all criteria pollutants (43

Federal Register 9038-9039), and falls within a Class II area for PSD purposes. The nearest Class I area, Canyonlands National Park, is located 35 miles northwest of the mill. This area is separated from the facility by the Abajo Mountains and is upwind as well; thus there should be no effect from facility emissions.

On-site monitoring of total suspended particulate concentrations was started in March, 1977. Twenty-four hour observations are taken every third day at monitoring site A, and every sixth day at site B, as a control. The most recent 13 months of data are summarized in Table 2.3 (B). As can be seen from this table, both the maximum 24-hour concentrations and the annual geometric mean are well within the applicable NAAQS.

Table 2.3 (B). Total suspended particulates (TSP) at White Mesa Project Site[a]

(micrograms per cubic meter)

Month/Year	No. of Samples Site A	Site B	Max 24-Hour Site A	Site B	Geometric Means Site A	Site B
Jun 79	4	10	24	54	18	20
Jul	0	9	--	23	--	17
Aug	3	10	21	40	16	18
Sep	3	9	35	43	20	20
Oct	4	10	51	65	31	28
Nov	3	8	29	41	25	23
Dec 79	5	8	26	39	19	24
Jan 80	6	11	38	88	11	16
Feb	6	9	16	25	6	5
Mar	5	10	16	16	5	5
Apr	4	8	48	42	22	12
May	5	9	33	62	19	19
Jun 80	3	6	43	66	31	36
13-Month Summary	51	117	51	88	16	16

[a] Period of record: June 1979 - June 1980.

Source: Stearns-Roger Corporation, *Annual Report, Meteorological and Air Quality Observation, White Mesa Uranium Project*, Table 13, July 1980.

2.4.1 Demography of the area

2.4.1.1 Current population and distribution

Utah is rather sparsely populated with a 1980 population of 1,459,010, according to a preliminary count of the 1980 census returns. This figure represents an increase of 399,737 or 37.7 percent from the 1970 census (1980 Census of Population and Housing, Bureau of the Census, PHC80-P-46). This population represents an overall density of 6.8 persons per square kilometer (17.7 per square mile), but nearly 70% of Utah's population lives in the counties of Salt Lake, Utah, and Weber where Salt lake City, Provo, and Ogden, respectively, are located.

San Juan County, where the White Mesa mill has been constructed, has a population of 12,270 (preliminary 1980), an increase of about 35% from 1970. Wayne County, the site of the Hanksville ore buying station, has a population of 1,918 (preliminary 1980, a 29% increase since 1970). Garfield County has a total population of 3,660 (preliminary 1980, a 16% increase from 1970). The data in Table 2.4 illustrate that while these three counties have experienced growth in recent years, their overall density has remained low.

The closest city to the mill site is Blanding (Table 2.5), which has a preliminary 1980 population of 3,118, up 38% from 1970. Monticello, the county seat, has a preliminary 1980 population of 1,930, 35% more than in 1970. Between them, these two communities account for nearly 41% of San Juan County's population (1980 Census of Population and Housing, Bureau of the Census). Another 45% of the total is made up of Navajo Indians living on or

Table 2.4. Area and population for Utah and Wayne, Garfield, and San Juan counties, 1970 and 1980

State or county	Land area		Total population			Population per square kilometer			
						1970		1980[a]	
	km^2	sq. miles	1970	1980[a]	Change (%)	km^2	sq. mile	km^2	sq. mile
Utah, total	213,180	82,340	1,059,273	1,459,010	37.7	5.0	12.9	6.8	17.7
Wayne	6,444	2,489	1,483	1,918	29.3	0.2	0.6	0.3	0.8
Garfield	13,507	5,217	3,157	3,660	15.9	0.2	0.6	0.3	0.8
San Juan	20,412	7,884	9,606	12,270	27.7	0.5	1.2	0.6	1.5

[a] Preliminary data.

Sources: U.S. Bureau of Census, 1970; Utah Population Work Committee, 1977.

1980 Census of Population anu Housing, Bureau of Census, Preliminary Reports, PHC 80-P-46.

near the Navajo Reservation in southern San Juan County (ER, p. 2-15). The town of Bluff has a population of about 300 (Leroy Atcitty, Postmaster, Bluff, Utah, personal communication, February 19, 1981), more than double its population in 1970 (ER, p. 2-18).

Within a 290 km (180 mile) radius of the mill there are several larger cities that are important regional centers (See Table 2.5 for distance relationships to the project sites). Moab, Utah, the closest and also the smallest, has a population of approximately 5,340 according to preliminary 1980 census records (1980 Census of Population and Housing, Bureau of the Census, PHC80-P-46). Cortez, Colorado, has a population slightly under 6,800 and Durango, Colorado has nearly 12,000 residents. Both Grand Junction, Colorado, and Farmington, New Mexico, have populations approaching 28,000.

Approximately 16 km (10 miles) from the Hanksville ore buying station is the town of Hanksville, which has a preliminay 1980 population of 358 (1980 Census of Population and Housing, Bureau of the Census PHC80-P-46).

The area within an 8 km (5 mile) radius of the mill is sparsely populated and primarily agricultural. It is estimated that about 70 to 80 people currently reside here. The closest currently inhabited dwelling unit is approximately 4.5 km (2.8 miles) north-northeast of the mill, but most area residents live in the Ute Mountain community of White Mesa, approximately 8.3 km (5.2 miles) to the southeast. The Blanding airport also lies within the 8 km (5 mile) zone, and approximately 30 to 40 people use that facility daily.

2.4.2.1 Social profile

Housing

Blanding. From 1972 to 1975, approximately 12 new units were added each year, but in 1976 that figure rose to 37.[2,3] In 1980, 49 new dwelling units were added, and this accelerated rate of construction appears to be continuing (F. Nielson, City Administrator of Blanding, personal communication, March 17, 1981). Projected preliminary housing units for 1980 total 829, which is a 43% increase over the 577 units noted in 1970 (1980 Census of Population and Housing, Bureau of the Census PHC80-P-46). Mobile homes in this area are often found on individual lots in single-family neighborhoods as well as in mobile home parks.

At present, the supply of new housing is generally keeping up with the number of residences and the vacancy rate is low. There were 20-25 vacant dwelling units in 1980, and the supply of rental units in Blanding, as in many small cities, is low (F. Nielson, City Administrator of Blanding, personal communication, March 17, 1981).

Monticello. During the five years of 1972 through 1976, the supply of housing in Monticello was increasing at approximately six units per year. In 1977 this figure jumped to around 60 units per year. However, the demand for housing has not yet exceeded the supply (R. Terry, City Manager of Monticello, personal communication, March 17, 1981). An annexation has doubled the size of the city and has provided room for more single-family homes. Approximately 15 vacancies now exist. Preliminary projected totals of housing units in 1980 number 635, a 43% increase over the total of 442 for 1970 (Community Economic Facts, Utah Industrial Development System, 1980, Monticello, Utah). As in Blanding, rental housing is scarce. A 23-unit apartment has been constructed to accommodate some of the demand for this kind of housing.

Bluff. Over the last five years, the supply of new housing in Bluff has increased at a rate of five or six new housing units annually and the demand has not exceeded the supply. The existence of approximately 70 vacant lots with water connections and available spaces in two mobile parks within the city limits indicate that Bluff is capable of accommodating future growth (ER, p. 2-56).

Hanksville. The majority of Hanksville residents live in mobile homes. Preliminary housing estimates for 1980 credit Hanksville with 160 housing units, a sizeable increase from the 1970 total of 64 (1980 Census of Population and Housing, Bureau of the Census, PHC80-P-46). There are 25 motel units available for long or short-term occupancy (Ms. Barbara Ekker, personal communication, Hanksville, Utah, February 9, 1981).

Public services

Blanding. Water is obtained from surface runoff and underground wells, and an 0.11-m^3/sec (1800-gpm) sewage treatment plant is operated by the city. Water consumption in 1976 averaged 0.023 m^3/sec (547,000 gpd). The current system is adequate to handle moderate population increases. Sewage treatment is provided through a lagoon system, and improvements are planned for the near future. Electricity from Utah Power and Light is provided through a cityowned distribution system; the city also provides solid waste collection and disposal. Propane gas is available through two private distributors, but there is no natural gas service (Community Economic Facts, Utah Idustrial Information System, Blanding, 1980).

Blanding has a full-time police force of three officers and an auxiliary force of eight, and a volunteer fire department provides fire protection. Health care is available through the 36-bed San Juan County Hospital in Monticello, a 30-bed nursing home in Blanding, and 2 local doctors, 3 nurses, and 1 dentist (Community Economic Facts, Utah Industrial Development Information System, 1980 edition, Blanding, Utah). There is a mental health clinic in town with one full-time therapist (ER, p. 2-47).

Two elementary schools and one combined junior-senior high school serve Blanding. The combined capacity of the elementary schools is 750 students; 651 are currently enrolled (Community Economic Facts, Utah Industrial Development Information System, 1980 edition, Blanding, Utah). The combined junior-senior high school has a 1980 enrollment of 608 students.

Blanding's recreational resources consist of one swimming pool, one lighted ball field, one nine-hole golf course, three parks and a school softball field and gymnasium that are also available for public use.[6] Local residents also have access to several national parks, forests, monuments and recreational areas (Table 2.7). In addition, the applicant has recently provided support for certain recreational endeavors in the local area through the sponsorship of athletic teams and related activities. To accommodate anticipated future growth, the city has set apart an area for an additional ball field and park.[6]

Monticello. Water is supplied by surface runoff and groundwater, and, as in Blanding, there is a city-operated water treatment plant. Improvements to the water supply system have been completed to raise its overall capacity to 200 acre-feet (R. Terry, City Manager of Monticello, personal communication, March 17, 1981). Primary and secondary sewage treatment is provided by a trickling filter plant (Community Economic Facts, Utah Industrial Development Information System, 1980 edition, Monticello, Utah). The City of Monticello distributes electricity supplied by Empire Electric to city residents (Community Economic Facts, Utah Industrial Development Information System, 1980 edition, Monticello, Utah). The transmission system is now at capacity, but Monticello's city manager has said that the city is currently considering ways to expand its service area. Natural gas is available through the Utah Gas Service and El Paso Natural Gas (Community Economic Facts, Utah Industrial Development Information System, 1980 edition, Monticello, Utah). Monticello currently operates a waste disposal service, and street maintenance is a joint responsibility of city and county.

Police and fire protection is provided by three full-time police employees and one part-time police employee. They are aided by the County Sheriff's Department and a volunteer fire department with three trucks (ER, pp. 2-53 and 2-54). The 36-bed San Juan County Hospital and a small mental health clinic with one therapist and one outreach worker are in Monticello. Monticello's other medical needs are currently served by 2 practicing physicians, 1 practicing dentist and 10 nurses (Community Economic Facts, Utah Industrial Development Information System, 1980 edition, Monticello, Utah).

There are an elementary school and a combined junior-senior high school in town, both of which are currently operating at about two-thirds of their peak capacity. The elementary school, which can handle 550 students, now has 384 enrolled. The combined junior-senior high school serves 337 students (Community Economic Facts, Utah Industrial Development Information System, 1980 edition, Monticello, Utah).

Three public parks, one swimming pool, one golf course, a local ski resort and the national park and recreation areas listed in Table 2.7 provide recreational opportunities for area residents. One of the city parks is currently being expanded, and it is the judgment of the city manager that these facilities are adequate to handle future mill-induced population increases. [6]

Bluff. The water system for Bluff consists of three artesian wells and a 760-m^3 (2 x 10^5-gal) storage tank capable of servicing a population almost double the present one. Sewage treatment is currently provided through individual septic tanks although construction of a community treatment facility has been proposed (ER, p. 2-56).

Two sheriff's deputies are responsible for local police protection, and fire protection is the responsibility of an eight-person volunteer fire department. Bluff residents have access to county health services in neighboring cities, and outreach workers for the Four Corners Mental Health Agency are available.

Table 2.7. Visitor statistics, recreation areas in southeastern Utah[a]

Area	Visitors (thousands)						
	1972	1973	1974	1975	1976	1977 (Jan. - Sept.)	1980
Glen Canyon National Recreation Area	60.8						1,647.0[1]
Canyonlands National Park	60.8	62.6	59.0	71.8	80.0	67.3	57.0[1]
Manti-La Sal National Forest (visitor days)[b]	105.3	100.9	88.7	76.4		NA[c]	(developed areas) 49.5[2] (dispersed use areas) 56.0[2]
Capital Reef National Park	272.0	311.2	234.0	292.1	469.6	364.2 (through August)	377.4
Hovenweep National Monument[d]	12.1	12.0	11.0	13.2	19.4	16.2	13.8
Natural Bridges National Monument	58.5	42.7	40.3	48.4	71.9	67.1	64.0

[a] Data refer to actual visitations for each area except Manti-La Sal National Forest. Here, data indicate recreation visitor days. A visitor day is the equivalent of one person entering an area for 12 hr.

[b] Data refer to the Monticello Ranger District only.

[c] Indicates data not available.

[d] Data refer to the Square Tower Ruin Unit, near Blanding.

Sources: ER, Table 2.2-5.

[1] Personal communication, M. Green, NPS, Park Operations, Denver, Colorado.

[2] Personal communication, J. Jensen, NFS, Manti-La Sal, Price, Utah.

One elementary school, with a capacity of 200, provides education for the 104 students. A p.oposal for expansion of recreational facilities was recently defeated by community voters, leaving one park, one ball field and the recreational areas shown in Table 2.7. [6]

Hanksville. A single well supplies water to Hanksville residents, and serves 40 customers. Water shares are purchased on an individual basis for $750 a share (Personal communication, Ms. Barbara Ekker, Hanksville, Utah, February 19, 1981). No community sewage is provided. A county dump is available for city waste disposal (ER, p. 2-72). The Gar-Kane Power Company supplies electricity in this area (ER, p. 2-74).

Law enforcement is provided by one part-time sheriff and road maintenance is also provided by the county. Ambulance and emergency medical services are available in town; however, the nearest medical clinic is in Green River, 97 km (60 miles) to the north. The nearest hospital is over 160 km (100 miles) away in Moab (ER, p. 2-72).

Hanksville's 52 elementary students attend a local school with an enrollment capacity of 60 (Personal communication, Ms. Barbara Ekker, Hanksville, Utah, February 19, 1981). Middle and high schoolers are bused to Bicknell, 105 km (65 miles) away. The middle school has a current enrollment of 105 and a capacity of 120; the high school has 155 students and the ability to take 200 (ER, p. 2-74).

Table 2.8. Selected demographic characteristics, San Juan, Wayne, and Garfield counties, compared to Utah (1970 and 1980)

	San Juan County	Wayne County	Garfield County	Utah
Total population[a], 1980	12,270	1,918	3,660	1,459,010
Race[b], 1980				
White	5,890	1,887	3,535	1,358,196
Other (%)	51.9	1.6	3.4	6.9
Education[c], 1970				
Median school years completed (population 25 years and over)	10.7	12.1	12.2	12.5
Percent of population with less than 5 years	27.0	1.2	0.3	2.0
Percent of population with 4 years of college or more	8.8	8.9	8.7	14.0
Age[c], 1970				
Median age	18.0	27.3	26.4	23.0
Percent under 5 years	13.9	7.4	8.2	10.6
Percent 5-17	36.0	35.4	32.6	29.6
Percent 17-64	45.6	49.3	49.4	52.5
Percent 65+	4.5	7.9	9.8	7.3

[a] *1980 Census of Population and Housing*, Bureau of the Census, Preliminary Reports, PHC 80-P-46.

[b] *Utah Affirmative Action Information*, Utah Department of Employment Security, February 1981.

[c] 1970, ER, Tables 2.2-4 and 2.2-1.

2.4.2.2 Economic Profile

Between 1970 and 1980, the number of nonagricultural payroll jobs in San Juan County increased by over 1,500, from 1,786 to 3,352. The relative importance of the various economic sectors also shifted in that period. Services increased slightly in importance, while trade and construction declined slightly. The significance of government, transportation, manufacturing and finance, insurance and real estate increased slightly, while the number of jobs in mining changed dramatically (Utah Department of Employment Security, Employment Newsletter, Southeastern District, Third Quarter 1980).

Because total employment increased so greatly, the absolute number of jobs rose in all categories. The largest by far, however, was in mining, which grew from 381 jobs in 1970 to 1,160 in 1980 (Table 2.9).

The mineral industry is extremely important to San Juan County, and uranium production is a substantial component of this sector. In fact, San Juan County is the largest producer of uranium in Utah, and this productivity is likely to continue (H.H. Doelling, Utah Geological and Mineral Survey, personal communication, March 17, 1981). Natural gas and crude oil are the other important materials being produced here (ER, p. 2-32).

Tourism is also an important part of San Juan County's economy, a part that has been increasing steadily in recent years. Between 1979 and 1980, tourist room rentals increased by 40.1 percent (Utah Department of Employment Security, Employment Newsletter, Southeastern District, Third Quarter 1980). Total nonagricultural payroll employment in Wayne County was 664 in the Third

Table 2.9. Nonagricultural payroll jobs in San Juan, Wayne, and Garfield counties from April 1977 to September 1980

	April 1977	Percent of total	April 1978	Percent of total	Percent change	July-Sept. 1979	July-Sept. 1980	Percent change
San Juan County								
Manufacturing	185	6.6	197	6.7	6.5	204	208	2.0
Mining	890	31.5	935	31.7	5.1	1126	1160	3.0
Construction	142	5.0	155	5.2	9.2	134	129	-3.7
Transportation, commerce, utilities	157	5.6	168	5.7	7.0	179	181	1.1
Trade	400	14.2	424	14.4	6.0	373	374	0.3
Finance, insurance, real estate	25	0.9	27	0.9	8.0	35	36	2.9
Services	303	10.7	322	10.9	6.3	354	374	5.7
Government	718	25.5	724	24.5	0.8	883	890	0.8
Total	2820	100.0	2452	100.0	4.7	3289	3352	1.9
Wayne County								
Manufacturing	28	6.5	24	6.5	3.6	29	30	3.4
Mining	48	11.1	50	11.2	4.2	192	198	3.[illegible]
Construction	63	14.6	64	15.4	9.5	49	47	-4.1
Transportation, commerce, utilities	2	0.5	2	0.4	-	3	3	0.0
Trade	44	11.4	52	11.6	6.1	86	85	-1.2
Finance, insurance, real estate	7	1.6	7	1.6	-	7	7	0.0
Services	23	5.3	24	5.4	4.3	37	40	8.1
Government	211	49.0	214	47.9	1.4	252	254	0.8
Total	431	100.0	447	100.0	3.7	656	664	1.2
Garfield County								
Manufacturing	237	19.1	252	19.4	6.3	315	330	4.8
Mining	46	3.7	48	3.7	4.3	186	192	3.2
Construction	57	4.6	62	4.8	8.8	54	52	-3.7
Transportation, commerce, utitlies	66	5.3	71	5.4	7.6	75	76	1.3
Trade	184	14.9	195	15.0	6.0	161	159	-1.2
Finance, insurance, real estate	14	1.1	15	1.2	7.1	20	20	0.0
Services	288	23.3	306	23.6	6.2	483	511	5.8
Government	347	28.0	350	26.9	0.9	480	485	1.0
Total	1234	100.0	1244	100.0	4.8	1774	1824	2.8

Source: Utah Department of Employment Security, Research and Analysis Section, adapted from Quarterly Employment Newsletter of Southeastern District of Utah, January-April 1978, Third Quarter 1980.

Table 2.10. Per capita incomes for Utah and Wayne, Garfield, and San Juan counties, 1973-1977 and 1979

State or county	1973	1974	1975	1976[a]	1977[b]	1979[c]
Utah	$4,100	$4,500	$4,800	$5,300	$5,900	$6,900
Wayne	3,100	3,400	3,800	4,100	6,100	5,800
Garfield	3,400	3,300	3,500	4,200	5,000	6,600
San Juan	2,400	2,700	2,900	2,900	3,400	4,700

[a] Revised

[b] Preliminary estimate

[c] Utah Department of Employment Security, Labor Market Information Services, December 1980.

Source: Utah Department of Employment Security, Research and Analysis Section, adapted from *Quarterly Employment Newsletter of Southeastern District of Utah*, January-March 1978.

Table 2.11. Total civilian labor and unemployment for Utah and Wayne, Garfield, and San Juan counties, 1970 and 1980

State or county	Labor force		Unemployment		Unemployment rate(%)	
	1970	1980[a]	1970	1980[a]	1970	1980[a]
Utah[b]	414,248	610,100	25.214	27,200	6.1	4.5
Wayne	664	1,287	57	67	8.5	5.2
Garfield	1,483	2,224	285	97	19.2	4.4
San Juan	3,015	5,306	322	427	10.7	8.0

[a] Preliminary.

[b] Data for State of Utah is 1979.

Source: Utah Department of Employment Security, Research and Analysis Section, adapted from *Quarterly Employment Newsletter of Southeastern District of Utah*, Third Quarter, 1980.

Quarter 1980 (Table 2.9). The government employed almost 39 percent of those workers, and construction, trade and mining activities accounted for nearly 49 percent (Utah Department of Employment Security, Employment Newsletter, Central District, Third Quarter 1980).

In Garfield County, nonagricultural employment for the Third Quarter 1980 totaled 1,824 (Table 2.9). The government accounted for about 26 percent of this employment, services for about 28 percent, manufacturing for about 18 percent and trade for about 7 percent (Utah Department of Employment Security, Employment Newsletter, Southeastern District, Third Quarter 1980). Garfield County is currently third in the state in uranium production (H.H. Doelling, Utah Geological and Mineral Survey, personal communication, March 17, 1981).

Between 1973 and 1977, per capita income for the state of Utah rose by 44 percent, from $4,100 to $5,900. Increases in per capita income for San Juan County did not keep pace with raises elsewhere. Income in 1973 was $2,400, 58.5 percent of the state average, and 1977 income was $3,400 or 57.6 percent of the state figure (Table 2.10).

Between 1970 and 1980, unemployment fell for the state as a whole and for Wayne, Garfield and San Juan counties. The state figure went from 6.1 to 4.5 percent; Wayne County, from 8.5 to 5.2 percent; Garfield, from 19.2 to 4.4 percent; and San Juan, from 10.7 to 8.0 percent (Table 2.11).

The number of retail and wholesale establishments and their sales are shown in Table 2.13 for San Juan County and the cities of Blanding and Monticello. Retail sales are almost evenly divided between Blanding and Monticello, together accounting for 94.3 percent of the county's total retail activity.

In 1977, San Juan County levied an ad valorem tax of 16 mills on the assessed value of all property in the county for the general fund. An additional 40 mills was collected for the county school district and a final 2 mills for the countywide water conservation district. In 1979, the communities of Monticello, Blanding and Bluff also levied an extra 17.7, 22 and 10 mills, respectively, on the assessed value of all property within their corporate limits. Finally, the Monticello and Blanding Cemetery Districts each collected 2 mills on all property within those district boundaries. Mines and mills are subject to the above taxes as is all other real property.

San Juan County handles its financial affairs through a number of separate funds, the largest of which is the general fund (Appendix C). Within this fund, the property tax comprises the largest single source of revenue, accounting for slightly over 33 percent of the 1977 total. Shared revenues from the state of Utah contributed another 20.1 percent and federal shared revenues and in-lieu-of-tax payments another 15.3 percent.

In the fiscal year ending in June 1977, the largest source of revenue for the city of Blanding's general fund (Appendix C) was the sale of a general obligation electric-, water- and sewer-improvement bond issue, yielding $225,000. This was followed by slightly over $55,000 from sales and use taxes and a little more than $44,000 from property taxes. Federal revenue sharing and waste collection and disposal fees were the other major sources of funds, each contributing about $18,000 to the total. Utility operations were financed through a separate fund.

Blanding's major expenditures in the same year were for public utility capital improvements and police expenses, each of which cost less than $50,000. Street maintenance cost about half this amount, and waste collection and airport funds made up the last of the major expenditures. In 1980, property and sales taxes for Blanding totaled $145,020, or 52.7 percent of general fund revenues (F. Nielson, City Administrator of Blanding, personal communication, March 17, 1981).

Table 2.13 Retail and wholesale activity in San Juan County, Blanding and Monticello (1980)

	San Juan County	Blanding	Monticello
Number of retail establishments	NA [a]	110 [b]	NA [a]
Retail sales	NA [a]	NA [a]	NA [a]
Number of wholesale establishments	NA [a]	2 [b]	NA [a]
Wholesale sales	NA [a]	NA [a]	NA [a]
Gross Taxable Sales	$46,750 [c]	$13,344 [c]	$13,967 [c]

[a] Information is not available.

[b] Utah Industrial Development Information System, *Economic Facts for San Juan County, Blanding, and Monticello, 1980.*

[c] Data for Four Quarters ending 6/30/80; Utah Department of Employment Security, *Employment Newsletter, Southeastern District, Third Quarter 1980.*

As in Blanding, Monticello has a separate fund for operating public utilities. Over $350,000 was spent during fiscal year 1977-1978. Over 60 percent of the city's general fund revenues for 1980 came from sales and property taxes, amounting to $177,000. Unlike the county, both Monticello and Blanding receive more of their general funds from sales taxes than from property taxes. In 1980, $95,000 was spent for police protection, which constituted the city's largest annual expenditure.

Table 2.14. Traffic volumes in 1979 for San Juan County and Blanding-Hanksville route

Highway	Segment	Average annual daily traffic	Approximate percentage of out-of-state passenger traffic
Utah Route 95	Blanding to Natural Bridges National Monument	450	20[a]
	Natural Bridges to San Juan-Garfield County line	185	10[a]
	San Juan-Garfield County line to Hanksville	530	19
Utah Route 163	Monticello to La Sal Junction	2760	21
	Monticello to Blanding	4245	10-25[a]
	Blanding to Utah Route 262 turnoff	3035	20-30[a]
	Utah Route 262 to Bluff	850	40[a]
	Bluff to Mexican Hat	1645	40[a]
Utah Route 263	Route 95 to Halls Crossing at Glen Canyon	155	20[a]
Utah Route 261	Route 95 to Mexican Hat	340	50[a]

[a] Information from 1975, ER, Table 2.2.9.

Source: *Traffic on Utah Highways 1979*. Utah Department of Transportation, Transportation Planning Division, Travel Analysis Unit.

REFERENCES FOR SECTION 2

1. Stearns-Roger Corporation, "Annual Report, Meteorological and Air Quality Observations, White Mesa Uranium Project", July 1980.

2. Title 40, Code of Federal Regulations, Part 52.

3. Bureau of the Census, 1980, 1980 Census of Population and Housing, PHC 80-P-46.

4. Utah Department of Employment Security, Employment Newsletter, Central District, Third Quarter 1980.

5. Utah Department of Employment Security, Employment Newsletter, Southeastern District, Third Quarter 1980.

6. Utah Industrial Development Information System. "Community Economic Facts", 1980 edition, for Blanding and Monticello, Utah.

7. Utah Department of Transportation, "Traffic on Utah Highways - 1979", June 1980.

3. OPERATIONS

3.1 MINING OPERATIONS

The White Mesa Uranium Project will process ores originating in independent and company-owned mines. Mines within 160 km (100 miles) of Energy Fuels ore buying stations (in Blanding or Hanksville) are expected to supply much of the ore processed by the facility. There will be no onsite mining activity. The environmental effects of the Blanding ore buying station (on the project site) are included in this assessment.

3.2 THE MILL

The proposed mill expansion will continue to utilize an acid leach-solvent extraction process for uranium recovery. Provisions for vanadium byproduct recovery are included in the design. The proposed expanded processing capacity of the mill is 3150 MT (3500 tons) per day. The expected average ore grade is 0.25% U_3O_8. The process will recover approximately 94% of the uranium in the ore. The expanded mill would operate on a 24 hr/day, 340 days per year schedule. Based on the above design parameters, the annual U_3O_8 production of the expanded White Mesa mill will be approximately 2858 MT (3150 tons). The estimated annual vanadium (V_2O_5) production is 2590 MT (2850 tons).

3.2.3 Nonradioactive wastes and effluents

3.2.3.1 Gaseous effluents

Milling operations will result in the release of nonradioactive vapors to the atmosphere. Emissions given in the White Mesa FES were adjusted for the proposed expansion by applying a scaling factor.

Leaching

The leaching of ores in the uranium and vanadium circuit will produce carbon dioxide gas, sulfur dioxide gas, water vapor, and some sulfuric acid mist. Based on the projected calcite concentration in the ore and the proposed expanded process conditions, emissions of carbon dioxide are estimated to be 3850 kg/hr (8400 lb/hr) and emissions of sulfur dioxide and sulfuric acid mist to be 0.040 kg/hr (0.09 lb/hr) from leaching.

Solvent extraction

The solvent extraction processes used in uranium and vanadium recovery will release organic vapors consisting of kerosene (95%) and small quantities of amine and alcohol compounds used in the extraction. Organic losses are estimated at 0.081 kg/hr (0.175 lb/hr). There are no federal or state emissions standards applicable to the release of this mixture. However, federal and state ambient air quality standards have been set at 160 g/m^3, averaged over 3 hours.

Product dryers

The yellowcake and vanadium black flake dryers will burn approximately 19 liters/hr (5 gph) of No. 2 fuel oil (1% sulfur), producing gaseous effluents containing nitrogen, carbon dioxide, water vapor, sulfur dioxide, and nitrogen oxides, as well as some ammonia from decomposition of the concentrate product. Radioactive effluent from this source is discussed in Section 3.2.4.6. It is estimated that the proposed expansion will result in concentrations of sulfur dioxide and nitrogen oxides of 1.6 kg/hr (3.5 lb/hr) and 0.40 kg/hr (0.88 lb/hr) respectively.

Because the heat input to the yellowcake and vanadium black flake dryers will be only 8.2×10^8 J/hr (7.9×10^5 Btu/hr), no federal or state emission standards apply to this source. However, federal and state ambient air quality standards apply to nitrogen oxides, sulfur dioxide, and particulate concentrations due to dryer operation.

Building and process heating

Steam necessary for building and process heating will be generated from coal-fired boilers. Approximately 81 MT (90 tons) of coal per day will be required at a heat input of approximately 7.9×10^{10} J/hr (7.5×10^6 Btu/hr). As a result of the boiler combustion, various stack gases will be released to the atmosphere, including carbon dioxide, water vapor, sulfur dioxide, and nitrogen oxides.

state and federal emission standards are not applicable to a steam generating boiler of this small size. However, federal and state ambient air quality standards will apply to the resulting ambient concentrations. The combustion of 81 MT (90 tons) per day of 0.3% sulfur coal would generate approximately 50 kg (1080 lb) of sulfur dioxide per day. Based on an industrial NO_x emission factor of 10 kg/MT (20 lb/ton) of coal burned, nitrogen oxide emissions should be 310 kg/day (1800 lb/day). Fly ash emissions from this proposed boiler are discussed in Section 3.2.3.3.

Building and process heating

The combustion of coal will produce two ash products, fly ash and bottom ash. With a coal usage rate of 81 MT (90 tons) per day, the total ash production would be less than 8.1 MT (9 tons) per day, which will be sent to the tailings retention system. These ash products would settle with the tailings solids and present no additional waste problems.

Stack emissions from the coal-fired boilers will pass through multiclones to remove fly ash, and less that 129 kg (285 lb) per day of particulate matter will be released to the atmosphere. Fly ash deposits from the precipitator will also be sent to the tailings impoundment (ER, p.3-21).

Vanadium product dryer

When ore characteristics permit, the vanadium recovery circuit will extract the vanadium from the uranium circuit effluent (Section 3.2.2.2). The precipitated vanadium product will be dried in an oil-fired dryer to give vanadium pentoxide (black flake). Vanadium pentoxide is toxic. Therefore, drying and packaging will occur in an isolated building, and emissions will be controlled by a wet fan scrubber operating at an equivalent venturi scrubber pressure of 51 cm (20 in) of water and an efficiency of 99%. Estimated particulate release rates from this source are 0.40 kg/hr (0.88 lb/hr).

3.2.4 Radioactive wastes and effluents

Mining and milling of natural uranium releases some radioactivity to the environment. Uranium-238 and its daughter products in the ore are the most significant sources of radiation. The ore processed by the White Mesa mill is expected to have an average grade of 0.25% uranium (as U_3O_8). Ore of this grade has an activity of about 705 pCi of uranium-238 per ton of ore. The activity from uranium-235 and its daughters is only 5% of that of the uranium-238 series and may be ignored as it is radiologically insignificant.

Ore buying, shipping, and milling processes offer several pathways for release of radioactive effluents to the environment (Figure 3.5). The applicant's existing Hanksville and Blanding ore buying stations and the White Mesa mill are designed to minimize the releases through these pathways. Effluents from the operation of these stations will be considered only as they impact the environment around the site. In the following sections each potential effluent source is discussed, and estimates of effluent releases based on operating data from other similar facilities will be presented.

3.2.4.1 Ore crushing and sampling

Run-of-mine ore will be received at the applicant's ore buying stations at Hanksville and Blanding. Ore from different mines will be segregated into "lots" to facilitate sampling and payment. The raw ore will pass through a primary crusher and be reduced to less than 3.8 cm (1.5 in). A fraction of the ore will be subjected to a crushing and sampling process that will produce a representative sample of the entire ore lot being processed. During the sampling process, radon gas and low-level radioactive ore dust will be released.

The Blanding ore buying station is expected to process 200 MT (219 tons) of ore per hour, operating on one 8-hour shift per day. All feeders, crushers, screens, chutes, and transfer points are enclosed in hoods connected via ducts to the three baghouse dust filters used in the plant. The filters are cleaned by a reverse jet of air, which knocks the dust into a bin at the bottom of the baghouse. The collected dust is recombined with the ore at appropriate points, so the ore grade is not altered (ER, p. 3-32).

The bag filters have a dust removal efficiency of around 99.5% (Reference 2). Assuming the ore to be fairly dry (6% moisture) and the dust load to the collector to be 0.008% by weight,[3] the dust loss from the total crushing and sampling process would be approximately 4×10^{-5}%. Conservatively assuming that the entire mill ore demand of 3150 MT per day is processed by the Blanding station primary crusher, the annual dust emission would be 0.429 MT per year. At an average grade of 0.25% U_3O_8, the concentration of uranium-238 in ore would be about 705 pCi/g. Also, the uranium concentration of fine crusher dusts is reported to be about 2.5 times the concentration in the gross ore.[3] Based on these data, and the assumption of secular equilibrium, approximately 7.6 x 10^{-4} Ci per year of uranium-238 and each radioactive daughter would be released. A more conservative factor of 8.82 x 10^{-3} was calculated by other methods for this analysis.[5]

Radon-222 gas would be released as a result of disturbance of the ore during processing. Roughly 10% of the equilibrium amount of radon is released during crushing and grinding operations.[4] Use of this value for the Blanding ore buying station is conservative because secondary crushing and grinding do not occur. Based on a 10% radon loss, an ore process rate of 3150 MT per day, and an equilibrium ore concentration of 705 pCi/g, approximately 76 Ci of radon-222 would be released each year.

3.2.4.3 Ore pads

Quantities of ore will be stored in stockpiles at the applicant's ore buying stations at Hanksville and Blanding. The effluents from the ore pad at the Blanding ore buying station, however, would act in synergism with the effluents from the proposed mill; therefore, the Blanding ore pad operations and effluents are discussed.

Because of present ore buying operations, the applicant is accumulating ore in a 2.4-ha (6-acre) area north of the existing Blanding ore buying station. The applicant estimated that a maximum of 2.3 x 10^5 MT (2.5 x 10^5 tons) of ore will be stockpiled at the Blanding site at the time of mill startup. This quantity of ore would create a pile 6.7 m (22 ft) tall covering the 2.4-ha (6-acre) stockpile area. During operations, the stockpile would be reduced to under 9 1 x 10^4 MT (1 x 10^5 tons).

Particulates and radon-222 will be the main atmospheric emissions associated with the ore piles. Based on the meteorological data and the dusting rates for tailings sands (as a function of wind speed) presented in Appendix D, and assuming that ore pile dust emissions will be 1% of those from an equivalent area of fine-grained tailings, the annual average ore pile dusting rate is estimated to be about 3.6×10^{-6} g/m^2-sec. For a surface area of 3.3-ha (8.3 acre), accounting for side areas and surface roughness, the annual ore pile dust release is estimated to be 3800 kg. At a gross ore concentration of 705 pCi/g and a fine concentration of 2.5 times that figure, the annual uranium-238 release from this source would be 5.0×10^{-3} Ci/yr. The release of each particulate daughter in secular equilibrium would also be 5.0×10^{-3} Ci/yr.

The applicant intends to moisten pile surfaces after ore is added or removed and this will act to reduce these releases. As the release estimates presented here are basically proportional to the area of the ore storage piles, they would not be significantly affected by changes in the volume of stored material as long as it is distributed over the same surface area.

Radon-222 will be produced in the pile from decay of radium-226. Most of the radon decays in place with only a small fraction of the radon escaping the piles via diffusion. The estimated annual radon release for the maximum stockpile case is approximately 1600 Ci/year. As mill operations progress and the size of the pile decreases to an equilibrium value under 9.1×10^4 MT, the radon release from this smaller pile will depend on pile geometry. The radon flux from the pile surface is virtually independent of thickness for thicknesses greater than 3 m (10 ft). Therefore, if the same area 3.3-ha (8.3 acre) is maintained for the equilibrium pile, the annual radon release would be the same as for the maximum stockpile, that is, 1600 Ci/year.

Dust control measures such as moistening the surface of the stockpiled ore will also reduce radon releases because the moisture will decrease the diffusion coefficient. This effect is expected to be small.

3.2.4.4 Secondary crushing and grinding

The White Mesa mill uses a semiautogenous (SAG) mill to perform secondary crushing and grinding of the ore. The SAG mill also functions as a primary crusher for ores received directly from mines (and not through ore buying stations). This process uses larger pieces of ore to crush and grind smaller pieces; thus the ore essentially grinds itself. Steel balls may be added as necessary to aid in grinding.

Because the SAG mill is a wet process, particulate releases are small. Assuming a release fraction of 1×10^{-4}%, a gross ore concentration of 705 pCi/g, a fine concentration 2.5 times higher, and a processing rate of 3150 MT/day, the annual release of uranium-238 and each daughter in secular equilibrium from secondary crushing and grinding is estimated to be 1.83×10^{-3} Ci. However, for the execution of the MILDOS code the figure of 4.08×10^{-5} Ci/yr was used, which was derived from estimates of emissions due to dumping ore into the receiving hopper.[5] Based on a release fraction of 20% the annual release of radon-222 gas from this source is estimated to be 190 Ci.

3.2.4.6 Yellowcake drying and packaging

Normally, the uranium concentrate (precipitated ammonium diuranate) will be dried at 650°C. The product (yellowcake) will be about 90% U_3O_8 and will contain about 94% of the uranium in the ore. In addition, yellowcake will contain about 0.5% of the thorium-230 and 0.1% of the radium-226 and daughters originally in the ore.[1,2,6] The uranium product dryer and product crusher will be isolated from other mill areas. Emissions will be controlled by wet fan scrubbers operating at an equivalent venturi scrubber pressure of 0.5 m (20 in) of water with an efficiency of about 99%. The solution and particulates collected from the scrubbers will be recycled to the No. 1 yellowcake thickener in the mill (ER, p. 3-19). Data presented in Table 9.13 of Reference 3 indicate that about 1.2% of the annual yellowcake production may be expected to reach the wet fan scrubbers. At a gross ore grade of 0.25% U_3O_8 and a recovery rate of 94%, the annual production of pure yellowcake (U_3O_8) would be about 2702 MT. Stack testing data at the White Mesa mill show a U_3O_8 release rate of 2.86 g/hr at the current annual production rate of 863 MT U_3O_8. Scaled up to the proposed annual production rate of 2702 MT U_3O_8, the release rate would be 8.95 g/hr. Conservatively using 365 days/yr of operation, this would result in an annual U_3O_8 release of about 79 kg. The uranium-238 release rate is then calculated to be about 0.022 Ci/yr. Releases of other isotopes would be about 1.1×10^{-4} Ci/yr of thorium-230 and 2.2×10^{-5} Ci/year each of radium-226 and lead-210. Releases of radon gas from this source are negligible.

3.2.4.7 Tailings retention area

An increase in production will decrease the time allotted for filling of the tailings retention cells. Without modification of the impoundment system the mill life will be shortened. The design currently employed is adequate for the next licensing term.

3.2.4.8 Uranium concentrate transportation

The uranium concentrate will be transported in 55-gal drums by truck because no rail transportation is available at the site. Uranium shipment, about 7875 drums each year, will result in an external radiation dose[6] to an individual of 2 mR/hr at any edge of the truckbed. Under normal operating conditions, no significant release of radioactive particulates would occur. However, release could occur during transportation accidents as discussed in Section 5.3.1.

3.2.4.9 Source terms

Sections 3.2.4.1 through 3.2.4.8 describe the nature and quantity of radioactive effluents conservatively estimated to be generated by milling operations at the White Mesa Uranium Project. Estimates employed in the above discussions were derived from project design parameters. The estimates reflect operation of the fully developed mill and tailings area. Initial releases from the tailings area will be lower than the estimated values for several years after startup. Therefore, the use of full-scale operation as the basis for estimates adds some additional conservatism to the analysis. Table 3.2 gives the design parameters used in estimates of radioactive release rates. The source terms for the milling operations and areas are presented in Table 3.3.

Table 3.2. Principal parameter values used in the radiological assessment of the White Mesa Uranium Project

Parameters	Value
General data	
Average ore grade, % U_3O_8	0.25
Ore-concentration, pCi of U-238 and daughters per gram	705
Ore processing rate, MT/day	3150
Days of operation per year	365
Blanding ore crusher	
Ore processing rate, MT/day	3150
Fraction released as particulates	2.0×10^{-5}
Fraction of radon released	0.1
Dust: ore concentration ratio	2.5
Ore storage piles	
Actual area, ha (acres)	5.4 (14)
Effective dusting area, ha (acres)	3.3 (8.3)
Annual average dust loss rate, g/m^2 sec	3.6×10^{-6}
Dust: ore concentration ratio	2.5
Semiautogenous grinder	
Ore processing rate, MT/day	3150
Fraction released as particulates	1.0×10^{-6}
Fraction of radon released	0.2
Dust: ore concentration ratio	2.5
Yellowcake drying and packaging	
Fraction U to yellowcake	0.94
Fraction Th to yellowcake	0.005
Fraction Ra and Pb to yellowcake	0.001
Annual U_3O_8 production, MT	2702
Annual yellowcake production, MT	3003
Fraction of yellowcake to scrubber	0.012
Scrubber release fraction	0.01
Tailings impoundment system	
Fraction U to tailings	0.06
Fraction Th to tailings	0.995
Fraction Ra and Pb to tailings	0.999
Area, ha (acres) per cell	25 (63)
Area subject to dusting, ha (acres)	61 (153)
Annual average dust loss rate, g/m^2 sec	1.3×10^{-7}
Dust: tails concentration ratio	2.5

Table 3.3. Estimated annual releases of radioactive materials resulting from the White Mesa Uranium Project

Source	Annual releases (Ci)[a]			
	U-238	Th-230	Ra-226	Rn-222
Blanding ore crusher	2.96×10^{-2}	2.96×10^{-2}	2.96×10^{-2}	$9.4 \times 10_{3}$
Ore storage piles	5.00×10^{-3}	5.00×10^{-3}	5.00×10^{-3}	1.6×10^{3}
Secondary crusher	4.08×10^{-5}	4.08×10^{-5}	4.08×10^{-5}	1.9×10^{2}
Yellowcake scrubber	2.38×10^{-2}	1.1×10^{-4}	2.38×10^{-5}	0.0
Tailings system	1.03×10^{-4}	1.64×10^{-3}	1.72×10^{-3}	8.18×10^{3}

[a] Releases of other isotopes in the U-238 decay chain are included in the radiological impact analysis. These releases are assumed to be identical to those presented here for parent isotopes. For instance, the release rate of U-234 is taken to be equal to that for U-238. Releases for Pb-210 are assumed the same as for Ra-226.

REFERENCES FOR SECTION 3

1. "Standards of Performance for New Stationary Sources", USEPA, Federal Register, Vol. 42, No. 160, August 18, 1977.

2. F. J. Miller, et al., "Size Considerations for Establishing a Standard for Inhalable Particles", Journal of Air Pollution Control Association, Vol. 29, No. 6, pp. 610-615 June 1979.

3. R. C. Dahlman, G. S. Hill, and J. P. Witherspoon, "Correlation of Radioactive Waste Treatment Costs and the Environmental Impact of Waste Effluents in the Nuclear Fuel Cycle", Vol. 1, ORNL/TM-4903, Oak Ridge National Laboratory, Oak Ridge, Tenn., July 1975, Table 9.12.

4. Reference 3, p. 151.

5. Fugitive Dust Emission Factors, Gary D. McCutchen, Colorado Department of Health, Air Pollution Control Division, Stationary Sources Section.

6. P.E. Morrow, et al., "Deposition and Retention Models for Internal Dosimetry of the Human Respiratory Tract", Health Physics, Vol. 12, pp. 173-207, February 1966.

4. ENVIRONMENTAL IMPACTS

4.1 AIR QUALITY

4.1.2 Operation

For the proposed expansion, coal use will increase 150% and ore handling and processing 175%. Emission rates and atmospheric concentrations given in this section of the White Mesa FES may reasonably be scaled up by either of the above two factors, according to the source under scrutiny.

The White Mesa Uranium Mill was given approval to construct by the Utah Division of Environmental Health on May 7, 1979.

The Environmental Protection Agency granted approval for a Prevention of Significant Deterioration (PSD) permit on May 4, 1979.

4.3.2 Groundwater

4.3.2.1 Water usage

The applicant's most recent permit allows utilization of up to 1.60 x 10^6 m^3, or 1303 acre-feet of water per year (personal communication, Dean Roberts, Energy Fuels). The expanded mill will use about 2.22 x 10^6 m^3 (1800 acre-feet) of water per year, most of which will be withdrawn from the Navajo sandstone aquifer. All other wells within 8 km (5 miles) produce from other formations. This usage should have no effect on other users.

4.7 RADIOLOGICAL IMPACTS

4.7.3 Radiation dose commitments to individuals

For assessment and monitoring purposes, the nearest occupied residence is approximately 5.2 km (3.2 miles) south-southeast of the mill building. An intermittantly occupied residence approximately 4.5 km (2.8 miles) north-northeast of the mill was not used as the nearest residence due to its proximity to the Plateau Resources, Ltd., operation. In the direction of the prevailing winds, there are no known residences within 10 km (6.2 miles). For assessment purposes, an arbitrary receptor was placed 10 km southwest of the mill (Table 4.6). The nearest potential residence location is 1.9 km (1.2 miles) due north of the mill building, where privately held acreage abuts the northern border of the Energy Fuels property. All other lands abutting the project site to the east, south, and west are the property of Energy Fuels Nuclear, Inc., or the U.S. Bureau of Land Management.

Nearby population centers are the community of White Mesa, about 8.3 km (5.2 miles) to the southeast with an estimated population of 300, and the city of Blanding, 9.3 km (5.8 miles) to the north-northeast with a 1980 preliminary population of 3,118 (see revised section 2.4.1.1).

Table 4.6 presents the yearly individual dose commitments, by pathway, for the nearest residence, the hypothetical nearest residence in the prevailing wind direction, and the hypothetical nearest potential residence. In addition, calculated doses for an individual in the community of White Mesa and in the city of Blanding are given.

Table 4.6.1. 40 CFR 190[a] Annual dose commitments to individuals from radioactive releases due to operation of the White Mesa Uranium Mill

REGION=ENERGY FUELS NUCLEAR CODE=MILDOS,REVO (7/79) DATE= 81/05/20.
METSET=SITE JN79-JN80 PAGE NO. 113
TIME STEP NUMBER 2, 1982-1995 3500TPD DURATION IN YRS IS... 12.7
NUMBER 1 NAME=NEAREST RESIDENCE X= 1.7KM, Y= -4.9KM, Z= -70.0M, DIST= 5.2KM, IRTYPE=10
40CFR190 ANNUAL DOSE COMMITMENTS COMPUTED FOR THIS LOCATION, MREM/YR

AGE	PATHWAY	WH.BODY	BONE	AVG.LUNG	LIVER	KIDNEY	BRONCHI
ADULT	INHAL.	4.65E-03	1.39E-01	2.56E-01	7.84E-03	3.86E-02	0.
ADULT	GROUND	5.12E-04	5.12E-04	5.12E-04	5.12E-04	5.12E-04	5.12E-04
ADULT	CLOUD	4.56E-09	4.56E-09	4.56E-09	4.56E-09	4.56E-09	4.56E-09
ADULT	VEG.ING.	8.28E-03	9.97E-02	8.28E-03	7.77E-03	2.36E-02	8.28E-03
ADULT	MEAT ING	1.41E-03	1.76E-02	1.41E-03	1.82E-03	5.37E-03	1.41E-03
ADULT	MILK ING	2.34E-03	2.46E-02	2.34E-03	5.10E-04	1.71E-03	2.34E-03
ADULT	TOTALS	1.72E-02	2.81E-01	2.68E-01	1.84E-02	6.98E-02	1.25E-02

REGION=ENERGY FUELS NUCLEAR CODE=MILDOS,REVO (7/79) DATE= 81/05/20.
METSET=SITE JN79-JN80 PAGE NO. 129
TIME STEP NUMBER 2, 1982-1995 3500TPD DURATION IN YRS IS... 12.7
NUMBER 9 NAME=NRST RES. PRVLING WD X= -7.1KM, Y= -7.1KM, Z= -70.0M, DIST= 10.0KM, IRTYPE=10
40CFR190 ANNUAL DOSE COMMITMENTS COMPUTED FOR THIS LOCATION, MREM/YR

AGE	PATHWAY	WH.BODY	BONE	AVG.LUNG	LIVER	KIDNEY	BRONCHI
ADULT	INHAL.	1.28E-02	3.85E-01	7.37E-01	2.15E-02	1.07E-01	0.
ADULT	GROUND	1.15E-03	1.15E-03	1.15E-03	1.15E-03	1.15E-03	1.15E-03
ADULT	CLOUD	1.32E-08	1.32E-08	1.32E-08	1.32E-08	1.32E-08	1.32E-08
ADULT	VEG.ING.	1.33E-02	1.61E-01	1.33E-02	1.23E-02	3.81E-02	1.33E-02
ADULT	MEAT ING	2.25E-03	2.82E-02	2.25E-03	2.88E-03	8.60E-03	2.25E-03
ADULT	MILK ING	3.78E-03	4.00E-02	3.78E-03	8.09E-04	2.93E-03	3.78E-03
ADULT	TOTALS	3.33E-02	6.15E-01	7.57E-01	3.87E-02	1.58E-01	2.05E-02

[a]Excludes contributions from Rn-222 and its daughters.

Table 4.6.2. 40 CFR 190[a] Annual dose commitments to individuals from radioactive releases due to operation of the White Mesa Uranium Mill

REGION=ENERGY FUELS NUCLEAR CODE=MILDOS,REVO (7/79) DATE= 81/05/20.
METSET=SITE JN79-JN80 PAGE NO. 117
TIME STEP NUMBER 2, 1982-1995 3500TPD DURATION IN YRS IS... 12.7
NUMBER 3 NAME=COMM. OF WHITE MESA X= 3.0KM, Y= -7.7KM, Z=-101.0M, DIST= 8.3KM, IRTYPE=10
40CFR190 ANNUAL DOSE COMMITMENTS COMPUTED FOR THIS LOCATION, MREM/YR

AGE	PATHWAY	WH.BODY	BONE	AVG.LUNG	LIVER	KIDNEY	BRONCHI
ADULT	INHAL.	2.07E-03	6.19E-02	1.14E-01	3.49E-03	1.72E-02	0.
ADULT	GROUND	2.33E-04	2.33E-04	2.33E-04	2.33E-04	2.33E-04	2.33E-04
ADULT	CLOUD	2.02E-09	2.02E-09	2.02E-09	2.02E-09	2.02E-09	2.02E-09
ADULT	VEG.ING.	3.84E-03	4.62E-02	3.84E-03	3.60E-03	1.09E-02	3.84E-03
ADULT	MEAT ING	6.52E-04	8.15E-03	6.52E-04	8.42E-04	2.49E-03	6.52E-04
ADULT	MILK ING	1.09E-03	1.14E-02	1.09E-03	2.36E-04	7.89E-04	1.09E-03
ADULT	TOTALS	7.88E-03	1.28E-01	1.19E-01	8.41E-03	3.16E-02	5.81E-03

REGION=ENERGY FUELS NUCLEAR CODE=MILDOS,REVO (7/79) DATE= 81/05/20.
METSET=SITE JN79-JN80 PAGE NO. 119
TIME STEP NUMBER 2, 1982-1995 3500TPD DURATION IN YRS IS... 12.7
NUMBER 4 NAME=BLANDING RESIDENT X= 1.8KM, Y= 9.1KM, Z= 130.0M, DIST= 9.3KM, IRTYPE=10
40CFR190 ANNUAL DOSE COMMITMENTS COMPUTED FOR THIS LOCATION, MREM/YR

AGE	PATHWAY	WH.BODY	BONE	AVG.LUNG	LIVER	KIDNEY	BRONCHI
ADULT	INHAL.	9.60E-03	2.89E-01	5.46E-01	1.03E-02	8.04E-02	0.
ADULT	GROUND	8.49E-04	8.49E-04	8.49E-04	8.49E-04	8.49E-04	8.49E-04
ADULT	CLOUD	9.54E-09	9.54E-09	9.54E-09	9.54E-09	9.54E-09	9.54E-09
ADULT	VEG.ING.	1.04E-02	1.26E-01	1.04E-02	9.63E-03	2.97E-02	1.04E-02
ADULT	MEAT ING	1.76E-03	2.20E-02	1.76E-03	2.25E-03	6.71E-03	1.76E-03
ADULT	MILK ING	2.94E-03	[illegible]12E-02	2.94E-03	6.32E-04	2.26E-03	2.94E-03
ADULT	TOTALS	2.55E-02	4.69E-01	5.62E-01	2.96E-02	1.20E-01	1.59E-02

[a] Excludes contributions from Rn-222 and its daughters.

Table 4.6.3. 40 CFR 190[a] Annual dose commitments to individuals from radioactive releases due to operation of the White Mesa Uranium Mill

REGION=ENERGY FUELS NUCLEAR CODE=MILDOS,REVO (7/79) DATE= 81/05/20.
METSET=SITE JN79-JN80 PAGE NO. 115
TIME STEP NUMBER 2, 1982-1995 3500TPD DURATION IN YRS IS... 12.7
NUMBER 2 NAME=NRST POTENTIAL RES. X= 0.0KM, Y= 1.9KM, Z= -3.1M, DIST= 1.9KM, IRTYPE=10
40CFR190 ANNUAL DOSE COMMITMENTS COMPUTED FOR THIS LOCATION, MREM/YR

AGE	PATHWAY	WH.BODY	BONE	AVG.LUNG	LIVER	KIDNEY	BRONCHI
ADULT	INHAL.	1.49E-01	4.46E+00	8.60E+00	2.49E-01	1.24E+00	0.
ADULT	GROUND	1.36E-02	1.36E-02	1.36E-02	1.36E-02	1.36E-02	1.36E-02
ADULT	CLOUD	1.56E-07	1.56E-07	1.56E-07	1.56E-07	1.56E-07	1.56E-07
ADULT	VEG.ING.	1.56E-01	1.89E+00	1.56E-01	1.44E-01	4.46E-01	1.56E-01
ADULT	MEAT ING	2.64E-02	3.31E-01	2.64E-02	3.38E-02	1.01E-01	2.64E-02
ADULT	MILK ING	4.43E-02	4.69E-01	4.43E-02	9.48E-03	3.44E-02	4.43E-02
ADULT	TOTALS	3.89E-01	7.17E+00	8.84E+00	4.50E-01	1.83E+00	2.41E-01

[a]Excludes contributions from Rn-222 and its daughters.

At each of these locations, dose calculations are based on the assumption that an individual obtains all of his food from that grown at his residence. Further, beef cattle were assumed to obtain 98% of their feed from grazing and locally grown feed.

4.7.4 Radiation dose commitments to populations

The annual doses to the current population estimated to exist within 80 km (50 miles) of the site are presented in Table 4.7 along with estimated annual doses to the same population from natural background radiation sources. Population dose commitments resulting from the operation of the White Mesa Uranium Mill represent less than 0.5% of the doses from natural background sources.

Table 4.7. Annual population dose commitments within 80 km (50 miles)

Organ	Population doses, man-rems/year[a]	
	Plants effluents	Natural background[b]
Whole Body	1.84	7,500
Bone	7.52	7,500
Average Lung	6.38	7,500
Bronchial epithelium	97.1	23,000

[a] Based on an estimated current population of 8688.

[b] The estimated natural background dose rate to the whole body is 161 millirems per year. The bronchial epithelium dose from naturally occurring Rn-222 is assumed to be 500 millirems per year (Section 2.10).

4.7.5 Evaluation of radiological impacts on the public

All radiation doses calculated to result to the surrounding population from uranium milling operations at the White Mesa site are small fractions of those arising from naturally occurring background radiation (see Table 4.7). They are also small when compared to the average medical and dental x-ray exposures currently being received by the public for diagnostic purposes.

Calculated annual individual dose commitments are only small fractions of present NRC limits for radiation exposure in unrestricted areas, as specified in 10 CFR, Part 20, "Standards for Protection Against Radiation". Dose commitments to actual receptors are well below limits specified in the EPA's "Radiation Protection Standards for Normal Operations of the Uranium Fuel Cycle" (40 CFR, Part 190), which became effective for uranium milling operations in December 1980. Table 4.8 provides a comparison of maximum calculated annual dose commitments with the radiation exposure limits of 40 CFR, Part 190.

Table 4.8. Comparison of annual dose commitments to individuals with applicable radiation protection standards

Organ	Estimated dose, mrem/yr	Applicable limit, mrem/yr	Fraction of limit
Nearest actual residence, 5.2 km (3.2 miles) south-southeast			
Present EPA standard (40 CFR, Part 190)[a]			
Whole Body	0.0172	25	0.0007
Bone	0.281	25	0.01
Average Lung	0.268	25	0.01
Kidney	0.0698	25	0.003
Bronchial epithelium	0.0125	b	
Nearest potential residence, 1.9 km (1.2 miles) north			
Present EPA standard (40 CFR, Part 190)[a]			
Whole body	0.389	25	0.02
Bone	7.17	25	0.29
Average Lung	8.84	25	0.35
Kidney	1.83	25	0.08
Bronchial epithelium	0.241	b	

[a] Doses computed for evaluation of compliance with 40 CFR, Part 190 are less than total doses because dose contributions from Rn-222 released from the site, and any radioactive daughters that grow in from released Rn-222 have been eliminated. Limits in 40 CFR Part 190 do not apply to Rn-222 or its radioactive daughters.

[b] Not limited

4.8 SOCIOECONOMIC IMPACTS

4.8.1 Demography and settlement pattern

4.8.1.1 Population increase from direct employment

Expansion of the White Mesa Uranium Mill is expected to add about 20 new employees (C. E. Baker, Energy Fuels Nuclear, personal communication, 2/27/81).

4.8.2 Social organization

In summary, the impact on community organization and facilities resulting from expansion of mill production is not projected to be significant. The absorption of the initial mill population by communities surrounding the project area revealed the socioeconomic flexibility of the area. Projected housing and community facility shortages for the project area did not materialize, and the communities of Blanding and Monticello especially continue to exhibit an ability to accommodate new population influx. Plans for housing accommodations by Energy Fuels Nuclear were never implemented because the need for them never developed. The impact, therefore, of approximately 20 new personnel on the socioeconomic capabilities of the project area is predicted to be very slight.

4.8.5 Transportation

Expansion of the White Mesa mill is expected to result in an increase of about 10 cars per day. Heavy vehicle traffic will increase by about 50 trucks per day (C. E. Baker, Energy Fuels Nuclear, personal communication, 2/27/81).

Table D.2. Wind Speed and Direction by Stability Class - White Mesa

REGION=ENERGY FUELS NUCLEAR | CODE=MILDOS,REVO (7/79) | DATE= 81/05/20.
METSET=SITE JN79-JN80 | PAGE NO. 3

JOINT FREQUENCY IN PERCENT, DIRECTION INDICATES WHERE WIND IS FROM FREQNS= .24753, .36553, .28169, .09357, .01070, .00098

MPH	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTALS
STABILITY CLASS 1																	
1.5	.1026	.1033	.1303	.2997	.3972	.6485	.6720	.6213	.9223	.6238	.5949	.5165	.3446	.2128	.2415	.0726	6.5039
5.5	.2607	.3019	.2470	.3430	.3293	.3156	.8370	1.1251	1.5368	1.2623	1.2075	.7409	.5077	.1784	.2195	.1509	9.5636
10.0	.1098	.2333	.2195	.1235	.1647	.1509	.3293	.3979	.7547	1.2898	1.3035	.8233	.3293	.1372	.2058	.2058	6.7783
15.5	.0274	.0137	.0274	0.0000	.0549	0.0000	.0137	.0823	.1372	.6723	.4940	.3979	.1784	.0137	.0412	.1235	2.2776
21.5	0.0000	.0137	0.0000	0.0000	0.0000	.0137	0.0000	0.0000	.0274	.0549	.0823	.0137	0.0000	0.0000	.0137	0.0000	.2194
28.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ALL	.5005	.6659	.6242	.7662	.9461	1.1287	1.8520	2.2266	3.3784	3.9031	3.6822	2.4923	1.3600	.5421	.7217	.5529	25.3420
STABILITY CLASS 2																	
1.5	.0002	.0297	.0719	.1820	.1123	.1559	.2263	2146	.1449	.:317	.1689	.0993	0.0000	.0143	0.0000	.0002	1.7015
5.5	.0137	.0823	.1647	.0823	.0686	.2058	.2607	.4254	.4116	.2470	.1372	.1372	0.0000	.0274	0.0000	.0137	2.2776
10.0	.0274	.0686	.0549	.0137	.0412	.1098	.2333	.3156	.3430	.2607	.2333	.2058	.0549	.0274	.0274	.0549	2.0719
15.5	0.0000	.0823	0.0000	.0274	.0137	0.0000	.0412	0.0000	.0274	.2333	.1509	.0686	.0412	0.0000	.0137	.0274	.7271
21.5	.0137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0137	.0274	.0412	.0137	.0137	0.0000	0.0000	0.0000	.1234
28.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ALL	.0550	.2622	.2915	.3054	.2358	.4715	.7615	.9556	.9406	1.0501	.7315	.5246	.1098	.0691	.0411	.0962	6.9015
STABILITY CLASS 3																	
1.5	.0002	.0141	.0428	.0700	.0838	.1534	.1959	.3071	.2096	.2639	.1524	.0975	.0416	.0002	0.0000	.0003	1.6328
5.5	.0274	.0274	.1509	.0960	.0960	.1509	.2607	.3293	.2470	.1235	.0274	.0823	.0137	.0274	0.0000	.0412	1.7011
10.0	.0686	.1509	.0412	.0137	.0549	.1921	.1784	.1784	.2607	.1784	.0960	.1921	.0686	.0137	.0274	.0274	1.7425
15.5	.0274	0.0000	.0137	.0137	0.0000	.0137	.0137	.0686	.1235	.1098	.1647	.1784	.1372	0.0000	.0412	.0549	.9605
21.5	.0274	.0274	.0137	0.0000	0.0000	0.0000	.0137	0.0000	.0137	.0274	.0686	.0137	0.0000	0.0000	0.0000	.0274	.2330
28.0	0.0000	.0137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0137
ALL	.1510	.2335	.2623	.1934	.2347	.5101	.6624	.8834	.8545	.7030	.5091	.5640	.2611	.0413	.0686	.1512	6.2836
STABILITY CLASS 4																	
1.5	.0009	.1120	.3765	.1797	.2210	.1388	.1936	.1804	.1671	.1382	.1931	.1383	.3328	.0415	.0141	.0007	2.4287
5.5	.3430	.7684	1.9621	.3293	.3293	.4802	.3842	.6175	.7684	.2470	.1921	.2744	1.0291	.0960	.1372	.2744	8.2326
10.0	.3019	1.1937	2.0582	.3430	.2607	.5351	.6449	.6175	.7821	.5900	.5900	.7684	.7409	.1509	.3568	.4116	10.3457
15.5	.1096	.1921	.2881	.0960	.0823	.1784	.1784	.1509	.3019	.4391	.3293	.1784	.2881	0.0000	.1235	.2058	3.1421
21.5	.0274	0.0000	.0412	0.0000	0.0000	.0137	0.0000	0.0000	.0274	.0823	.0137	.0412	0.0000	0.0000	.0137	.0412	.3018
28.0	0.0000	0.0000	0.0000	0.0000	.0137	0.0000	0.0000	0.0000	.0137	0.0000	.0137	0.0000	0.0000	0.0000	0.0000	0.0000	.0411
ALL	.7830	2.2662	4.7261	.9480	.9070	1.3462	1.4011	1.5663	2.0606	1.4966	1.3319	1.4007	2.3909	.2884	.6453	.9337	24.4920
STABILITY CLASS 5																	
1.5	.0708	.1692	.5570	.2356	.1249	.0979	.0978	.0157	.0986	.0976	.0979	.1401	.2650	.0835	.0703	.0146	2.2365
5.5	.4116	.8233	1.2075	.2744	.1921	.3019	.2881	.4254	.4665	.2333	.3019	.4940	.6723	.1647	.2881	.1784	6.7235
10.0	.3019	1.0703	1.0154	.1784	.1235	.2195	.2195	.2470	.3156	.2333	.2744	.1372	.7958	.0823	.1098	.1098	5.4337
15.5	.0823	.0960	.1372	.0137	.0274	.0823	.0549	.0137	.1647	.0686	.1509	.0686	.4940	0.0000	.0412	.1647	1.6602
21.5	0.0000	.0137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0274	.0274	.0412	0.0000	0.0000	0.0000	0.0000	.0274	.1371
28.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0274	.0411
ALL	.8666	2.1725	2.9171	.7021	.4679	.7016	.5740	.7018	1.0728	.6602	.8663	.8399	2.2271	.3305	.5094	.5223	16.2321
STABILITY CLASS 6																	
1.5	.6353	.3671	.7804	.8166	.9018	.8844	.8032	.7722	.8620	.8180	.8050	.4317	.5252	.2881	.4137	.3451	10.2498
5.5	.6037	.5763	.7684	.5351	.5626	.4391	.5626	.4528	.6586	.4602	.6312	.3568	.6998	.2470	.2058	.2744	8.0544
10.0	0.0000	.5488	.4802	0.0000	.0137	.0137	.0137	.0823	.0960	.0412	.0686	.0686	.3293	.0274	0.0000	.0137	1.7972
15.5	0.0000	.0823	.0549	0.0000	0.0000	.1098	.0274	0.0000	.0823	.0549	.0412	.0274	.0823	0.0000	0.0000	.0274	.5899
21.5	0.0000	.0137	0.0000	0.0000	0.0000	0.0000	.0137	0.0000	0.0000	.0137	.0137	0.0000	0.0000	0.0000	0.0000	0.0000	.0548
28.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ALL	1.2390	1.5882	2.0839	1.3517	1.4781	1.4470	1.4206	1.3073	1.6989	1.2080	1.5597	.8845	1.6366	.5625	.6195	.6606	20.7461
ALL	3.5951	7.1885	10.9051	4.2668	4.2696	5.6051	6.7716	7.6410	10.0058	9.0210	8.6807	6.7060	7.9855	1.8339	2.6056	2.9168	99.9981

Table D.5. MILDOS Inhalation Dose Conversion Factors

REGION=ENERGY FUELS NUCLEAR
METSET=SITE JN79-JN80

CODE=MILDOS,REVO (7/79)

DATE= 81/03/26.
PAGE NO. 75

INHALATION DOSE CONVERSION FACTORS, MR/YR PER PCI/M3

	U-238	U-234	TH-230	RA-226	PB-210	BI-210	PO-210
SIZE= 1.0UM, RHO=8.9	U-238	U-234	TH-230	RA-226	PB-210	BI-210	PO-210
WH.BODY	9.82E+00	1.12E+01	1.37E+02	3.58E+01	4.66E+00	0.	5.95E-01
BONE	1.66E+02	1.81E+02	4.90E+03	3.58E+02	1.45E+02	0.	2.43E+00
AVG.LUNG	1.07E+03	1.21E+03	2.37E+03	4.88E+03	5.69E+02	0.	3.13E+02
LIVER	0.	0.	2.82E+02	4.47E-02	3.69E+01	0.	5.34E+00
KIDNEY	3.78E+01	4.30E+01	1.37E+03	1.26E+00	1.21E+02	0.	1.79E+01
SIZE= 1.0UM, RHO=2.4	U-238	U-234	TH-230	RA-226	PB-210	BI-210	PO-210
WH.BODY	4.32E+00	4.92E+00	1.66E+02	3.09E+01	4.36E+00	0.	4.71E-01
BONE	7.92E+01	7.95E+01	5.95E+03	3.09E+02	1.35E+02	0.	1.92E+00
AVG.LUNG	1.58E+02	1.80E+02	3.22E+03	6.61E+03	7.72E+02	0.	4.20E+02
LIVER	0.	0.	3.43E+02	3.87E-02	3.45E+01	0.	4.22E+00
KIDNEY	1.66E+01	1.89E+01	1.67E+03	1.09E+00	1.13E+02	0.	1.42E+01
SIZE= 5.0UM, RHO=2.4	U-238	U-234	TH-230	RA-226	PB-210	BI-210	PO-210
WH.BODY	.16E+00	1.32E+00	1.01E+02	4.00E+01	4.84E+00	0.	7.10E-01
BONE	1.96E+01	2.14E+01	3.60E+03	4.00E+02	1.50E+02	0.	.89E+00
AVG.LUNG	1.24E+03	1.42E+03	1.38E+03	2.84E+03	3.30E+02	0.	1.88E+02
LIVER	0.	0.	2.07E+02	4.97E-02	3.83E+01	0.	6.36E+00
KIDNEY	4.47E+00	5.10E+00	1.00E+03	1.41E+00	1.25E+02	0.	2.13E+01
SIZE=35.0UM, RHO=2.4	U-238	U-234	TH-230	RA-226	PB-210	BI-210	PO-210
WH.BODY	7.92E-01	9.02E-01	5.77E+01	3.90E+01	4.43E+00	0.	7.28E-01
BONE	1.34E+01	1.46E+01	2.07E+03	3.90E+02	1.38E+02	0.	2.96E+00
AVG.LUNG	3.33E+02	3.80E+02	3.71E+02	7.64E+02	8.70E+01	0.	5.75E+01
LIVER	0.	0.	1.19E+02	4.85E-02	3.51E+01	0.	6.52E+00
KIDNEY	3.05E+00	3.47E+00	5.73E+02	1.38E+00	1.15E+02	0.	2.19E+01
SIZE= .3UM, RHO=1.0	U-238	U-234	TH-230	RA-226	PB-210	BI-210	PO-210
WH.BODY					7.46E+00	0.	1.29E+00
BONE					2.32E+02	0.	5.24E+00
AVG.LUNG					6.27E+01	0.	2.66E+02
LIVER					5.91E+01	0.	1.15E+01
KIDNEY					1.93E+02	0.	3.87E+01

EXTERNAL WHOLE BODY DOSE CONVERSION FACTORS

	U-238	TH-230	RA-226	PB-210	RN-222	PO-218	PB-214	BI-214
GROUND, MR/YR PER PCI/M2	3.70E-06	6.12E-07	9.47E-07	2.27E-06	5.03E-08	1.10E-08	3.16E-05	1.85E-04
CLOUD, MR/YR PER PCI/M3	1.23E-04	3.59E-06	4.90E-05	1.43E-05	2.83E-06	6.34E-07	1.67E-03	1.16E-02
WORKING LEVEL CONCENTRATION FACTORS, WL PER PCI/M3			....	....	....	1.03E-06	5.07E-06	3.73E-06
WORKING LEVEL CONCENTRATION FACTORS, WL PER PCI/M3			....	....	....	1.03E-06	5.07E-06	3.73E-06

Table D.6. MILDOS Ingestion Dose Conversion and Environmental Concentration Factors

REGION=ENERG/ FUELS NUCLEAR
METSET=SITE JN79-JN80

CODE=MILDOS,REVO (7/79)

DATE= 81/03/26.
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INGESTION DOSE CONVERSION FACTORS, MR PER PCI INGESTED

AGE GROUP	TISSUE	U-238	U-234	TH-234	TH-230	RA-226	PB-210	BI-210	PO-210
INFANT	WH.BODY	3.33E-04	3.80E-04	2.00E-08	1.06E-04	1.07E-02	2.38E-03	3.58E-07	7.41E-04
INFANT	BONE	4.47E-03	4.88E-03	6.92E-07	3.80E-03	9.44E-02	5.28E-02	4.16E-06	3.10E-03
INFANT	LIVER	0.	0.	3.77E-08	1.90E-04	4.76E-05	1.42E-02	2.68E-05	5.93E-03
INFANT	KIDNEY	9.28E-04	1.06E-03	1.39E-07	9.12E-04	3.71E-04	4.33E-02	2.08E-04	1.26E-02
CHILD	WH.BODY	1.94E-04	2.21E-04	9.88E-09	9.91E-05	9.87E-03	2.09E-03	1.69E-07	3.67E-04
CHILD	BONE	3.27E-03	3.57E-03	3.42E-07	3.55E-03	8.76E-02	4.75E-02	1.97E-06	1.52E-03
CHILD	LIVER	0.	0.	1.51E-08	1.78E-04	1.84E-05	1.22E-02	1.02E-05	2.43E-03
CHILD	KIDNEY	5.24E-04	5.98E-04	8.01E-08	8.67E-04	4.88E-04	3.67E-02	1.15E-04	7.56E-03
TEENAGE	WH.BODY	6.49E-05	7.39E-05	3.31E-09	6.00E-05	5.00E-03	7.01E-04	5.66E-08	1.23E-04
TEENAGE	BONE	1.09E-03	1.19E-03	1.14E-07	2.16E-03	4.90E-02	1.81E-02	6.59E-07	5.09E-04
TEENAGE	LIVER	0.	0.	6.68E-09	1.23E-04	8.13E-06	5.44E-03	4.51E-06	1.07E-03
TEENAGE	KIDNEY	2.50E-04	2.85E-04	3.81E-08	5.99E-04	2.32E-04	1.72E-02	5.48E-05	3.60E-03
ADULT	WH.BODY	4.54E-05	5.17E-05	2.13E-09	5.70E-05	4.60E-03	5.44E-04	3.96E-08	8.59E-05
ADULT	BONE	7.67E-04	8.36E-04	8.01E-08	2.06E-03	4.60E-02	1.53E-02	4.61E-07	3.56E-04
ADULT	LIVER	0.	0.	4.71E-09	1.17E-04	5.74E-06	4.37E-03	3.18E-06	7.56E-04
ADULT	KIDNEY	1.75E-04	1.99E-04	2.67E-08	5.65E-04	1.63E-04	1.23E-02	3.83E-05	2.52E-03

ENVIRONMENTAL CONCENTRATION FACTORS

CONCENTRATION FACTOR	FOOD TYPE	U-238	TH-230	RA-226	PB-210
BIV, DIMENSIONLESS	ED.ABG.	2.50E-03	4.20E-03	1.40E-02	4.00E-03
BIV, DIMENSIONLESS	POTATO	2.50E-03	4.20E-03	3.00E-03	4.00E-03
BIV, DIMENSIONLESS	BELOW G.	2.50E-03	4.20E-03	1.40E-02	4.00E-03
BIV, DIMENSIONLESS	FORAGE	2.50E-03	4.20E-03	1.80E-02	2.80E-02
BIV, DIMENSIONLESS	ST. FEED	2.50E-03	4.20E-03	8.20E-02	3.60E-02
FBI, PCI/KG PER PCI/DAY	MEAT	3.40E-04	2.00E-04	5.10E-04	7.10E-04
FMI, PCI/L PER PCI/DAY	MILK	6.10E-04	5.00E-06	5.90E-04	1.20E-04
FRACTION IN ED PORTION	ED.ABG.	1.00E+00	1.00E+00	1.00E+00	1.00E+00
FRACTION IN ED PORTION	POTATO	1.00E-01	1.00E-01	1.00E-01	1.00E-01
FRACTION IN ED PORTION	BELOW G.	1.00E-01	1.00E-01	1.00E-01	1.00E-01
FRACTION IN ED PORTION	FORAGE	1.00E+00	1.00E+00	1.00E+00	1.00E+00
FRACTION IN ED PORTION	ST. FEED	1.00E+00	1.00E+00	1.00E+00	1.00E+00

5. ENVIRONMENTAL EFFECTS OF ACCIDENTS

5.1 MILL ACCIDENTS INVOLVING RADIOACTIVITY

The specific activities of the radioactive materials handled at the mill are extremely low: about 10^{-9} Ci/g for the ore and tailings and about 10^{-6} Ci/g for the refined yellowcake products. The quantities of materials handled, on the other hand, are relatively large: 2702 metric tons (MT) of yellowcake per year, representing about 1770 Ci of radioactivity. To be of concern, these very low specific activities require the release of exceedingly large quantities of materials; driving forces for such releases will not exist at the proposed White Mesa mill.

Guidelines have not been published for the consideration of accidents at uranium mills; therefore, the postulated plant accidents involving radioactivity are considered here in the following categories:

1. Trivial incidents (i.e., those not resulting in a release to the environment),
2. Small releases to the environment (relative to the annual release from normal operation), and
3. Large releases to the environment (relative to the annual release from normal operations).

5.1.1.2 Major pipe or tank rupture

All mill drainage, including that from chemical storage tanks, will flow into a catchment basin upstream from the tailings impoundment site. The mill will deliver approximately 131.8 MT (145.8 tons) of solids per hour and approximately 133.2 m^3 (132.91 MT (147.07 tons)) of solution per hour to the tailings cell. Should the rupture of a pipe in the tailings distribution system occur, the liquid would flow into the catchment basin where it could be pumped to the tailings cell. Chemicals could be recovered, transferred to the tailings cell, or neutralized in the catchment basin. Residue from a slurry loss would be cleaned up and the contaminated soil removed to the tailing retention area.

5.1.2 Small releases

The following accidents, due to human or equipment failure, would release small quantities of radioactive material to the environment. The estimated releases, however, are expected to be small in comparison with the annual release from normal operations.

5.1.2.1 Failure of the air cleaning system serving the yellowcake drying area

In the original design of the mill, a loss of water pressure to the scrubber or a failure of the fan drive would sound an alarm. During negotiations for the original licensing of the mill, however, it was decided to install an interlock system so that in the event of scrubber failure the yellowcake dryer would be shut down. This interlock system prevents the loss of U_3O_8 in the event of an electrical or mechanical failure.

5.1.2.2 Fire in the solvent extraction circuit

The solvent extraction circuit will be located in a separate building that is isolated from other areas due to the large quantities of kerosene present. From chemical industry data, the probability of a major fire per plant-year[1] is estimated to be 4×10^{-4}. However, at least two major solvent extraction circuit fires are documented in the literature, one of which destroyed the original solvent extraction circuit at one mill in 1968.[1] There have been approximately 540 plant-years of mill operation in the United States, equivalent to about 320 plant-years handling 390,000 MT of ore per year. Thus, judging from historical incidents, the likelihood of a major solvent extraction fire at the proposed mill is assumed to fall in the range of 4×10^{-4} to 6×10^{-3} per year.

In the event of a major fire, it is conservatively assumed from previous estimates that 1% of the maximum uranium inventory, or approximately 17.7 kg (39 lb), would be released into the environment.[2,3] It was assumed that the conservative meteorological conditions of 1 m/sec wind speed and a Pasquill type-D stability would exist for the ground-level release. It was also assumed that all the material was distributed over a single 22.5^{o} sector. The maximum dose commitments to the nearest resident (4.8 km (3 miles) from point of release) were total-body, 0.0016 millirem; bone, 0.04 millirem; lung, 0.480 millirem; and kidney, 0.012 millirem. The maximum dose commitments to the potential nearest resident (1.6 km (1 mile) from point of release) were total-body, 0.0197 millirem; bone, 0.59 millirem; lung, 7.1 millirem; and kidney 0.158 millirem.

5.3 TRANSPORTATION ACCIDENTS

Transportation of materials to and from the mill can be broken down into three categories: (1) shipments of ore from the mine to the mill, (2) shipments of refined yellowcake from the mill to the uranium hexafluoride conversion facility, and (3) shipments of process chemicals from suppliers to the mill. An accident for each of these categories has been postulated and analyzed. The results are given in the following discussion.

5.3.1 Shipments of yellowcake

Refined yellowcake product is generally packaged in 55-gal, 18-gauge drums holding an average of 364 kg (800 lb) and classified as Transport Group III Type A packaging (49 CFR, Parts 170-189 and 10 CFR, Part 71). It is shipped by truck an average of 2100 km (1300 miles) to a conversion plant, which transforms the yellowcake to uranium hexafluoride for the enrichment step of the light-water-reactor fuel cycle. An average truck shipment contains approximtely 45 drums, or 16 MT (17.5 tons), of yellowcake. Based upon the White Mesa mill capacity of 1,150,000 MT (1,277,500 tons) of ore annually and a yellowcake yield of 2702 MT (3,150 tons), an average of approximately 180 such shipments are required annually.

From published accident statistics,[4,5] the probability of a truck accident is in the range of 1.0×10^{-6} to 1.6×10^{-6} per kilometer (1.6×10^{-6} to 2.6×10^{-6} per mile). Truck accident statistics include three categories of traffic accidents: collision, noncollision, and other events. Collisions involve interactions of the transport vehicle with other objects, whether moving vehicles or fixed objects. Noncollisions are accidents in which the transport vehicle leaves the transport path or deviates from normal operation in some way, such as by rolling over on its top or side. Accidents classified as other events include personal injuries suffered on the vehicle, records of persons falling from or being thrown against a standing vehicle, cases of stolen vehicles, and fires occurring on a standing vehicle. The likelihood of a truck shipment of yellowcake from the mill being involved in an accident of any type during a one-year period is approximately 0.49.

5.3.2 Shipments of ore to the mill

Hanksville and Blanding are ore buying stations servicing small- and intermediate-sized mines throughout southeastern Utah and southwestern Colorado. Because of the small sizes of the mines, shipments of ore will be sporadic; therefore, the average shipping distance for the ore will vary throughout the life of the project. The applicant estimates the radii of the Hanksville and Blanding buying station service areas to be 160 km (100 miles) and 201 km (125 miles) respectively. Ore collected at the Hanksville station will be shipped an additional 193 km (120 miles) to the mill at Blanding. Based on projected capacities of the 2 ore buying stations, approximtely 25% of the total ore requirements would be supplied by the Hanksville station. On this basis the ore will be shipped an average of 258 km (160 miles). This value is an upper limit because most of the mines will be well within the service areas. To deliver 1,150,000 MT (1,?77,500 tons) of ore in trucks with a 30-ton capacity would require 42,580 trips per year, or a total of 1.09×10^7 vehicle-km (6.8×10^6 vehicle-miles). For the accident probability cited in the previous section, 1.0×10^{-6} to 1.6×10^{-6} accidents per kilometer

(1.6×10^{-6} to 2.6×10^{-6} per mile), accidents involving ore trucks would occur at the rate of 14.1 per year. However, because of the low specific activity of the ore and the ease with which the contaminant can be removed, the radiological impact is considered to be insignificant.

5.3.3 Shipments of chemicals to the mill

Truck shipments of anhydrous ammonia to the mill, if involved in a severe accident, could conceivably result in a significant environmental impact. Approximately 30 shipments of anhydrous ammonia will be made annually in 18 MT (20-ton) loads from a supplier located approximately 320 km (200 miles) from the mill.

Utilizing data given in this section in the White Mesa FES, the probability of an injury to the general public resulting from an average shipment of anhydrous ammonia is roughly 3×10^{-7} per kilometer (4.8×10^{-7} per mile). This estimate is probably too high for shipments near the White Mesa mill because of the relatively low population density. Nevertheless, if this estimate is used, the likelihood of an injury to the general public resulting from shipments of ammonia to the mill is predicted to be roughly 2.9×10^{-3} per year.

Sulfuric acid shipments to the White Mesa mill will amount to about 14 truck loads per day. Tentative plans are to ship acid into Moab or Thompson, Utah, by rail; the acid will then be loaded into specifically designed tank trucks for transportation to the White Mesa mill. Moab is about 130 km (80 miles) from the site. Using statistical data from Section 5.3.2, less than 0.1

accident per year should be observed. Because sulfuric acid is not volatile, the risk to the general public is no greater than that from other collisions.

Amine shipments will be made by truck into the White Mesa mill. Only one truck load about every 25 days will be required, and the risk of injury to the general public should be no greater than 1.4×10^{-3} per year. Transport of all such commodities will be in accordance with all applicable state and federal rules and regulations.

REFERENCES FOR SECTION 5

1. Directorate of Regulatory Standards, U.S. Atomic Energy Commission, "Environmental Survey of the Uranium Fuel Cycle", Report WASH-1248, April 1974.

2. Battelle Northwest Laboratories, "Considerations in the Assessment of the Consequences of Effluents from Mixed Oxide Fuel Fabrication Plants", Report BNWL-1697, Richland, Washington, June 1973.

3. Directorate of Licensing, U.S. Atomic Energy Commission, "Proposed Final Environmental Statement, Liquid Metal Fast Breeder Reactor Program", Report WASH-1535, December 1974.

4. Directorate of Regulatory Standards, U.S. Atomic Energy Commission, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Plants", Report WASH-1238, December 1972.

5. Battelle Northwest Laboratories, "An Assessment of the Risk of Transportation Plutonium Oxide and Liquid Plutonium Nitrate by Truck", Report BNWL-1846, Richland, Washington, August 1975.

7.3.2 Groundwater

Operation at the proposed production rate should result in the use of about 2.22×10^6 m^3 (1800 acre-feet) of water per year, (most of which is drawn from the Navajo aquifer). The usage of water by the applicant should have no adverse effect on other users. Preoperational and operational monitoring of the groundwater is required (Section 6.3.2), and mitigation measures will be taken if unexpected groundwater contamination is observed.

9. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

9.1 LAND AND MINERAL

9.1.2 Mineral

No major irreversible or irretrievable commitments of mineral resources are anticipated other than (1) the uranium and vanadium that will be recovered; (2) the 29,565 MT (32,850 tons) of coal that will be burned each year; and (3) the yearly consumption of 11.5 MT (12.8 tons) of kerosene and 166 m^3 (43,750 gal) of fuel oil in processing operations.

9.4 MATERIAL RESOURCES

Major irretrievable and irreversible commitments of material resources* incurred per year of White Mesa mill operation are 1.1×10^5 MT (1.2×10^5 tons) of sulfuric acid; 8.4×10^3 MT (9.3×10^3 tons) of manganese dioxide, 4.32×10^3 MT (4.76×10^3 tons) of sodium chlorate; 3.36×10^3 MT (3.71×10^3 tons) of soda ash; 7.68×10^2 MT (8.47×10^2 tons) of ammonium sulfate; 5.13×10^2 MT (5.65×10^2 tons) of anhydrous ammonia; and 1.59×10^2 MT (1.75×10^2 tons) of flocculant. In addition, small amounts of Isodecanol, Amine, and various laboratory chemicals will be consumed.

These materials are not in short supply and are common to many industrial processes.

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*Assuming 25% of the ore is processed for vanadium.

10.6 ALTERNATIVE OF NO LICENSING ACTION

In the event that the NRC should deny a permit for expansion of the White Mesa mill, three possible alternatives are envisioned: (a) reduction in the national volume of uranium produced, (b) milling the uranium produced at another existing facility, or (c) construction of a new facility to handle potential production increases. Expansion of the existing mill at White Mesa should provide an effective solution to the milling of additional ore and toll milling from less efficient mills. A consolidation of uranium milling operations is consistent with the NRC philosophy of large concentrated, rather than small distributed facilities.