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State Policies and Requirements for Management of Uranium Mining and Milling in New Mexico

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Volume I - Executive Summary

Sharla G. Vandevender

Sandia National Laboratories

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STATE POLICIES AND REQUIREMENTS FOR MANAGEMENT OF
URANIUM MINING AND MILLING IN NEW MEXICO

VOLUME I

EXECUTIVE SUMMARY

by

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Office of Technology Impacts
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ABSTRACT

This volume summarizes the results of a cooperative effort with the State of New Mexico to study the potential environmental and resource-related problems associated with uranium mining and milling. Four issues identified in a conference jointly sponsored by the state and DOE's predecessor, ERDA, were addressed by three state agencies: The Office of the State Engineer, the Environmental Improvement Agency (EIA), and the Energy Resources Board. The individual studies of water availability, environmental quality, power availability and community impacts are published separately as Volumes II-V of this report. The recommendations are that DOE consider proposals from the State Engineer and the Environmental Improvement Division to develop programs which would lead to resolution of the issues they have presented. It is also recommended that DOE enter into discussions with the State Energy and Minerals Department (formerly ERB) to determine whether and to what extent DOE participation in their recommended programs is appropriate.

DISCLAIMER

This report was prepared by Sandia National Laboratories for the U.S. Department of Energy under contract number DE-AC02-79OR21400. The views and opinions contained herein are those of the author and do not necessarily represent those of the U.S. Department of Energy or Sandia National Laboratories.

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ACRONYMS

FEDERAL AGENCIES

AEC	ATOMIC ENERGY COMMISSION
DOE	DEPARTMENT OF ENERGY
ERDA	ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION (NOW DOE)
OEPA	OFFICE OF ENVIRONMENTAL POLICY ANALYSIS (NOW OTI/PAD)
OTI	OFFICE OF TECHNOLOGY IMPACTS
PAD	POLICY ANALYSIS DIVISION
EPA	UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
USGS	UNITED STATES GEOLOGICAL SURVEY
NSRC	UNITED STATES NUCLEAR REGULATORY COMMISSION

STATE AGENCIES

EIA	ENVIRONMENTAL IMPROVEMENT AGENCY (NOW EID)
EID	ENVIRONMENTAL IMPROVEMENT DIVISION
END	ENERGY AND MINERALS DEPARTMENT
ERB	ENERGY RESOURCES BOARD (NOW EMD)
NMBM & MP	NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES

OTHER

CMP	GRANTS MINERAL FELT
SJCP	SAN JUAN STRUCTURAL BASIN
SNLA	SANDIA NATIONAL LABORATORIES, ALBUQUERQUE

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I. INTRODUCTION

In 1977, the Sandia Laboratories' Office of Environmental Policy Analysis and the State of New Mexico agreed upon a cooperative analysis of environmental, health, resource use, socioeconomic and institutional (EHRSI) problems resulting from uranium mining and milling in the state. Four issues were identified by state agencies as potentially significant constraints to increasing uranium production in New Mexico. Sandia had initiated the cooperative analysis by organizing a conference on the coordination of environmental analysis activities. The conference, held in Grants, New Mexico, in May, 1977, was cosponsored by the EPDA Office of Environmental Policy Analysis and the New Mexico Environmental Improvement Agency. A tour of the Kerr-McGee uranium mine and mill was included.

The objectives of the conference were: 1) to develop a mutual understanding of the issues, 2) to explore a mechanism by which to include local and state officials in national energy planning regarding New Mexico, and 3) to determine what actions were needed to facilitate analysis of the most critical issues. The conferees agreed that four major uranium production issues must be resolved to avoid potential conflicts between federal and state interests. As a result of the conference, Sandia Laboratories entered into negotiations with three agencies of the State of New Mexico for an assessment of the issues from the State point of view. Four contracts were signed in September

of 1977. Each contract provided for consideration of one of the four issues which had been identified in May.

The studies conducted by the State agencies were to have these five common features:

1. Identification of all governmental activities and associated decision makers that influence the issue under consideration.
2. Description of the policy options that are most relevant from the State's point of view for coordination with federal, state, and local government activities.
3. An outline and cost estimate of technical, scientific, and engineering support services required for development of the prospective options.
4. Operational and organizational recommendations for a cooperative policy-option analysis program.
5. An estimate of the resources required to provide the technical, scientific and engineering information and services which DOE would be asked to contribute to the proposed policy option analysis.

The issues and the State agencies contracted to explore them were as follows:

1. The New Mexico State Engineer agreed to a study of water availability and the related issues associated with uranium mining and milling in the San Juan Structural Basin. The State Engineer was expected to define the need for and the requirements of a

program to provide necessary information for management of the water resources in the Basin.

2. The New Mexico Energy Resources Board agreed to consider community impact assistance requirements in the Grants Mineral Belt. The Energy Resources Board was expected to define the problem and identify a program which would allow avoidance of socio-economic constraints on uranium production.
3. The New Mexico Environmental Improvement Agency, Radiation Section, agreed to provide a comprehensive description of its regulatory authority and planned regulatory developments. The agency was to describe the data and analysis needed to support regulatory development.
4. The New Mexico Energy Resources Board agreed to assess the electric power allocation for uranium development and the effects of competing power demands by the various energy industries, other industrial users, and communities in New Mexico.

These program planning studies were designed to provide DOE a basis for understanding the issues, the decision points, and the State's preferred alternatives for programs to solve EMSI problems while increasing uranium production. Upon receipt of the studies, this office examined the issue analyses and recommendations of the State. The State, in turn, was invited to provide comments on the Sandia companion papers.

For two of the contracted studies, the Sandia analysis and the State's paper* comprise one volume (in two parts) of State Policies and Requirements for Management of Uranium Mining and Milling Impacts in New Mexico, prepared for publication by Sandia Laboratories. The third study stands alone as Volume IV. The fourth study did not provide an analysis of the issue; it proposed a management program, which comprises Volume V. The documents were prepared for the Office of Technology Impacts, the Department of Energy successor to the ERDA Office of Environmental Policy Analysis.

The five volumes of the study are as follows:

Volume I - Executive Summary, SAND 79-0973;

Volume II - Water Availability in the San Juan Structural Basin, SAND 78-1331;

Volume III - Adverse Effects of Uranium Mining and Milling on the Physical Environment,
SAND 78-1332;

Volume IV - The Supply of Electric Power and Natural Gas Fuel as Possible Constraints on Uranium Production, SAND 79-7105

Volume V - State Policy Needs for Community Impact Assistance, SAND 79-7093.

This volume, the Executive Summary, provides an overview of New Mexico's contribution to the supply of uranium along with the summary of the four studies. The national uranium supply and

*The State's issue paper in each volume is reproduced exactly as presented to Sandia, without modification.

demand and the implications for New Mexico are discussed briefly. The uranium-producing region of the state is then described to provide a framework for the summary of the four pages which follows. The state agencies' proposed programs are outlined and recommendations are made for DOE consideration of the state's requirements.

PART ONE: BACKGROUND

11. URANIUM DEMAND AND SUPPLY

Today, nuclear power provides about 10 percent of the U.S. supply of electricity. By 1985, an additional 75 nuclear plants that are already planned or under construction are expected to be in operation, doubling the percentage of electricity supplied by nuclear power.⁽¹⁾ The Supply Analysis Division of the Atomic Energy Commission estimates that 30,000 tons per year of U_3O_8 concentrate will be required to fuel these plants and satisfy current enrichment contracts. A recent survey of the perceived requirements for fuel for nuclear facilities with nuclear reactor projects yielded similar results. These facilities were indicated that they would require 25,800 tons of U_3O_8 from domestic sources in 1985, with the remainder coming from imports (1,900 tons already committed) and inventories (28,700 tons in 1980).⁽²⁾ This section examines the ability of the uranium industry in New Mexico to continue to supply about half of the demand for U_3O_8 .

NATIONAL SUPPLY PROJECTIONS

In 1977, 16,700 tons of U_3O_8 were produced domestically, an increase of 1,900 tons since 1975.⁽⁴⁾ This represents an increase of about 10 percent per year. To meet future requirements and maintain the same levels of imports and inventories, U_3O_8 production will have to increase almost 6 percent per year from now until 1985.

Although this rate of increase does not seem unrealistic, given the jump in production between 1975 and 1977, it does require resources from new areas that are not yet producing. The grouped production centers into three classes, depending on the stage of development.⁽²⁾ Class 1 centers consist of existing mills and supporting mines at which U_3O_8 concentrate is now being produced. Class 2 centers include uranium mills and supporting resources at which construction commitments are evident and mine development has been announced or is underway. Class 3 centers are potential prospects where the amount and grade of uranium reserves justify production, but no commitments have been made.

Figure 1, from data developed by the Supply Analysis Division in October 1978, relates national uranium requirements to the quantity of resources that could be produced from each production center category. It assumes a mid-level estimate within the range of industrial capability forecasts presented in the DOE paper. It is evident from this graph, the country requires production from Class 2 centers before 1982, and Class 3 centers in 1984.

Viewed from this perspective, the challenge of increasing uranium production becomes one of converting Class 2 and 3 centers to Class 1 production centers in time to meet the demand. DOE now estimates that this process requires three years for Class 2 centers. The cost of production and the quantities that will be produced are uncertain for Class 2 centers. Class 3 centers are much less certain than Class 2 centers, because commitments to develop the mines and mills have not yet been

FIGURE 1

PRODUCTION CAPABILITY AS OF 1978
AT THE MID LEVEL
 U_3O_8 IN CONCENTRATE
ANNUAL BY CLASS OF RESOURCE

- • • REQUIREMENTS — ENRICHMENT CONTRACTS
- CLASS 1 EXISTING FACILITIES
- CLASS 2 COMMITMENT MADE TO CONSTRUCT NEW FACILITIES
- CLASS 3 OTHERS WITH SUFFICIENT RESERVES AND LEADTIME

SOURCE: DOE SUPPLY ANALYSIS DIVISION, 1978

1977. DOE estimates that three to six years lead time is needed for the production from Class 3 centers.⁽⁵⁾

It is clear that little additional delay can be tolerated in bringing new centers from exploration through the permitting process to production. If lead times continue to increase, it will become increasingly difficult to supply uranium needed for plants from domestic sources.

IMPLICATIONS FOR NEW MEXICO

About 46 percent of the nation's uranium supply, and 60-70 percent of the demand, is currently come from New Mexico. In 1977, this amount was 13,800 tons of U_3O_8 at a price of \$13/kg.⁽⁶⁾ If New Mexico continues to produce 46 percent of national production, approximately 13,800 tons of U_3O_8 are projected to be produced in 1985.

Table 1 assumes that New Mexico will continue to produce 46 percent of national supply, as projected by DOE. However, it is a view that only a small quantity of U_3O_8 must come from Class 3 centers by 1982, but that production from these centers will be nearly a third of the total by 1987. By 1991, a small amount of New Mexico's uranium must also come from Class 3 centers.

TABLE 1
NEW MEXICO PRODUCTION OF ^{235}U
AND ^{238}Pu WITH ENRICHMENT FACILITIES*

	1983	1985	1987
	Thousands of lbs. a		
^{235}U	10.6	10.1	10.1
^{238}Pu	2.3	1.7	1.7
0	0	0	0
Total	12.9	11.8	11.8

*Based on 46 percent of national requirements, as projected by Kiewit, October, 1974, in its 1980-1981 production capacity forecast, p. 8.

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III. NEW MEXICO'S URANIUM PRODUCTION

A. REGION

Uranium deposits occur in 29 of New Mexico's 32 counties. As shown in Figure 2, the northwest quadrant of the state contains the rich uranium resources which have supported the development of the nation's uranium industry. Within the quadrant, the primary producing area is called the Grants Mineral Belt (GMB). The 2500-7100 acre GMB covers portions of four counties, McKinley, Valencia, and Grant, all of which are rich in uranium, of which the former two are the current producers. Figure 2⁽¹⁾ is a map of the state showing the location of the GMB.

The northwest quadrant is also the state's principal coal producing area. The coal deposits being exploited lie just north of the GMB. Economically exploitable coal also occurs in the GMB. The state's second-most important oil and gas producing region lies somewhat farther north. Figure 3 shows the proximity of these resources to the GMB.

Within this quadrant, about 45% of the surface ownership is owned by the federal, 21% private and 3% state. The Grand Junction District of DOE estimated in a private communication to the NM Geologist (May 1978) that the 50.1b* reserves of uranium are owned as follows: private - 54%, federal - 27%, Indian - 17%, and state - 2%.

*Based on cost (see Ref. 2). Based on estimated operating costs and capital costs not yet incurred.

FIGURE 2
NEW MEXICO URANIUM RESOURCES

SOURCE: P. R. GRANT, JR., ENERGY IN NEW MEXICO, 1975

Grants Uranium Belt
Known Ore Deposits

FIGURE 3

RELATIONSHIP OF URANIUM BELT TO COAL AND GAS AND OIL FIELDS

SOURCE: VOLUME IV

Figure 4 shows the location of the communities and roads in the region. The communities where impacts have been or will be most severe are Gallup, Grants, Milan, Thoreau, Crownpoint, Bagnate, San Mateo, and Bluewater.

HISTORY OF PRODUCTION

The deposits near Grants were discovered in 1950 and 1951; production began in 1952. The Laguna Pueblo deposits were also discovered in 1951; these deposits support the largest uranium mine in the U. S., the open-pit Jackpile mine.* The Adirondack Lake deposits were discovered in 1955. These early discoveries were all at shallow depths. New mines are now producing from 1800-foot depths at Churchrock, and shafts are under construction at depths to about 3000 feet at San Mateo and Crownpoint.

The GMP is the most important uranium resource region in the United States. It has produced more than 40% of the total domestic supply of uranium for the Nation. In 1977, New Mexico produced 46% of the nation's U_3O_8 . The state has 60% of the \$15/lb. reserves, 53% of the \$30/lb. reserves, and 52% of the \$50/lb. reserves. Figure 5 shows the proportion of New Mexico production to total U. S. production⁽²⁾ for 1963 through 1977. (Production for Wyoming and all other states is also shown.) Prior to 1963, uranium produced in New Mexico accounted for 62% of all AEC purchases of U_3O_8 .⁽³⁾

*About 40% of the state's production in 1976 was from Indian lands, primarily from the Jackpile mine.⁽¹⁾

20. CRADO

FIGURE 5

URANIUM ORE PRODUCTION BY STATE — 1963 THROUGH 1977

SOURCE: STATISTICAL DATA OF THE URANIUM INDUSTRY, 1978

The four active open-pit mines and 28 active underground mines in the state are shown* in Tables 2 and 3. In addition, 11 mines are under development and 20 are in the planning stage. These are shown in Tables 4 and 5. There are also about 150 abandoned uranium mines in the state.

The five uranium mills currently operating in the state are shown in Table 6. The eight mills under development are shown in Table 7. The total capacity of the operating mills is 21,060 tons of ore per day. The five planned mills for which data are available will increase production capacity to 36,000 tons/day by 1982. In addition there are four in-situ leaching projects and one pit leaching project under development (Table 8).

There are three inactive tailings piles in the GMP and one in the northwest corner of the state near Shiprock. Each of the operating mills has an active tailings pile, as shown in Table 9. The approximate rate of production of mill tailings is about 21,000 tons/day. At present, inactive tailings piles have an accumulation of 5.6×10^6 tons of material and occupy about 211 acres. The cumulative tonnage in active piles is already about ten times that in the inactive piles. If New Mexico's uranium production continues to supply 46% of the estimated U. S. demand, about 1.4×10^8 tons of tailings will have accumulated by the year 1990. These tailings will be accumulated in a large number

*Tables 1-3 are from Part Two⁽⁴⁾ of Volume III. The statistics given are for December 1977. Tables 2-5 list mine locations by Township north of the New Mexico Base Line and Range west from the New Mexico Principal Meridian. They can be located on Figure 4.

of relatively small piles dispersed throughout the region, as the practice of the industry has been to build relatively small mills for short lifetimes (2000 ton/day capacity over 10 years operating lifetime).

ACTIVE OIL FIELD PRODUCTION DATA (1960-1977)

NAME	COMPANY	LOCATION	STARTING DEPTH (ft)	DEPTH DIS-MINIMUM MT (1000 cfr)	DEPTH (1000 cfr)
Section 22	Kerr-McGee	T14P10W	327	-	2,500
Section 33	Kerr-McGee	T14P9W	-	-	
Section 30	Kerr-McGee	T14P9W	750	360	
Section 24	Kerr-McGee	T14P10W	937	146	
Section 17	Kerr-McGee	T14P9W	1,090	212	
Section 30W	Kerr-McGee	T14P9W	715	290	
Section 19	Kerr-McGee	T14P9W	783	153	
Section 35	Kerr-McGee	T14P9W	1,398	350	1,300-1,500
Section 36	Kerr-McGee	T14P9W	1,492	180	1,300-1,500
Ann Lee	UNC	T14P9W	-	-	192
Section 27	UNC	T14P9W	350	166	96
Sandstone (John Bully Shale)	UNC	T14P9W	940	220	352
Section 25	MR-BH	T14P10W	611	270	2,000 including Sec 32
Section 24	MR-BH	T14P10W	650	353	
Section 15 (and Gravel)	MR-BH	T14P10W	611	120	
Section 21	MM	T14P9W	515	72	600 (2)
West Ranch	Cole	T14P10W	260	8	
Section 32	MR-BH	T14P9W	590	22	
Johnny M. Exploration	Pandora	T14P9W	1,380	155	
Hope Exploration	Pandora	T14P10W	415	42	50
Barren Ridge Exploration	Pandora	T14P9W	415	42	50
Star Apok 31	MR-BH	T14P9W	315	20	300
Church Creek	MR	T14P9W	215	10	1,000
Barren Ridge	MR	T14P9W	415	42	50
Star Apok 31	MR-BH	T14P9W	315	20	300
Star Apok 31	MR-BH	T14P9W	315	20	300

HYDROLOGIC DATA FOR THE SOUTHERN APPALACHIAN BASIN (1977)

<u>NAME</u>	<u>COMPANY</u>	<u>LOCATION</u>	<u>DEPTH (ft)</u>	<u>PROFECTY ADP (1000 cfm)</u>	<u>DISCHARGE WATER (gpm)</u>
Haystack	Toddillo	T13NR10W	adit		dry
Section 13	UN-HB	26M N Grants	618		perhaps a small amount
St. Anthony	UNC	T11NR4W	375		should be small
Marguez	Bokum	T13NR5W	2,200		81-162
Nose Rock	Phillips	T19NR12W	3,000	500	3,500 dropping to 2,500
Churchrock #2	Kerr-McCee	T17NR16W	2,300		4,000-6,000
Mt. Taylor	Gulf	T13NP8W	3,000		6,000
Rio Puerco	Kerr-McCee	T12NP3W	850		500
Section 12	Cobb	T14NP10W	721		dry
Old Church Rock	UNC	T16NR16W			NA

TABLE 5

MINES PLANNED FOR DEVELOPMENT

NAME	COMPANY	LOCATION	DEPTH (ft)	PROJECTED DISCHARGES	
				AIR (1000 cfm)	WATER (gpm)
P-#2 P-#3	Anaconda	Paguete	adit		
P-15	Anaconda	Paguete	adit		
P-17	Anaconda	Paguete	adit		
P-12	Anaconda	Paguete	adit		
P-12A	Anaconda	Paguete	adit		
P-19	Anaconda	Paguete	adit		
Narrow Canyon	Pioneer Nuclear	T18NR14W T17NR14W	2,500	300	3,000
Nose Rock Section 39	Phillips	T19NR12W	3,000	500	3,000 dropping to 2,500
Section 29	Conoco	T17NR12W	2,200		3,500
Borrego Pass	Conoco	T15NR10W			
Bernabe	Conoco	T12NR11W T12NR2W			
JJ #2	Sohio	T11NR5W			
Crowpoint	Mobil	T17NR13W	2,200		1,500
Dalton Pass #1	TVA UNC	T17NR14W	2,200		2,000
Dalton Pass #2	TVA UNC	T17NR14W	2,200		2,000
Dalton Pass #3	TVA UNC	T17NR14W	2,200		2,000
Dalton Pass #4	TVA UNC	T17NR14W	2,200		2,000
Dalton Pass #5	TVA UNC	T17NR13W	2,200		2,000
Union Carbide	Union Carbide	25th St T11NR10W	pit 400		500

7,500 at
any one
time

TABLE 6
OPERATING NEW MEXICO URANIUM MILLS

<u>Company</u>	<u>Location</u>	<u>Size⁽²⁾ (tons/day)</u>	<u>Began Operation</u>
Kerr-McGee	Ambrosia Lake	7,000	1958
CR-HP	Milan	3,400	1958
Anaconda	Bluewater	6,000	1953
UNG	Church Rock	3,000	1977
SOHIO	Bar-L-Ranch	<u>1,660</u>	1976
		21,060	

TABLE 7
URANIUM MILLS PROPOSED FOR NEW MEXICO

<u>COMPANY</u>	<u>LOCATION</u>	<u>SIZE</u> <u>(ton/day)</u>	<u>TAILINGS DISCHARGE</u> <u>(gal/day)</u>	<u>TAILINGS AREA</u> <u>(acres)</u>	<u>EXPECTED</u> <u>OPERATING DATE</u>
Phillips	Nose Rock (North of Crownpoint)	2,500	1,440,000	297	1979
Mobil/TVA	Dalton Pass (West of Crownpoint)	5,000		300	1980
Gulf	San Mateo	4,200	1,400,000	418	1981
Bokum	Marquez	2,000; 50% expansion later	(6,300 lb/min)	314	1979
Western Nuclear	Smith Lake	300 (mobile) 3-5 yr life		Hope to use some in backfill	1979
Conoco	Crownpoint				1982

TABLE 8
PROPOSED LEACH PROJECTS

<u>COMPANY</u>	<u>LOCATION</u>	<u>DEPTH</u> (feet)
<u>In Situ</u>		
Mobil	Crownpoint	2,000
Exxon	Bar L Area	650-700
Burns, TVA	Navajo Reservation	2,000
Teton	Church Rock	2,000
<u>Pit</u>		
Union Carbide	25 M NE Albuquerque	400

TABLE 9

NEW MEXICO TAILINGS PILES

<u>FACILITY</u>	<u>LOCATION</u>	<u>ESTIMATED TAILINGS (tons)</u>	<u>TOTAL AREA (acres)</u>	<u>HEIGHT (feet)</u>	<u>ESTIMATED RA-226 CON- TENT (curies)</u>
A. INACTIVE					
Footo Mineral	Shiprock	1,700,000	26 and 46	14-40 15 avg.	1,095
Homestake	Milan	1,218,000	48	?	577
Phillips	Ambrosia Lake	2,684,000	91	33-3	1,580
Anaconda	Bluewater	765,000	75	?	?
B. ACTIVE (December 1977)					
Kerr-McGee	Ambrosia Lake	23,000,000	265	100 (max.)	12,850
United Nuclear Homestake Partners	Milan	16,200,000	105	75	5,660
Anaconda	Bluewater	13,600,000	266	21	7,600
Sohio	Cebolleta	540,000	60	35	247
United Nuclear	Churchrock	10,000	24	8	2.6
C. PROPOSED (December 1977)					
Phillips	Nose Rock	(1,440,000)*	297		
Mobil/TVA	Dalton Pass	?	300		
Gulf	San Mateo	(1,400,000)*	418		
Bokum	Marquez	(6300 lb/min)	314		
Western Nuclear	Smith Lake	?	?		
Conoco	Crownpoint	?	?		

Source: Environmental Improvement Division, Radiation Protection Section, New Mexico Health and Environment Department.

*Gallons per day tailings discharge.

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PART TWO: SUMMARY

IV. URANIUM PRODUCTION ISSUES

The papers submitted to Sandia Laboratories in fulfillment of the state agency contracts were expected to contain discussions which defined the issues addressed. Where appropriate, recommendations for programs which would lead to mitigation of the issues were also to be included. The issue discussions presented ranged from detailed background information and problem definitions to virtually no discussion at all. The issues which were considered are summarized here.

WATER AVAILABILITY

Limited water availability may constrain uranium production in the San Juan Structural Basin (SJSB) in northwestern New Mexico. The dramatic increase in mine dewatering (the withdrawal of water to prevent mine flooding) accompanying the growth of uranium mining and milling may impair existing water allocations. The problem is accentuated by these basic issues:

- * The uncertainty of water availability and quality in the SJSB.
- * Potential depletion of the groundwater supply.

The uncertainties of water availability could mean that the DOE "most probable" estimate ⁽¹⁾ of annual output of U_3O_8 in New Mexico (36,000 short tons in 2000) may be high.

At present, uranium companies are not required to apply for rights to the water they discharge because they do not utilize the water for any "beneficial use" defined by state law. Recently a number of uranium companies have applied for rights to the water they expect to discharge from new mines. Their combined applications total 113,190 acre feet per annum. The companies plan to use the water for irrigation or milling operations, or to transfer it to other users such as the Public Service Land Company. The companies may be applying for the rights to discharge water as a move to protect themselves against future state legislation that could require them to find a beneficial use before they can begin dewatering their mines.

A bill was introduced in both the 1977 and 1979 legislative sessions which would have redefined mine dewatering as a beneficial use, thus making the mines subject to regulation by the State Engineer. The Legislature directed the Legislative Council to study the issue in 1979. Industry representatives have drafted a legislative proposal for regulating the dewatering of mines.

If the proposed regulations are enacted, mine dewatering will require the replacement of water for water rights which are impaired. To prevent violation of the Colorado River Compact, some water rights along the San Juan River and elsewhere would have to be retired. The State Engineer has projected that discharge rates from mine dewatering could possibly lower the flow of the San Juan River by as much as 33,000 acre feet a

year. However, the effects might not be evident for many years and could persist long after mining ceases.

The principal considerations of the State Engineer's issue paper are: 1) the water management system, 2) mine water use and dewatering, 3) competition for water, and 4) lack of data.

The Water Management System

Water rights are purchased in the market place. The mining industry could purchase most of the rights it needs. However, restrictions on the industry's efforts could occur as a result of New Mexico's water management system. The New Mexico State Engineer reviews and decides all pending water right applications. His decisions are based on the estimated amount of water available and the need to avoid impairment of other water rights. Thus, the companies must apply to the State Engineer for a permit to appropriate water for beneficial use or to change the place or purpose of existing water rights. The State Engineer's decision on an application is subject to appeal to the courts.

Mine Water Use and Dewatering

Uranium mining and milling involve the use and discharge of water. Uranium ore is found in the same geologic formation in the SJSB as is the major potable water supply the region depends on for human and animal use. To obtain the ore the water must be removed from the mine. Estimates of current mine water discharge range from 60,000-70,000 acre feet per annum. Uranium companies have already applied for rights to

over 113,000 acre feet per annum for beneficial uses. The discharge rate could rise to 230,000 acre feet per year.

Competition for Water

Competition for water is intense and can be expected to increase. The competition is between the following uses: stock, domestic, industrial, tribal, and public water supply. The uranium industry is expected to grow from the present 32 mines and 5 mills to 43 mines and 13 mills by the early 1980s. Refer to Tables 3 and 4 for the current and projected water discharge rates of the mines. The State Engineer now expects 60 mines to discharge about 100,000 ac-ft/yr by 1987.

The energy boom towns must keep their water supplies ahead of increasing demand. The incorporated communities do possess the power to condemn the water supplies they require. The Indian tribes do not recognize the State Engineer's authority over water occurring on their lands. The majority of water applications before the State Engineer are under protest by the U.S. Park Service and the Navajo Tribe. One major application, although unprotested, was initially denied because it would impair the water supply at Crownpoint, a Navajo community.

Lack of Data

One of the principal factors that could lead to a constraint on the expansion of uranium mining and milling is that the State Engineer lacks needed data on groundwater flow and availability throughout the Basin, especially in some areas where mining can be expected to be intense. The State

Engineer must proceed with decisions on pending permits, whether he has the additional information or not. In the absence of sufficient data to prove that a proposed appropriation will not impair any existing water rights, the Engineer must resolve any doubt that there might be impairment or deny the permit.

The State Legislature historically has been unwilling to fund programs of the type recommended by the State Engineer. The program would provide data needed to improve a mathematical model of the SJSE developed by the U. S. Geological Survey. The State expects industry and the federal government to assist in solving problems which result from national programs that benefit the nation as a whole.

ENVIRONMENTAL QUALITY

Recent studies (2,3,4,5) of the environmental impacts associated with the mining and milling of uranium ores indicate that the wastes produced in the milling phase of the nuclear fuel cycle may in the long term prove a greater public health hazard than wastes produced at the back end of the fuel cycle. i.e., geologically buried spent fuel or reprocessing wastes. The State of New Mexico thus has reason for concern over the activities of uranium extraction and milling industries located within its boundaries. To date, about six million tons of mill tailings have accumulated in inactive piles and sixty million tons of tailings are in place within the Grants Mineral Belt.

But until very recently, public awareness of the potential hazards of these front end activities has been slight.

New Mexico has the authority to regulate, constrain or even curtail the development of its uranium resources through the application of mill licensing requirements and the enforcement of stringent air and water quality standards. State authority over certain radioactive materials is assumed from the Federal authority through the Agreement States Provision of the Atomic Energy Act of 1954. The authority to enforce air and water quality standards derives from a mandate for compatibility of State standards with those Federal standards administered by the USEPA. In either case, compatibility requires only that State standards and rules be "at least" as stringent as Federal standards and rules.

New Mexico began to assume its authority over the uranium milling industry in May, 1974. Since then it has not seen a need for regulations and standards that are more stringent than Federal regulations and standards. Nonetheless, New Mexico is working hard to meet its mandate for adequate protection. Recently approved changes in State regulations affecting the uranium development industry would, if implemented, bring State practice into line with current or anticipated USNRC practices applying in non-agreement states. The constraining effects of an application of USNRC licensing requirements upon New Mexico's part of the uranium industry would probably be slight in the long run.

Compatibility between State and Federal environmental standards or regulations presents the largest potential for conflict between State and Federal policies. Because of uncertainty concerning the plans of Federal regulatory agencies, and the time lag introduced by the State's legislative process in appropriating funds, New Mexico may in the future find its status as an agreement state in jeopardy (See Volume III). The impact of such conflict upon the uranium industry and upon common goals for environmental quality would be temporary but still more detrimental than a smooth, anticipated transition to NRC-type licensing and regulatory standards.

The impact of the uranium industry on the region's air and water quality has not been fully assessed. Solid data on present levels of air and water contamination is not available to support analysis of the effects of the contamination on the health and safety of the public. The state Environmental Improvement Division suspects that the impacts may be of consequence. Until the recent major spill of 95 million gallons of tailings liquids and 100 tons of solids which flowed down the Rio Puerco through Gallup and into Arizona, public concern occurred only in certain areas where planned industry activity was opposed.

The state has no baseline data on air and water quality in the GMB taken prior to the initiation of uranium development activities there; thus the levels of change that resulted from *unregulated mine and mill operations are unknown*. The state has not funded programs to monitor levels of change in air and water

quality caused by firms operating under the licensing regulations proposed. The lack of site-specific baseline measurements is the major problem relating to enforcement of air and water quality standards. The EID would have the opportunity to make baseline measurements in those relatively undisturbed areas targeted for development (Crownpoint and Churchrock), if it had the funds.

POWER AVAILABILITY

The Energy Resources Board study dealt with electrical power development projections, power needs for projected uranium production and natural gas requirements. The ERB study concluded that neither the projected electrical expansion nor natural gas availability will be a constraint on uranium development.

Five basic reasons were set forth to support the conclusions: 1) present New Mexico generating capacity is in excess of demand, 2) planned capacity together with existing capacity is more than adequate to meet known future requirements, 3) lead times for bringing uranium facilities and electrical power on line are similar, 4) environmental requirements can be met and adequate finance and construction lead times have been provided, and 5) at worst, the utility companies and uranium companies can use oil, the standby fuel. It seems safe to conclude that any constraints on power expansion to satisfy future demands, including uranium production, will result from environmental, health, resource use, socioeconomic, and institutional issues.

rather than from natural gas shortages and curtailments. These factors can be expected to affect uranium production more as direct constraints than they will through constraints on power production.

Two issues could potentially affect the availability of electric power for uranium mining: transmission rights-of-way across Indian lands, and water availability and use. Transmission rights-of-way from power generating stations to the uranium mines and mills will cross Indian lands and require approval of tribal councils. Concerns about the environmental effects of these lines could preclude their approval as could disputes over the cultural and economic values of the rights of way. Water availability for power plant cooling could also constrain electric power generation and hence uranium mining. A number of uranium companies are prepared to avoid these issues by generating their own electric power on site. However, the availability of diesel fuel may limit the feasibility of on-site generation.

A third issue which may affect expansion of electric power capacity is Navajo tribal controls. Currently the tribe is attempting to enforce very stringent sulfur emission standards and associated penalties. The tribe is also opposing some coal development on Navajo lands and is attempting to tax the energy industries operating on the reservation.

COMMUNITY IMPACTS

Two principal issues could affect the development of communities to support the uranium mining and milling industry: adequate community planning capability and availability of financing for energy communities. Few of the energy impacted communities in the state have a formal planning capability. As a result, they are unable to forecast problems and plan mitigation programs that would help them manage their growth. The state could take several steps to alleviate this: develop a system that provides a community with "early warning" of impending population increases; provide technical assistance in community planning; and monitor growth in impacted communities. Improving planning capability at the state and local levels is dependent on financial and technical assistance from government and industry.

Once an improved community capability is in place, the next requirement is financing for housing and public facilities. Financing can come from three sources: traditional lenders of construction and mortgage money, government impact assistance funds and the uranium companies themselves. The availability of construction and mortgage money from banks and savings and loans is constrained by numerous factors, not generally subject to state influence. Current federal monetary policies, which are not influenced by state action, are tightening the supply of money across the country. This policy makes housing difficult to finance, especially in a rapidly growing state like

New Mexico. The money that is available tends to go to the areas of least risk, particularly Albuquerque.

The one thing the state could do to improve this situation is to develop a plan for economic base diversification in the energy communities. Some assurance that employment will continue longer than home mortgage pay-back periods so that homeowners can buy and sell homes would greatly improve the home mortgage situation. A plan for economic base diversification would also make it easier for communities to sell bonds for public facilities because bond holders would be assured of continuing project revenues for repayment after mining activity declines.

In the absence of traditional money sources, energy impacted communities rely heavily on state and federal aid. Even if federal programs are established, it is probable that the allocation available to New Mexico and other Rocky Mountain energy producing states will be inadequate.

The state Community Assistance Council has made a number of grants to energy communities to fund critically needed sewer and water projects. However, the amount of money appropriated for this agency is small compared with needs and must be allocated throughout the state. Severance tax-secured bonds finance a considerable portion of the state's development, but they, too, are applicable throughout the state for a wide variety of public projects.

The energy companies themselves have financed some of the planning, housing and public facilities needed for energy

development. However, most mining companies prefer to avoid the "company town" syndrome and see themselves only as community developers of last resort.

Insufficient skilled manpower is often cited by the energy companies as a major constraint on development. Two principal issues need to be resolved before the number of trained personnel will be adequate to meet state uranium production requirements: adequate housing and public facilities, and vocational education and training programs. The quality of the community greatly affects the productivity and turnover rates of labor, and hence the cost of uranium. Resolution of all of the issues affecting communities would help to alleviate the manpower shortage.

In order to maintain its share of national uranium production, New Mexico will need to increase its uranium workforce by 9,000 over the next six years. If the shortage of underground miners is a national one, then considerable training will be necessary. A workforce increase of 9,000 translates into a training requirement of about 975 people per year--far in excess of the state's one uranium miner training program which is designed to turn out 100 miners per year. Additional state and federal financial assistance for training and the cooperation of industry and labor could make training more widely available.

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3. "Report to the American Physical Society by the Study Group on Nuclear Fuel Cycles and Waste Management", American Physical Society, July 1977 (Section VDI and VD2). (To be published in the Reviews of Modern Physics.)
4. "Effects of Fuel Cycle Alternatives on Nuclear Waste Management," by T. H. Pigford and Jor-Shan Choi, in proceedings of the Symposium on Waste Management, Tucson, Arizona, October 3-6, 1976 (USERDA Research and Development Report) CONF-761020, p. 39-57.
5. "Radiotoxic Hazard Measure For Buried Solid Radioactive Waste," Jan Hamstra, Nuclear Safety, v. 16, No. 2, pp. 180-189.

V. STATE REQUIREMENTS FOR MITIGATING THE ISSUES

The papers submitted to Sandia Laboratories in fulfillment of the state agency contracts all contained proposals for programs which would give the state a better understanding of the issues involved. The programs are summarized here.

DATA AVAILABILITY

The State Engineer's discussion of the issue was detailed and provided background information. It also briefly described an ongoing study of the groundwater hydrology of the area of concern, the San Juan Structural Basin. The study has been underway for four years. The U. S. Geological Survey and the New Mexico Bureau of Mines and Mineral Resources (NMBSMR) have participated along with the State Engineer. The work is also based on two prior years of study by the NMBSMR. This study has resulted in development of a model of the groundwater hydrology of the basin. Effective and accurate utilization of the model to predict the effects of mine dewatering on the groundwater supply and the surface water flows requires additional data. The State Engineer's paper proposed a well drilling program to provide those data. The program would require about two years to complete. Table 10 summarizes the principal water issues and the factors affecting their resolution. Table 11 summarizes the well drilling program. It gives the location, number of wells and the data objectives of each set of wells. Table 12 provides three alternative programs ranging from four to thirty-six to

forty-four wells. Table 13 gives the costs estimated in 1970 for the three alternatives.

A well drilling program is considered by the authors to be necessary in order to allow the development of the state's uranium resources to be optimal relative to the water resources. The authors recommend that the Department of Energy consider a more specific proposal from the New Mexico State Engineer to develop a well-drilling program. The USGS, ANM&NM, and DOE's National Uranium Resource Evaluation drilling program should participate with the State Engineer. Where their lands are involved, the Navajo Tribe should also participate.

The State Engineer's issue paper, along with an additional analysis of the problem of mine dewatering, is contained in Volume II of this series, Water Availability in the San Juan Structural Basin, SAND 78-1331. The proposed drilling program is presented in detail in Volume II.

TABLE 10

Water Availability

<u>Principal Issues</u>	<u>Factors Affecting Resolution</u>
Approval/disapproval of water use applications	Estimates of amount of ground- water available
	Protection of others' water rights
	Effects of dewatering on surface water flows and groundwater availability
	Effects of dewatering on groundwater quality
Regulation of mine dewatering through state legislation	Support of state engineer and industry
	Availability of staff and resources for adequate enforcement
Conflicts with Indians and other users regard- ing water rights	Various court decisions

TABLE 11

Summary of the Wells Required by the State Engineer

<u>Site</u>	<u>Wells</u>	<u>Objectives</u>
San Juan River/ Hogback Mountains	5 both sides of Hogback	Effects of mine dewatering on San Juan River. Data on watering-bearing units in vicinity of river. Gradients and discharge rates.
"Basement" Well/ Rio Grande Trough	1 10,000 feet deep	Direction of deep ground water flow. Mine dewatering impact on Rio Grande Basin.
Crownpoint (major impact area: coal, uranium, municipal)	3 Crownpoint/ Big Bend and Lake Valley	Extent of basin's fresh water supply. Interface of fresh and saline water.
Churchrock and Ambrosia Lake	2 Grants Mineral Belt	Drawdown, discharge and recharge rates. Effects of mine dewatering.
Chaco Drainage	30 Uranium exploration area	Shallow water quality and quantity.
Northeast: Aztec and Rio Arriba County	2 Deep wells. Exploration areas	Water resources in NM-Colorado border area. Recharge potential. Quality and yield characteristics of aquifers.
Chuska Mts.	1 Deep well (recharge area)	Water levels and recharge rates. Sandstone unit potential for water development.

TABLE 12

Alternative Well Locations and Numbers

<u>Area</u>	<u>Number of Wells</u>		
	<u>Alternative</u> <u>One</u>	<u>Alternative</u> <u>Two</u>	<u>Alternative</u> <u>Three</u>
Chuska Mts (West)			1
Northeast Aztec Rio Arriba			2
Chaco Drainage Shallow Wells		30	30
Big Bend of Chaco River	1	2	3
Churchrock and Ambrosia Lake			2
San Juan River/ Hogback	2	3	5
Pasement/Rio Grande Trough	<u>1</u>	<u>1</u>	<u>1</u>
Total	4	36	44

TABLE 13

Estimated Costs of the Well Drilling Programs

ALTERNATIVE ONE

22,000 ft total drilling	1,105,000
Testing (22 zones)	305,000
Shallow wells	30,000
Evaluation of Data	225,000
Evaluation of Mining and Milling Requirements and Disposal Methods	95,000
Total	\$1,760,000

ALTERNATIVE TWO

32,000 ft total drilling	1,610,000
Testing (32 zones)	445,000
Shallow Wells	30,000
Evaluation of Data	400,000
Evaluation of Mining and Milling Requirements	25,000
Evaluation of Disposal Methods	100,000
Total	\$2,610,000

ALTERNATIVE THREE

62,000 ft total drilling	3,120,000
Testing (62 zones)	860,000
Shallow Wells	30,000
Evaluation of Data	450,000
Evaluation of Mining and Milling Requirements	2,000
Evaluation of Disposal Methods	100,000
Total	\$4,585,000

ENVIRONMENTAL QUALITY

Radioactive materials released to the environment by the uranium mining and milling industry have potential for serious environmental and public health impacts. Available data, although limited, indicate that impacts of these materials may have been underestimated. The Program Plan submitted by the Environmental Improvement Division, Radiation Protection Section, provided a comprehensive review of the problem. The principal issues are summarized in Table 14. The Program Plan proposes an independent, comprehensive and scientific study of air and water quality in the Grants Mineral Belt. The data base provided by such a study would build a foundation on which the state could rely to promulgate its own standards and regulations for the uranium mining and milling industry. With good data, the EID could advocate and set legally defensible standards that would effectively minimize litigation. Some form of federal assistance would be necessary for the EID to implement the program. The State Legislature has not provided sufficient funds to support comprehensive monitoring and analysis. The authors believe that it would be appropriate for DOE to provide intensive technical assistance as well as funds for those programs that demonstrably contribute to the State's ability to regulate the environmental quality of the uranium producing region.

The proposed Program Plan is comprised of a monitoring program and a research program. Each has several parts which are summarized in Tables 15 and 16. The type of activity and the

annual cost in 1977 dollars is shown. The Program Plan is presented in detail in Volume III of this series, Adverse Effects of Uranium Mining and Milling On the Physical Environment, SAND78-1332. The authors recommend that DOE solicit specific proposals from the New Mexico Environmental Improvement Division for the development of monitoring and research programs. Both the USNRC and USEPA should be consulted on development of these programs.

TABLE 14

Environmental Regulations

<u>Principal Issues</u>	<u>Factors Affecting Resolution</u>
Promulgation of ambient radon standards	Data on effects of radon on public health Data on ambient radon levels Resumption of monitoring program Passage of state legislation
Tightening of licensing procedures for mines and mills	Public hearings on procedures Legislative approval of financial issues Approval of NRC
Clarification of conflicting regulations and jurisdictional issues among federal agencies	Promulgation of state's own standards for mining and milling Findings of independent air and water quality study for Grants area

TABLE 15

Proposed EID Monitoring Programs*

	Annual 1978 \$1000 (1977)
Baseline Monitoring Program (1978 level of effort)	100
Instrumentation Development, Calibration and Testing	41
Water Quality Monitoring	42
TOTAL	\$183

TABLE 16

Proposed EID Research Programs*

	Annual 1978 \$1000 (1977)
Meteorology of GMB	10
Radon Sources	10
Ambient Radon	10
Working Level Exposure	10
Instrumentation Research	10
Hydrology (water quality emphasis)	10
TOTAL	\$120

*Priorities are not implied by the order given to programs in the tables.

POWER AVAILABILITY

The paper submitted by the Energy Resources Board* provided a description of the state's electric power sector, supply and demand, and of the natural gas supply and demand. The paper concluded that there will be little negative impact on U_3O_8 production due to electrical capacity shortages resulting from natural gas curtailments. However, the paper did not consider secondary factors which may affect new power capacity development. The principal issues are summarized in Table 17.

Appendices F and G to the paper briefly proposed studies which could be pursued to give the state a better understanding of power development issues. Table 18 summarizes the studies and the estimated annual budget proposed. If the state chooses to pursue the studies, DOE should request the state to provide more discussion of secondary factors in support of specific proposals for federal funding. Consideration should be given to preliminary analyses of land use, compilation of current litigation concerning power development, establishment of a data bank of energy requirements for energy production, and analysis of potential constraints of federal, Indian and state air quality standards on power capacity expansion.

Volume IV of this series, The Supply of Electric Power and Natural Gas Fuel as Possible Constraints on Uranium Production, DOE 79-7105, is the ERB paper.

*Now the Energy and Minerals Department.

TABLE 17
Electric Power

Principal Issues	Factors Affecting Resolution
Transmission rights-of-way on Indian lands	Approval of tribal council and individuals Provision of diesel-powered electric generators by company Availability of diesel
Water availability for new generating stations	Beneficial use of water mine water effluent Groundwater rights in the Juan Basin
Radio Environmental Controls	DOI removal of siting and emission regulations and permits.

TABLE 18

Energy Resources Board Proposed StudiesLAND USE

Preliminary Data Survey	\$ 5,000
Comprehensive Data Collection	20,000
Data Analysis	20,000
Travel/Per Diem	<u>1,500</u>
	\$ 46,000

LITIGATION

Preliminary Data Survey	\$ 2,500
Comprehensive Data Collection	20,000
Data Analysis	30,000
Travel/Per Diem	<u>4,000</u>
	\$ 56,000

FUTURE DATA REQUIREMENTS

Preliminary Data Survey	\$ 2,000
Comprehensive Data Collection	<u>18,000</u>
	\$ 20,000

RIGHTS OF WAY

Comprehensive Data Collection	\$ 4,000
	<u>-----</u>
TOTAL	\$126,500

COMMUNITY IMPACTS

The paper submitted by the Energy Resources Board is a proposal for a community impacts management program. The paper focuses on the management program with definition of the problem confined to a compendium of employment and population forecasts in an appendix. The forecasts were taken from a number of state documents which analyze the problem; references are given. Table 19 summarizes the issues.

Table 20 summarizes the management system proposed, showing the estimated level of effort required and the cost in 1978 dollars. The management program was designed for an eight-year period. It is presented in three options, with the first option applying only to areas within the Grants Mineral Belt where substantial uranium production is expected but communities are least prepared. In general, the second option includes the adjacent impacted areas and the third option incorporates areas outside the GMB where uranium development will occur along with coal development. Some tasks are divided by levels of activity and institutional involvement rather than geographically.

The proposal has merit although the paper did not follow the pattern intended for the study. The authors recommend that DOE begin discussions with the New Mexico Energy and Minerals Department to determine whether and how DOE could participate in such an impact management program. The program is presented as Volume V of this series, State Policy Needs for Community Impact Assistance, SAND78-1335.

TABLE 19

Community Impacts

<u>Principal Issues</u>	<u>Factors Affecting Resolution</u>
Community planning capability	<p>Financial and technical assistance from government and industry</p> <p>Government appropriations and allocation</p> <p>Industry cooperation</p>
Financing for housing and public facilities	<p>Traditional construction and mortgage funds</p> <p>Federal monetary policy</p> <p>Regional money market</p> <p>Economic diversification</p> <p>State and federal impact assistance funds</p> <p>Passage of enabling legislation and appropriation, and allocation to New Mexico</p> <p>Community Assistance Council Appropriation</p> <p>Competing demands for severance tax bonds</p> <p>Willingness of uranium companies to finance development</p> <p>Return on investment considerations</p> <p>Other investment alternatives</p> <p>Policies to minimize involvement with public sector</p>
Availability of vocational education and training programs	<p>Federal financial assistance</p> <p>Industry and union cooperation</p>

TABLE 20

Eight-Year Community Impact Management Program

Table 20a. Eight-Year Effort Levels by Program Element

<u>Program Element</u>	<u>Level of Effort (person-months/yr)</u>		
	<u>Option 1</u>	<u>Option 2</u>	<u>Option 3</u>
Early Warning System	75	120	175
Community Planning and Technical Assistance	112	272	432
Flexible Finance	24	36	48
Growth Monitoring System	28	70	112
Manpower	12	24	36
Diversification	12	18	27
Appropriate Technology Communities	<u>21</u>	<u>36</u>	<u>51</u>
Totals	284	576	881

Table 20b. Yearly Levels of Effort and Cost Estimates for all Elements

<u>Year</u>	<u>Effort Level (person-months)</u>			<u>Cost in \$1000 (1978) @ \$4k/person-month</u>		
	<u>Options</u>			<u>Options</u>		
	<u>1</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>3</u>
1	65	112	161	260	448	644
2	66	128	195	264	512	780
3	33	68	105	132	272	420
4	33	68	105	132	272	420
5	33	68	105	132	272	420
6	18	44	70	72	176	280
7	18	44	70	72	176	280
8	<u>18</u>	<u>44</u>	<u>70</u>	<u>72</u>	<u>176</u>	<u>280</u>
TOTALS	284	576	881	1136	2304	3524

APPENDIX

ERDA NEW MEXICO CONFERENCE ON COORDINATION OF ENVIRONMENTAL POLICY ANALYSIS

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