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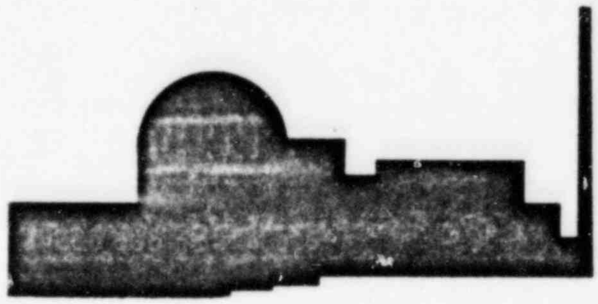

THE IDAHO NATIONAL ENGINEERING LABORATORY AS A SITE FOR A LARGE LMFBR

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~~Industry and Energy~~

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THE IDAHO NATIONAL ENGINEERING LABORATORY (INEL) AS A SITE FOR A LARGE LMFBR

1.0 INTRODUCTION

For the past two years the United States Department of Energy has been sponsoring studies that have as a principal objective the conceptual design of a large LMFBR (Liquid Metal Fast Breeder Reactor). The studies, known as the CDS (Conceptual Design Studies), were carried out in two phases.

Phase I, completed in 1979, dealt with preconceptual matters such as the choice between a pool or a loop, specifications of steam quality, plant size, etc. Phase II studies, now in progress, are concerned with the actual conceptual design. Current plans call for the completion of the studies and the submittal of a report to the Congress and the President in March 1981. After a suitable period of review, of the order of six months, a decision will be made whether or not to proceed with construction. If the project is authorized, matters of plant siting must immediately be addressed.

One possible and very attractive location for such a plant is the INEL (Idaho National Engineering Laboratory) located between Arco and Idaho Falls, Idaho. The INEL, formerly the NRTS (National Reactor Testing Station), comprises 572,000 contiguous acres of government-owned uninhabited rangeland that was set aside in the late 1940's as a site for the construction, testing, and operation of a wide variety of government-owned reactors and ancillary facilities. The remoteness of the INEL, its seismic stability, the ready availability of water, and the capability of the region surrounding the INEL to assimilate the electrical output of a large breeder plant are aspects consistent with important siting criteria. The availability of a large work force of highly trained personnel (professionals, technicians, administrative-managerials, and construction workers), the regional endorsement of nuclear power, and the availability of some of the world's finest support facilities are additional factors that favor an INEL siting. In view of the remoteness with respect to population centers and the lack of stream drainage from the station into existing waterways, the potential impact of a large breeder plant on the environment should be no greater, and could very likely be less, than for many other potential sites.

The compatibility of the INEL with critical siting criteria, demographic features, and existing support facilities are examined and discussed below. Intentionally omitted are references to plant specifics such as configuration, licensability, fuel type, etc., since such specifics are separable from physical siting criteria.

2.0 SUMMARY

The possibility of locating a large LMFBR at the INEL in southeastern Idaho has been examined from the viewpoints of major siting criteria. The results of these studies are summarized below.

2.1 Demographic Features

2.1.1 Remoteness

The INEL consists of 572,000 contiguous acres of uninhabited government-owned rangeland. Almost all of the land surrounding the INEL is owned by the federal government and is administered by the Bureau of Land Management.

2.1.2 Population Density Near the INEL

The population density in the transition region from federally controlled to privately owned land is exceedingly sparse; i.e., less than five inhabitants per square mile.

2.1.3 Population Centers

The nearest city to the INEL is Idaho Falls, population approximately 40 000, at a distance of 40 miles from site center.

2.1.4 Prevailing Winds Relative to Population Centers

Prevailing winds are from the southwest and northeast quadrants. Surrounding population patterns are such that off-site winds blow in the direction of sparsely populated areas.

2.1.5 Nuclear Experience at the INEL

The INEL was established in 1949 as a national location for centralizing the construction, operation, and testing of a wide variety of reactor concepts. During the past 30 years, 52 separate reactor concepts have been built and operated or tested. As a result, a large fraction of the local populace is familiar with the construction and operation of nuclear facilities.

2.2 Water Requirements and Availability

The low relative humidities at the INEL make evaporative cooling towers attractive and feasible for condenser cooling. Water requirements for the proposed plant and its ancillary facilities will amount to a maximum of 15,000 gpm or 17,700 acre-feet per year.

The Snake River Plain, on which the INEL is located, overlies one of the largest and most productive self-charging aquifers in the nation. Substantially more than one million acre-feet of water per year are withdrawn for agricultural, industrial and municipal use. The impact of an additional 17,700 acre-feet withdrawal, the maximum expected, should be less than 2%.

2.3 Seismic Considerations

The Snake River Plain and the INEL, in particular, are quiet seismic areas. The results of recent U. S. Geological Survey studies lead to the conclusion that the seismic risks of locating a large reactor at the INEL are comparable to those for typical eastern locations and less than those for existing or proposed reactor sites in western locations. The Safe Shutdown Earthquake (SSE) criterion for an INEL siting is 0.22 g. For comparative purposes, SSE values of 0.25 g and 0.67 g have been established for the Clinch River, Tennessee and San Onofre, California sites, respectively.

2.4 Transmission and Marketing of Power

As the results of discussions with utility personnel and a review of regional power needs, along with plans for updated transmission facilities, it seems reasonably certain that 1000 MW of electrical power from a large fast breeder could be assimilated in the Idaho-Utah-Wyoming area after startup; i.e., after 1990.

2.5 Shipment of Large Components

Most of the materials and components needed for the construction of a large LMFBR at the INEL can be shipped by rail or truck. Large components that must be shop fabricated can be shipped by barge to Lewiston, Idaho and transported by multiaxled trucks to the INEL. Other large components can be shipped in pieces and field assembled at the INEL.

2.6 Public Acceptance

Public reaction to siting a large LMFBR at the INEL would be overwhelmingly favorable. Thirty years of living near the INEL has created a level of nuclear understanding unsurpassed elsewhere. At all levels of government, i.e., municipal, county, legislative, state, and congressional, the attitude is agressively pronuclear.

2.7 Support Facilities

Comprehensive and sophisticated support facilities are already in place. Of particular importance are the breeder-oriented facilities at ANL-W, i.e., EBR-II, HFEF/N, HFEF/S, ZPPR, and TREAT.

Other nuclear facilities located at INEL, e.g., ATR, ETR, PBF, LOFT, and ICPP, are of significant interest and importance because they represent a large pool of talent and experience, even though the physical facilities, per se, might have little or no direct application to the construction and operation of a large LMFBR.

Facilities of a less specialized nature include a computer center, radiological and environmental science laboratory, reactor crew training facility, waste storage facilities, technical libraries, warehouses, photolabs, printing facilities, cafeterias, dispensaries, communication services, fire fighting facilities, plant and site security services, etc.

3.0 DESCRIPTION OF THE INEL

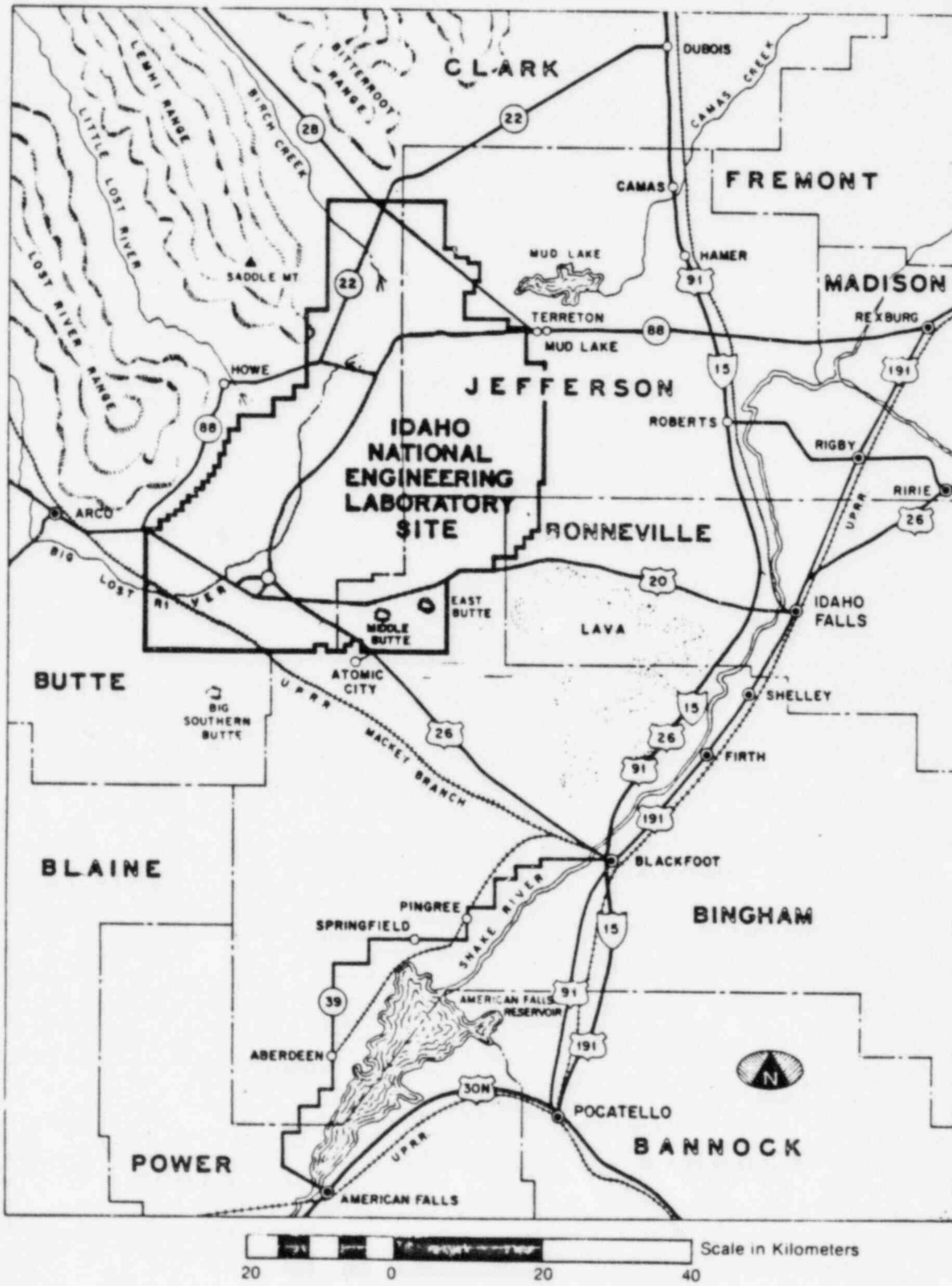
3.1 Physiography

The INEL is located along the western edge of the Snake River Plain at an average elevation of 4900 feet. (See Fig. 3.1 for the orientation of the INEL with respect to towns, cities, highways, and prominent landmarks.) Located immediately to the northwest are the Lost River, Lemhi, and Bitterroot mountain ranges. Mountains in these ranges are among the tallest in Idaho. Many have peaks with elevations higher than 12,000 feet. The southernmost edges of the three ranges merge with the Snake River Plain near the western and northern boundaries of the INEL.

Dotted across the surface of the plain are many extinct volcanic cones and craters. A secondary volcanic rift, which may be associated with a long fracture called the Great Rift, extends northeasterly from Craters of the Moon National Monument (to the west) towards the Big Southern Butte.

The plain extends approximately 350 miles across southern Idaho and at places exceeds 60 miles in width. Except for a few prominent buttes with elevations up to 7500 feet, the plain ranges in elevation from 2300 feet in the west to 6000 feet in the east.

The INEL consists of 572,000 contiguous acres of rolling semi-arid desert land. Its surface is broken with numerous basaltic outcrops



Map showing the location of the INEL with respect to nearby communities in South-Eastern Idaho

Fig. 3.1

and slopes generally towards the north. Soil depth ranges from zero at outcrops to as much as 380 feet in depressions filled with waterborne and wind-blown sediments.

Essentially all of the INEL is undeveloped desert-type rangeland. The station permits the grazing of cattle and sheep except on specific areas near operational facilities. As a measure of agricultural productivity, 10-15 acres of undeveloped land are needed to sustain one cow for one month.

The areas immediately outside the INEL boundaries consist primarily of uninhabited or very sparsely populated land physiographically similar to that of the INEL. Almost all of the land surrounding the INEL is owned by the Federal Government and administered by the Bureau of Land Management.

3.2 The INEL as a Reactor Test Site

The INEL was selected in 1949 as a national location for centralizing the construction, operation and testing of a wide variety of reactor types. During the past 30 years, 52 separate reactor concepts have been built and operated, or tested. Of these, 17 remain operational today; the remaining 35 have been phased out upon the completion of their missions. Of historical interest is the fact that all three major reactor technologies, i.e., pressurized water, boiling water, and fast breeder were pioneered at the INEL. Brief descriptions of some of the more important existing facilities and services are given in Sections 6 and 7, respectively.

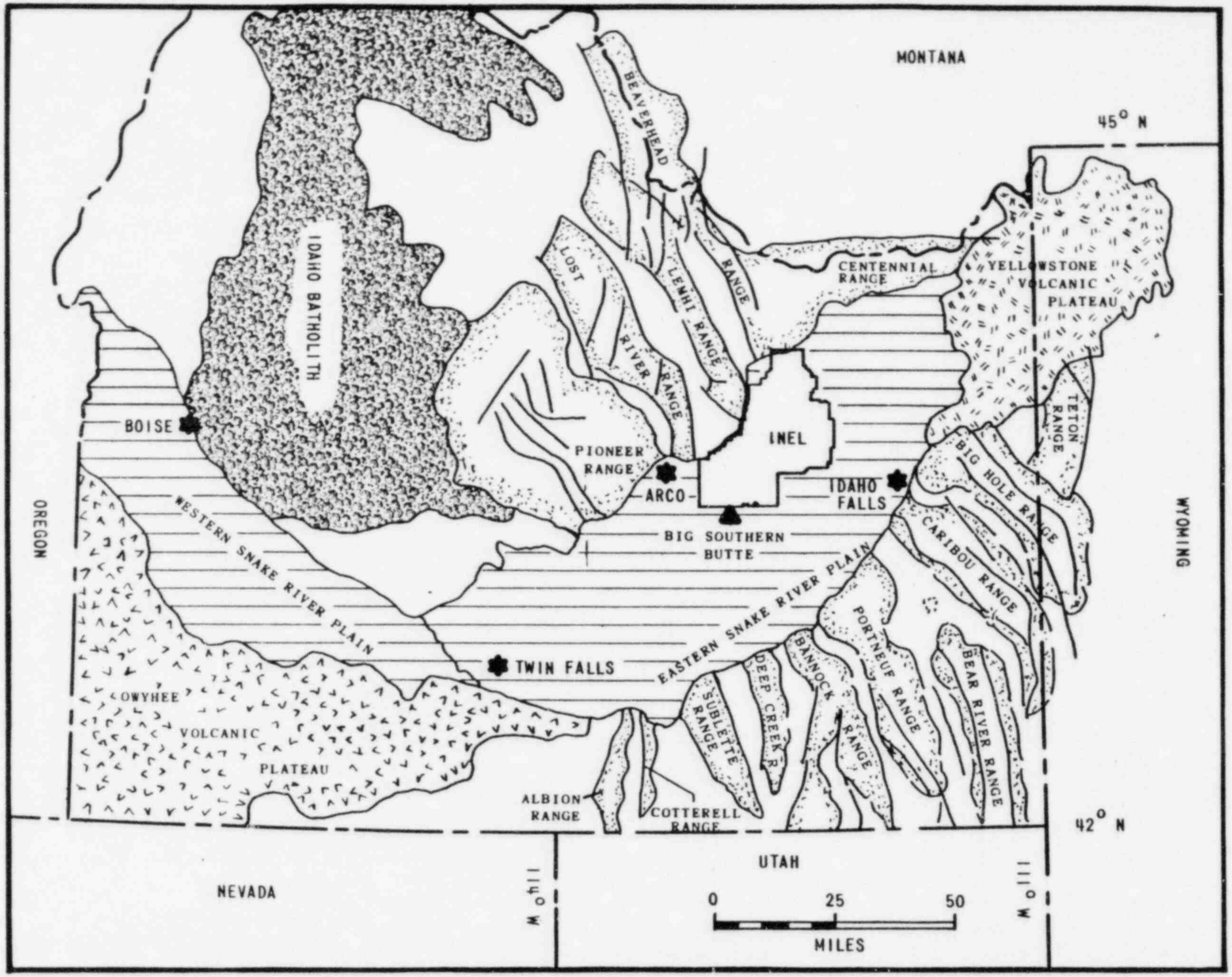
3.3 Geology

The Snake River Plain is a broad structural depression probably caused by a combination of faulting, downwarping, rifting and caldera collapse of the earth's crust. Subsequent widespread accumulations of basaltic rock, terrestrial and waterborne sediments, and layers of volcanic rock filled the trough.*

The Snake River Plain is a topographic depression 40-60 mi wide and 360 mi long that cuts an arcuate trough across southern Idaho (Fig. 3.2). It extends from the Oregon-Idaho border on the west for about 180 mi southeast to Twin Falls and then for about 180 mi northeast to Ashton, forming a continuous physiographic feature.

The plain is bounded on the north by granitic rocks of the Idaho batholith and by folded rocks in block-fault mountains that were uplifted along normal faults. The plain is bounded on the southeast by folded rocks in fault-block mountains of the Basin and Range province that were also uplifted along normal faults. Rhyolitic and basaltic volcanic rocks bound the plain on the southwest, and younger rhyolitic and basaltic volcanic rocks occur at the northeast end of the plain (Fig. 3.2).

*The geology and volcanology of the Snake River Plain are described in many reports (Armstrong and others, 1975; Robertson and others, 1974; Kuntz, 1978; Kuntz and others, 1979; LaPoint, 1977; Mabey, 1978; Malde and Powers, 1962; Christiansen and McKee, 1978).



Generalized Map of Southern Idaho Showing Geographic and Geologic Features.

Fig. 3.2

The Snake River Plain can be divided into two parts, the western and eastern regions. The two parts of the plain have different structural, geological, and geophysical characteristics. Because the INEL is located in the eastern Snake River Plain, a brief discussion of the geology of that region is given.

The eastern Snake River Plain (hereafter called the plain) is a broad flat lava plain consisting of basalt lava flows and interbedded, thin deposits of silt, sand, gravel, and clay. Drainage is dominated by the Snake River, which flows along the southeast margin of the plain. A topographic ridge of volcanic origin extends from the center of the plain northeastward toward Ashton and coincides with the long axis of the plain. Rivers entering the plain from the mountains to the north are deflected by the ridge into closed basins.

Lava flows on the plain were erupted from volcanic vents aligned along volcanic rift zones. The volcanic rift zones trend at right angles to the long axis of the plain, and many appear to be extensions of range-front faults which bound block-fault mountains on the margins of the plain. Radiocarbon ages of organic soils which were buried beneath lava flows show that volcanism has occurred throughout the plain in the last 15,000 years.

The origin and early volcanic history of the plain are not clearly known because the older rocks are buried by basalt lava flows and sediments. The results of recent studies indicate that rhyolitic ash flows and rhyolitic lava flows are present beneath the basalt-sediment cover of the plain in some localities.

Available geological data suggest that the plain has been the site of a northeasterly moving, rhyolitic volcanic system. Rhyolitic calderas began to form near Twin Falls about 14 million years ago and each successively younger caldera occurred farther to the northeast. The youngest caldera in the chain was formed about 600,000 years ago in Yellowstone National Park. The location of the caldera chain in the plain was probably governed by interaction between lithospheric plates of the western United States and a zone of structural weakness in the crust.

The INEL occupies a physiographic basin within the plain. Elevations within the INEL range from 4,800 to 5,500 feet above sea level. Except for a few small areas, the INEL is underlain by a succession of ancient and geologically recent basaltic lava flows. The beds are nearly horizontal, with no structural deformation evident.

Much of the INEL surface area consists of lava flows in which the original configurations have changed but little. Other portions of the surface are covered by alluvial sediments that range from large gravel to silty clay. Flood plain alluvium follows the course of the Big Lost River to playa (drainage) basins near the northern portion of the station. Surface soils over the remainder of the INEL consist of wind and waterborne deposits. Sandy soils derived from wind-worked beach and bar deposits in playa areas are present in the northern portion of the station.

The INEL includes the southern tips of three mountain ranges: the Lost River, Lemhi, and Bitterroot. The ranges are long and narrow; they are about 10 mi wide and are separated by intervening alluviated valleys, also about 10 mi wide. The tops of the ranges reach elevations of 10,800 feet. The average elevation of the valleys at their mouths along the northwest margin of the INEL is about 4,800 feet.

The Big Lost River, the Little Lost River, and Birch Creek drain the valleys in the area and end in closed basins or playas, the Big Lost River Sinks, the Little Lost River Sinks, and the Birch Creek Sinks, all located along the northwest margin of the plain. The natural course of these rivers was across the plain to the Snake River, the major drainage in southern Idaho, but that course is now blocked by the topographic ridge. The Snake River and its tributaries extend along the southeast margin and drain the valleys southeast of the plain.

Surface deposits in the INEL area are confined to the valleys, the lower slopes of the mountain ranges, the areas of the closed basins, and along the Big Lost River. Stream deposits consisting of gravel and sand occur along Birch Creek and the Little Lost and Big Lost Rivers. Alluvial fans extend from the range fronts to the streams in the valleys.

Clay and silt were deposited on the floors of lakes formerly located in the closed basins. Shoreline, bar, and beach deposits of gravel, sand, and silt occur along the margins of the old lakes. Wind deposits of sand occur in longitudinal and transverse dunes located downwind of the lake deposits. Playa deposits of sand, silt, and clay occur in depressions in low areas in lava-covered areas that are intermittently flooded. Older lava flows in the INEL area are covered by as much as 325 feet of wind and water deposits. Alluvial deposits as deep as 380 feet occur along the northern edge of the INEL. Open-ended or completely closed lava tubes with diameters up to 30 feet and as long as several hundred yards are found at a few locations. The INEL is characterized by lava outcrops, rolling semiarid terrain, and three volcanic cinder cones: the Big Southern Butte, the Middle Butte, and the East Butte.

Volcanism has long been prevalent throughout the area. The latest eruption occurred approximately 2,000 years ago at the Craters of the Moon National Monument, approximately thirty miles west of the INEL. Basalt volcanism produces similar structures and landforms throughout the world. Many of the volcanic structures and landforms observed on the plain are similar to those formed in historic time on the island of Hawaii. Volcanoes in the INEL area are chiefly of the shield type. Shield volcanoes are broad, dome-shaped, gently sloping cones built up by the accumulation of many lava flows. The lava flows move relatively unexplosively and radially away from the summit vent area. The fluid lava flows spread widely and cooled as thin, nearly horizontal sheets approximately 15-30 ft thick. The maximum length of lava flows from some of the largest shield volcanoes in the INEL area is about 20 mi and the largest lava flows cover about 170 sq mi.

Most lava flows in the INEL area consist of three components: a thin top layer of fine-grained vesicular and clinkery basalt; a thick central massive layer consisting of coarser-grained lava with vertical joints; and a thin base layer consisting of fine-grained blocks of lava that are typically oxidized.

3.4 Seismology

See Section 4.2.

3.5 Climatology

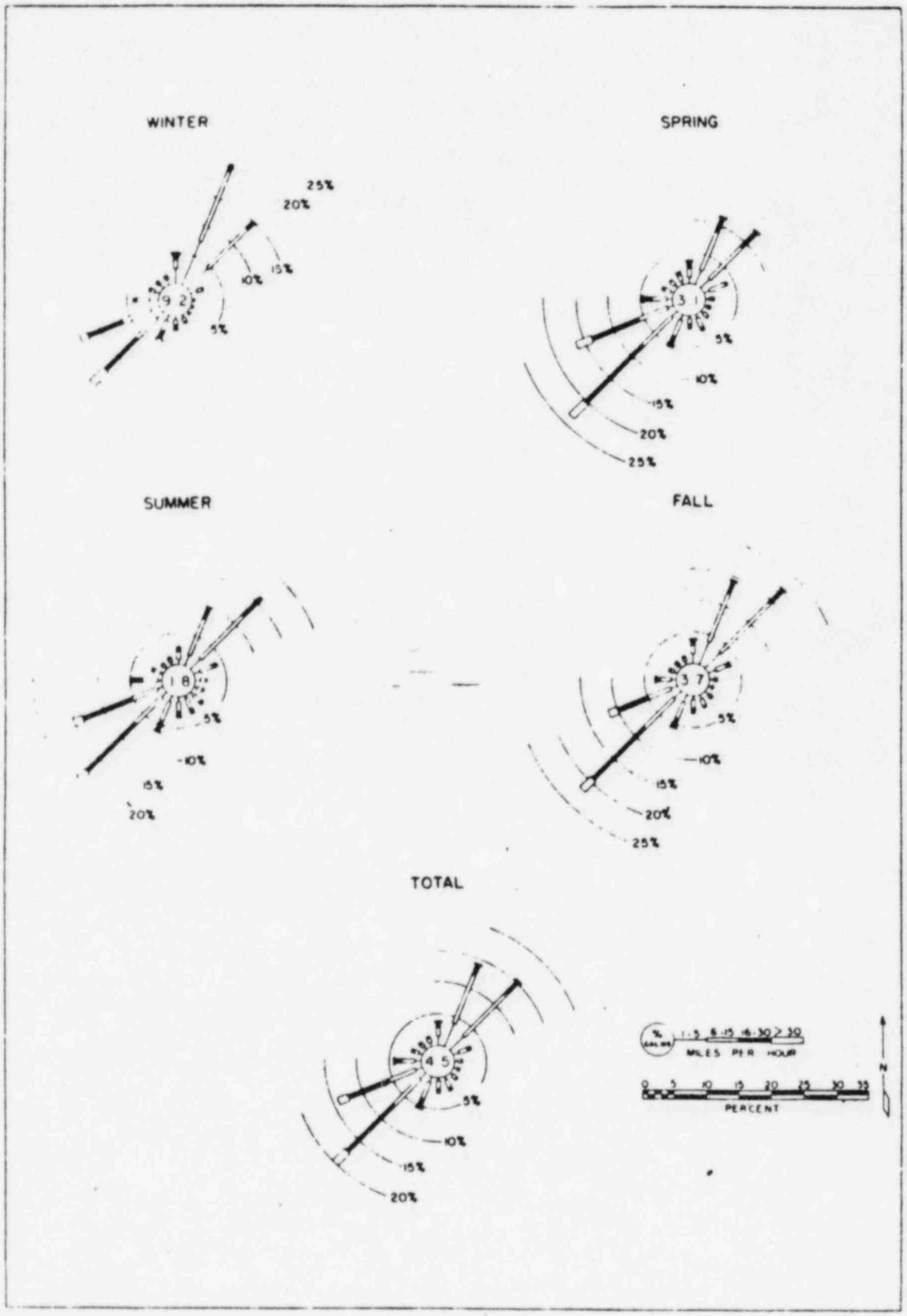
The semiarid climate of the INEL is typical of high mountain valleys of the Intermountain West. Limited amounts of precipitation, low humidities, relatively cloud-free skies, and a large year-to-year variability in rainfall characterize the area. Large daily and annual ranges of temperature are characteristic features.

Aside from short summer cloudbursts and blizzard conditions during the winter, the weather is seldom extreme. Tornadoes are extremely rare. Funnel clouds have been sighted but none has been known to have touched ground at the INEL. Although small hail frequently occurs with summer storms, no damage has ever been noted at the INEL.

The predominant air masses over the area originate from the Pacific Ocean. Flows from Pacific air masses exert a moderating effect on temperatures in both summer and winter. Mountain barriers to the north impede the flow of extremely cold air masses from the Canadian shield. Although the principal sources of moisture throughout the year are of Pacific origin, moisture from the Gulf of Mexico during May and June may contribute to the rainfall pattern. An average annual precipitation of 8.5 in. includes 26 in. of snow. Snow depth averages less than 7 inches during any winter month. Average humidity ranges from a high of 70% in February to 30% in July. Humidities as low as 4% are occasionally measured. Large differences in temperature may be noted throughout the year. Temperatures as high as 104°F and as low as -43°F have been recorded.

Inversion conditions are common. As an annual average, lapse (normal) conditions exist 52% of the time; inversion conditions prevail for the remaining 48%. Inversions during periods of winter calm are the most intense. Clear skies, a general snow cover, and long nights provide ideal conditions for radiative cooling.

Winds from the southwest and from the north and northeast predominate, as indicated by the wind rose of Fig. 3.3. Strong gusts of winds can occur in the vicinity of thunderstorms. The highest speed recorded at the INEL (20 feet above ground) was 78 mph from the west-southwest.



GFA 250-ft Wind Roses, July 1951 through May 1962.

Fig. 3.3

In general, the climate is invigorating with warm days, cool nights and low humidity during the summer months. Winters are somewhat cold and relatively dry.

3.6 Hydrology

(See Sect. 4.1)

3.7 Ecology

Vegetation at the INEL is dominated by sagebrush and squirrel-tail grass. Less frequent plant life includes the Rocky Mountain Juniper and several varieties of shrubs, grasses and weeds. Most are indigenous to the region; a few such as crested wheatgrass and other grasses have been introduced successfully to control wind and water erosion and to supplement native species for spring and fall grazing. The amount of ground surface covered by plant canopies ranges from a low of 10% to a high of 45% in the more productive areas.

A wide variety of insect life is indigenous to the region. At least 740 species have been identified. By far the most common types are those of butterflies and moths. Ants, represented by 11 species, are extremely common. Equally abundant are cicadas, leafhoppers, mirid bugs, small flies and parasitic wasps. Annoying insects are practically non-existent. Conspicuously absent are mosquitoes, gnats, horse flies, deer flies, and ticks.

Reptiles are well represented. Three species of lizards include the northern sagebrush lizard (the most prevalent) followed by the pigmy horned lizard and Great Basin skink. Snakes are reasonably abundant. Most common of all is the Great Basin rattlesnake. Other species include the Great Basin gopher snake, the wandering garter snake and the western yellow-bellied racer.

At least forty species of birds are known to inhabit the INEL during the breeding season. Species that nest on the INEL include Brewer's sparrow, sage sparrow, sage thrasher and horned lark. Others that probably nest on the INEL are the western meadowlark, rock wren, mourning dove, brown-headed cowbird, and night hawk. Marsh hawks, kestrels, and prairie falcons are frequently seen. Other raptors such as the ferruginous hawk, rough-legged hawk, golden eagle and bald eagle are known to nest and winter on the INEL. Peregrine falcons have occasionally been sighted on the INEL but these, apparently, nest and winter elsewhere.

The presence of man-made lagoons attracts birds that are otherwise non-indigenous. Included among these are Canadian geese, mallards, teals, widgeons, sandpipers, western kingbirds, and Wilson's phalaropes. Raptors are quite common.

At least 24 species of mammals are indigenous to the area. The largest of these are antelope and deer. Smaller species include badgers, coyotes, red foxes, bobcats, rabbits, ground squirrels, chipmunks, gophers, bats and mice.

Of the various species of wildlife on the INEL only two, bald eagles and Peregrine falcons are on the endangered species list.

3.8 Landmarks

The INEL is characterized by lava outcrops, rolling semi-arid terrain, and three volcanic cinder cones: the Big Southern Butte, the Middle Butte, and the East Butte. Other permanent features include intermittent streams (in flow during the annual run-off); various playas (natural drainage ponds); and the Birch Creek, Big Lost River, and Little Lost River sinks near the northern edge of the INEL.

The Craters of the Moon National Monument is located approximately thirty miles west of the INEL. This region, along with portions of the INEL, is characterized by cinder cones and lava flows from volcanic eruptions which occurred as recently as 2000 years ago. Open-ended or completely closed lava tubes with diameters up to 30 ft and as long as 200-300 yds may be found at a few locations on the INEL site.

3.9 Historical Information

Man unquestionably inhabited the INEL as early as 10,000 years ago. Evidence of his occupation appears mainly in the form of a widespread surface scatter of stone tools, principally spear points and arrowheads. Nearly all caves and prominent rock overhangs show evidence of prehistoric human habitation.

Very likely the region bounded by the INEL served as a wintering area for various nomadic tribes. The availability of water in the form of snow; and a plentiful supply of wintering big-game animals were very likely irresistible attractions. The climate 10,000 years ago was much wetter than present and pine forests extended from the mountains onto the plains.

4.0 CRITICAL SITING CRITERIA

Of the many siting criteria that must be considered, four deserve special attention. These are the availability of water, seismic stability, the ability of surrounding areas to absorb the electrical output of the plant, and the capability for shipping large shop-assembled components to the plant site.

4.1 Water Requirements and Availability

Estimates of water requirements for plant cooling are based on the following assumptions: a power output of 1000 MWe and superheated steam conditions of 850°F and 2200 psig. Also assumed is the use of conventional wet, evaporative cooling towers for condenser cooling.

On the basis of these assumptions the maximum cooling tower makeup requirement (including evaporation, drift and blowdown) is 11,000 gpm. Demineralizer makeup, process cooling, sanitary needs, and miscellaneous uses will require the additional pumping of approximately 4,000 gpm. Assuming a 75% plant capacity factor the maximum annual usage rate will be about 5.8 billion gallons or 17,700 acre-feet. As shown below, requirements such as these are small relative to the availability of water in the INEL aquifer.

Surface water at the INEL consists of three streams that drain through mountain valleys: Big Lost River, Little Lost River, and Birch Creek. These three waterways flow only intermittently and terminate in four playas in the north-central part of the INEL. No surface streams leave the site.

Flow from the Little Lost River and Birch Creek seldom reaches the INEL boundaries. Except in years of extremely high runoff, the Little Lost River with an average discharge northwest of Howe, Idaho, of 70-cubic feet per second (cfs), (50,000 acre-feet/year) and Birch Creek with an average discharge near Reno, Idaho, of 70 cfs (57,000 acre-feet/year) are consumed in irrigation before they reach the INEL. Water from Birch Creek can become a flood threat to facilities along northwestern portions of the site in times of extreme runoff; otherwise, the two waterways have a minimal effect on INEL hydrology.

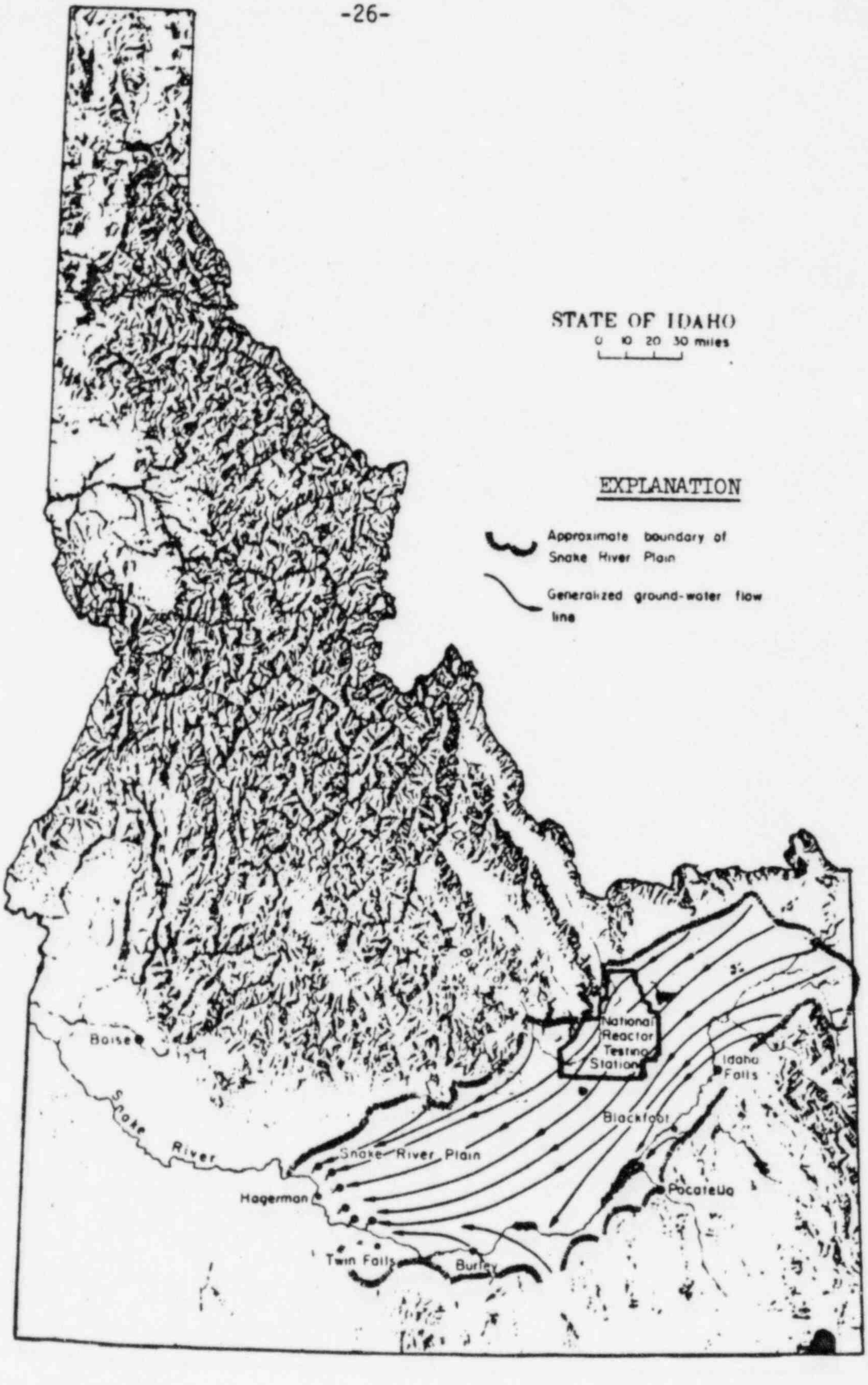
Significant runoff does occasionally reach the INEL from the Big Lost River. This river drains the Big Lost River Valley and flows past Arco onto the Snake River Plain where it turns northeastward through the INEL. Water which is not lost from the river by evapotranspiration and infiltration into porous sediments in the channel bottom drains onto three playas near Test Area North (TAN). At times water flow does not reach the INEL, and at other times Big Lost River runoff overflows its own playas and drains into the Birch Creek Playa. The average discharge of the Big Lost River is 297 cfs (214,700 acre-feet/year) at Mackay Dam. A maximum discharge of 397,000 acre-feet/year occurred in 1965.

The Big Lost River is affected by diversions for irrigation and by two major artificial controls. These are Mackay Dam, 30 miles northwest of Arco, and a flood-control diversion system on the INEL. The flood-control diversion system was constructed in 1958 to prevent flooding of INEL facilities downstream by diversion of runoff waters to the south-western part of the INEL. Other than water lost to evaporation, the entire flow of the Big Lost River infiltrates into the unsaturated zone overlying the Snake River Plain aquifer. This recharge has a noticeable local effect on the aquifer and perched water beneath the channel bed during times of high runoff.

4.2 Ground Water

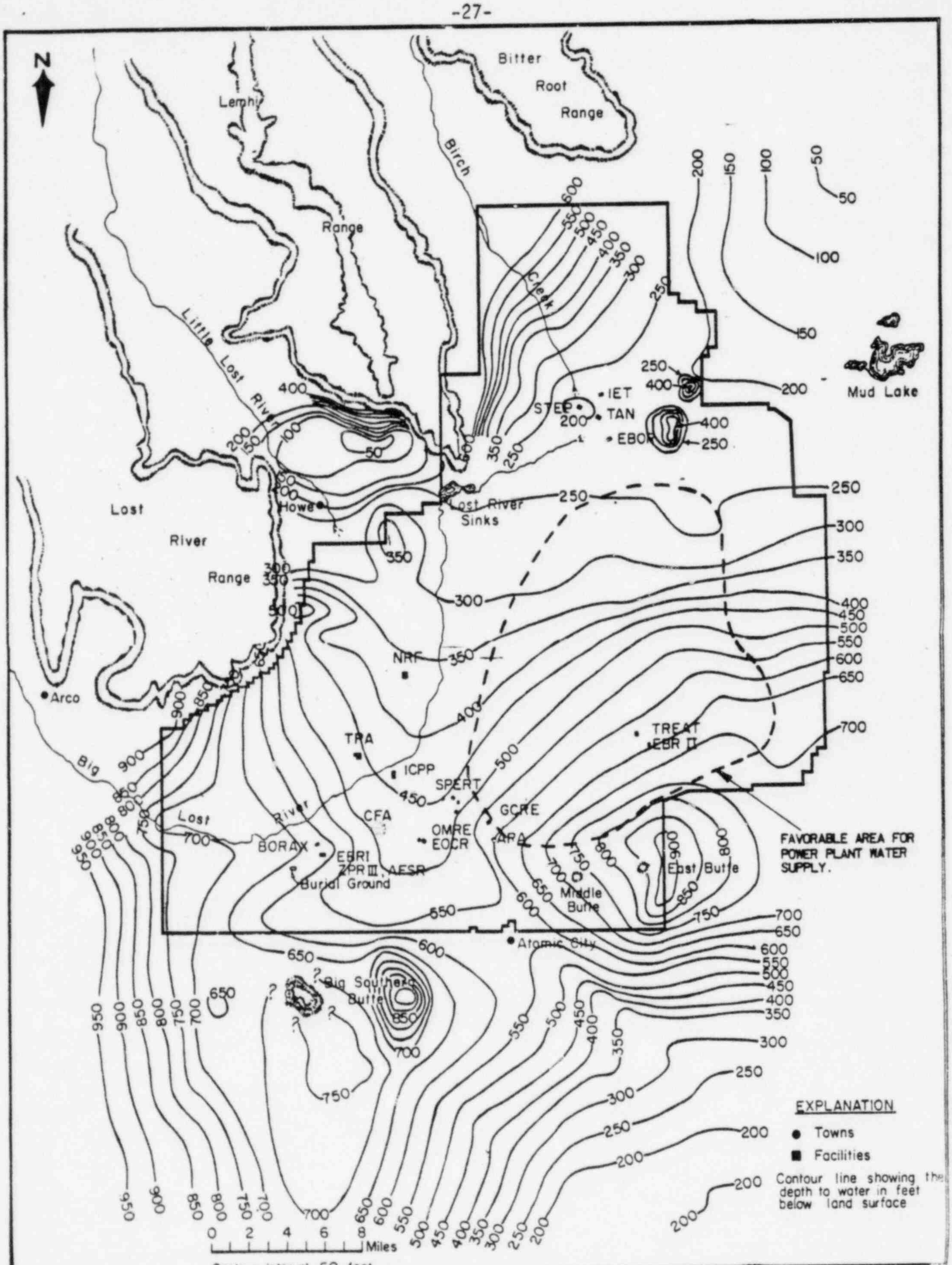
The principal aquifer that underlies the portion of southern Idaho which includes the INEL area is the Snake River Plain aquifer. The aquifer is approximately 200-miles long by 50 to 60 miles wide, comprises an area of about 9,600-square miles, and is characterized by a high degree of heterogeneity (Fig. 4.1). It is composed of thin basalt flows with interbedded layers of sediments. Most of the permeable zones occur along the upper and lower edges of the basaltic flows which have large irregular fractures, fissures, and voids. Recent data indicates that the thickness of the more permeable part of the aquifer at the INEL is between 700 and 1,500 feet. The depth to the aquifer at the INEL varies from 200 feet in the north to 900 feet in the south (Fig. 4.2). The water table slopes from the northeast to the southwest at an average gradient of five feet per mile.

Average flow rates vary due to the aquifer heterogeneity. Studies conducted at the INEL indicate natural flow rates in the range of



Relief Map with Inferred Groundwater Flow Lines.

Fig. 4.1



CONTOUR MAP OF DEPTH OF WATER TABLE BELOW SURFACE OF INEL Fig. 4.2

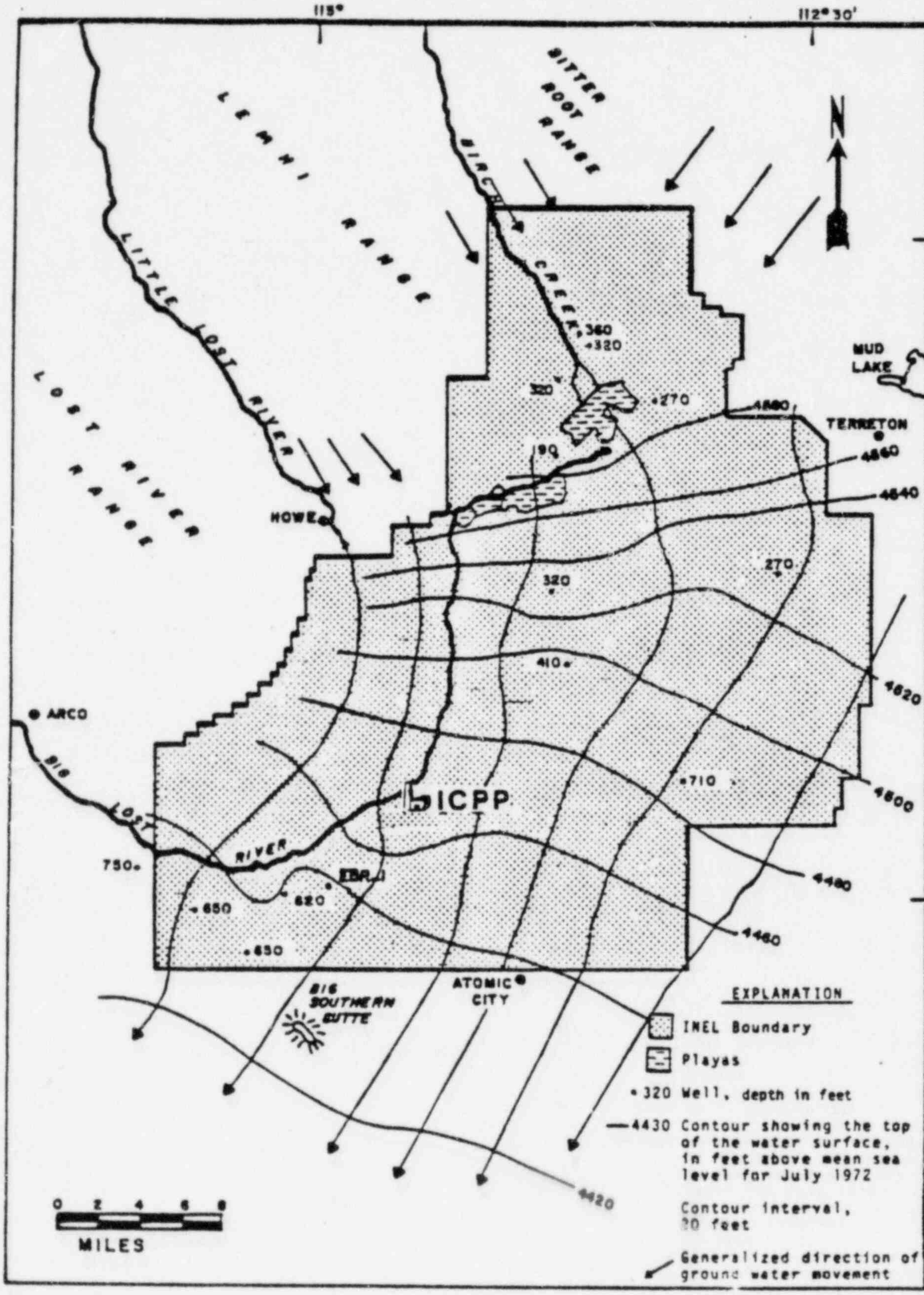
5 to 20 feet per day with an average near 20 feet per day. However, these locally-measured rates may not be representative of flow rates throughout the aquifer. Calculations suggest that the rates are reasonable.

The aquifer is recharged in the north and northeastern margins of the plain and discharges to the south and southwestern areas (Fig. 4.3). The average annual recharge and discharge of the aquifer is approximately 6.5 million acre-feet. About three-fourths of the discharge occurs in large springs between Twin Falls and Bliss and about one-fourth of the discharge is in springs southwest of Blackfoot.

The aquifer provides water for all the INEL operations, extensive irrigation use, domestic use, municipal use and industrial use. Water from springs emerging in the Twin Falls-Bliss area is used to raise fish commercially. About one million acre-feet of water is pumped from the aquifer for irrigation annually.

The rocks beneath the Snake River Plain serve as a underground reservoir area and a distribution system. It has been estimated that the Snake River Plain aquifer contains about 1 billion acre-feet of water of which about 500 million acre-feet of water may be recoverable.

The INEL pumps about 2.5-billion gallons of water per year from the aquifer. This averages less than 8,000 acre-feet per year. About half of the water pumped is returned to the subsurface by waste-disposal operations. It has been estimated that the pumpage at INEL that is



Groundwater Table Levels and Flow Path at INEL

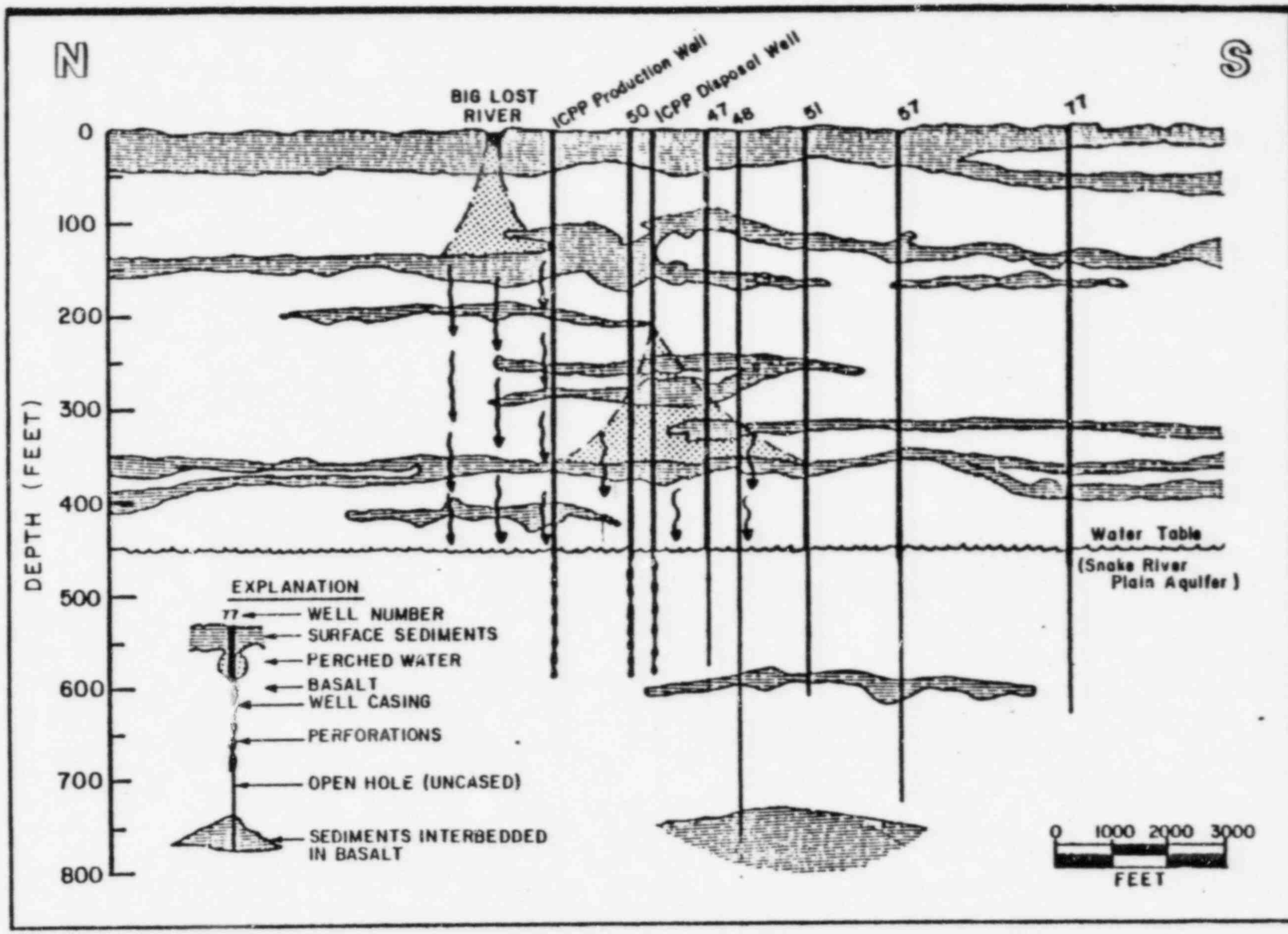
Fig. 4.3

consumed is less than 1 percent of the water that flows beneath the INEL. Thus, considerable additional water is available for development.

The water levels in the Snake River Plain aquifer change in response to recharge and pumpage. The water level in some wells has fluctuated within a range of only 4 feet during the past 30 years. The largest fluctuation of the water level in one well since 1950 has been about 22 feet. The average water level fluctuation has been less than 10 feet.

The Snake River Plain aquifer is moderately to highly permeable. The relative permeability of the aquifer is shown by the specific capacity of the wells that obtain water from the aquifer. The specific capacity is the yield of the well in gallons per minute per foot of drawdown during pumping. Specific capacities of wells on the INEL range from less than 200 to more than 3,000 gpm. The lower values are usually found in areas where interbedded sediments have filled some of the fractures in the basalt. The specific capacity increases toward the eastern part of the INEL, away from the mountains along the western edge of the Snake River Plain. Some of the best wells can be pumped at a rate of 2,500 gallons per minute with less than 1 foot of drawdown. This ranks with the most permeable aquifers found anywhere.

At various locations beneath the INEL site, there are zones of perched water above the aquifer (see Fig. 4.4). Recharge effects from the Big Lost River are very pronounced in the perched water beneath the



Geologic Cross Section Through the ICPP Area Showing Generalized Stratigraphy, Perched Water, Wells, and Regional Water Table (modified from Robertson, et al., 1974)

Fig. 4.4

river and in the Snake River Plain aquifer. Large perched water bodies have been found beneath the Test Reactor Area. The largest perched water body is one-mile long by one-half mile wide. A much smaller perched water body has been found beneath the ICPP. It occurs in the shallow alluvium and in the basalt at a depth between 340 and 420 feet. The U.S. Geological Survey (USGS) is monitoring the perched water for the presence of radionuclides and chemical water quality perameters.

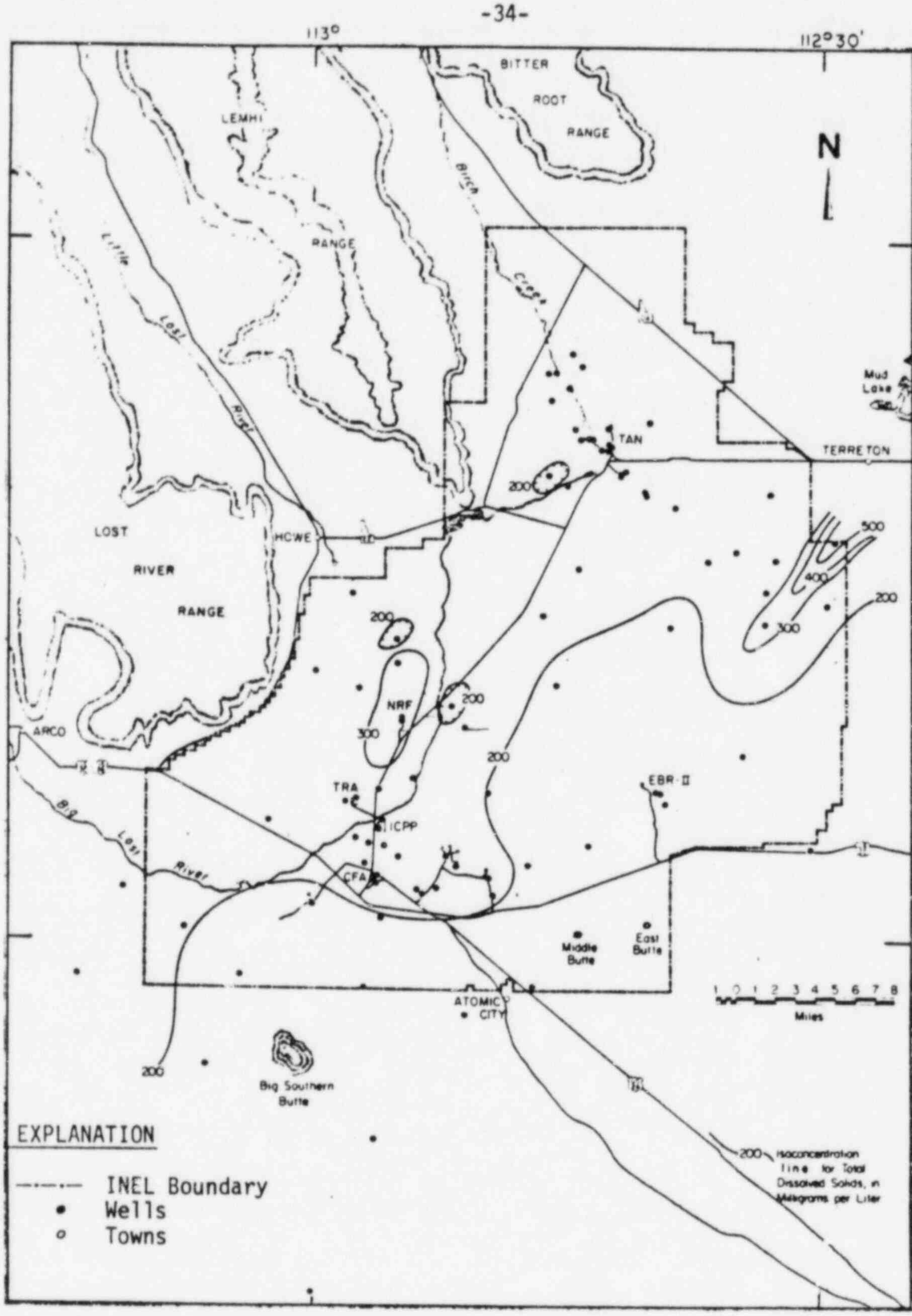
The composition of surface and ground waters is influenced by reactions with rocks. Water leaving recharge areas contains chemical constituents representative of the dominant rock types. High precipitation in the mountains bordering the eastern Snake River Plain supplies water with low total dissolved solids which can generally be used for many purposes without treatment. The dominant recharge areas to the Snake River Plain aquifer which influence water beneath the INEL is from the northwest and northeast. The ground-water flows fairly rapidly in the more permeable parts of the aquifer allowing minimal rock-water interactions. Other chemicals are derived from irrigation waters and chemical wastes.

As water percolates downward or flows laterally underground, it dissolves some of the rocks through which it passes. The extent to which the chemistry of water will be altered by its host rock depends upon such factors as: (1) mineral composition of the rock, (2) solubility of the various minerals, (3) water temperature, (4) acidity of the original precipitation (rain or snow), (5) geochemical changes due to ion exchange or sorption as the water flows through the aquifer, and (6) the flow rate.

The ground water at the INEL is generally of the calcium-magnesium-bicarbonate type. This chemical composition reflects the abundant limestone and dolomite in the recharge area of the northwest. Liquid-waste-disposal operations and irrigation practices also have a localized effect on the character of the Snake River Plain aquifer beneath the INEL. Maps are available that show the areal distribution of calcium, magnesium, sodium-potassium, bicarbonate, sulfate, chloride, fluoride, silica, temperature, and specific conductance. Maps of the INEL showing total dissolved solids, calcium, sodium, sulfate and temperature are given in figures 4.5 through 4.9.

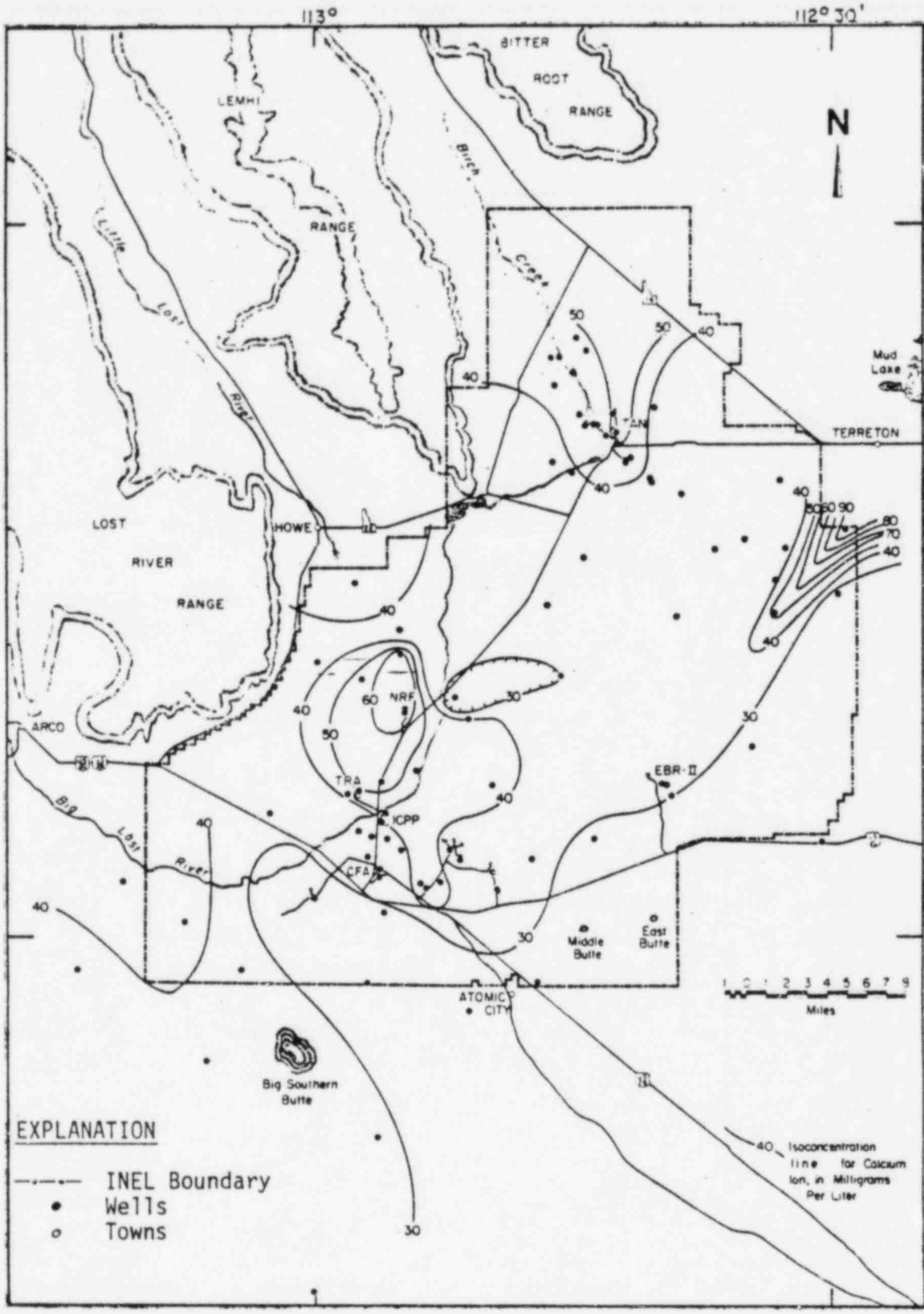
Where waters from the carbonate dominated northwest are present there is a significant content of calcium, magnesium, and bicarbonate. Toward the east across INEL, the content of SiO_2 and fluoride increase indicating the major input of waters recharged to the Snake River Plain aquifer to the north and northeast with chemistry imprinted by the silicic volcanic rocks of the Yellowstone area.

There are two groups of waters within the dominant calcium bicarbonate type. These are a western group generally of higher calcium bicarbonate contents and an eastern group slightly higher in sodium and sulfate-chloride. Other waters are generally from: 1) wells penetrating



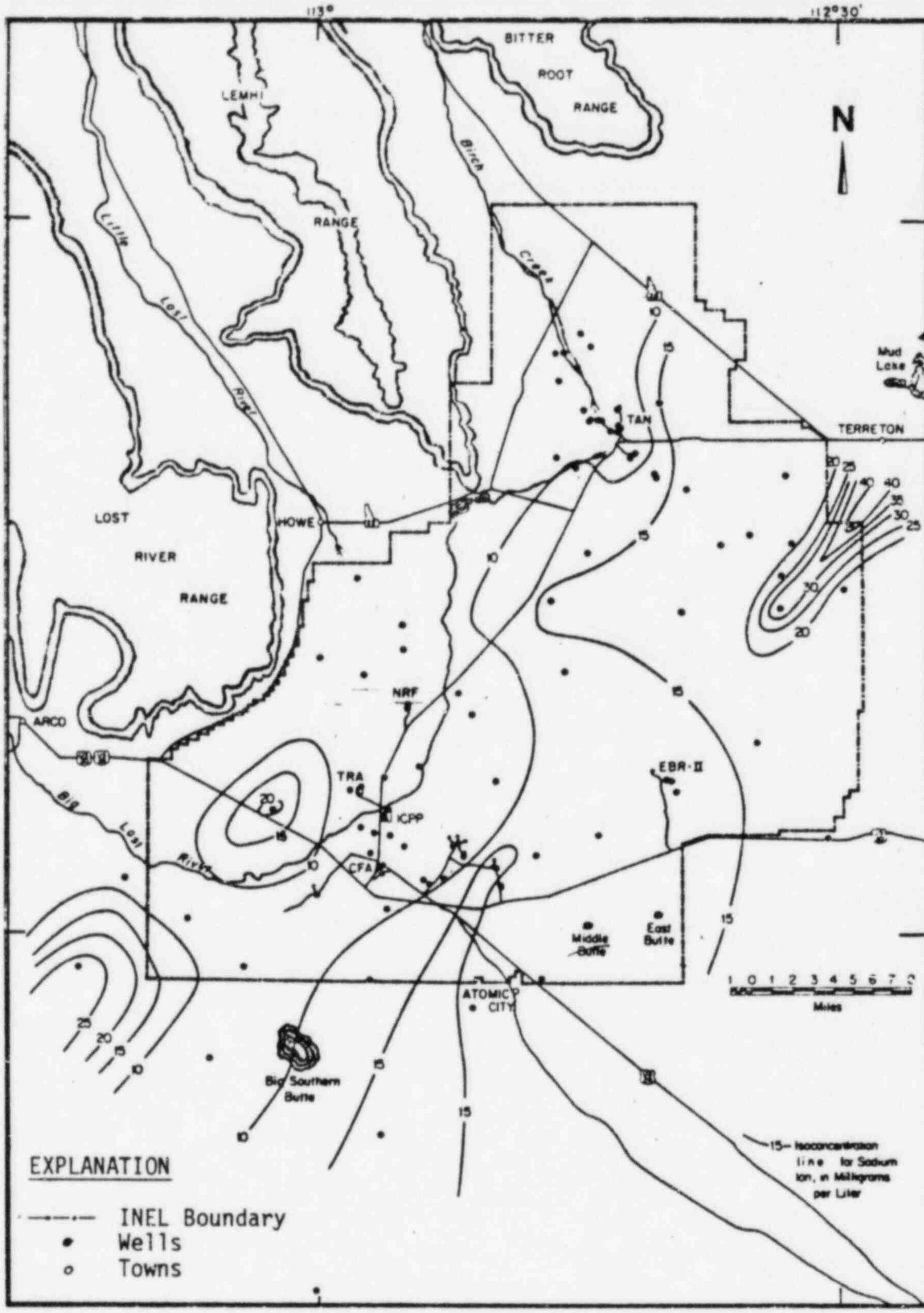
Map of the INEL vicinity showing the natural distribution of dissolved solids (residue on evaporation) in the Snake River Plain aquifer water.

Fig. 4.5



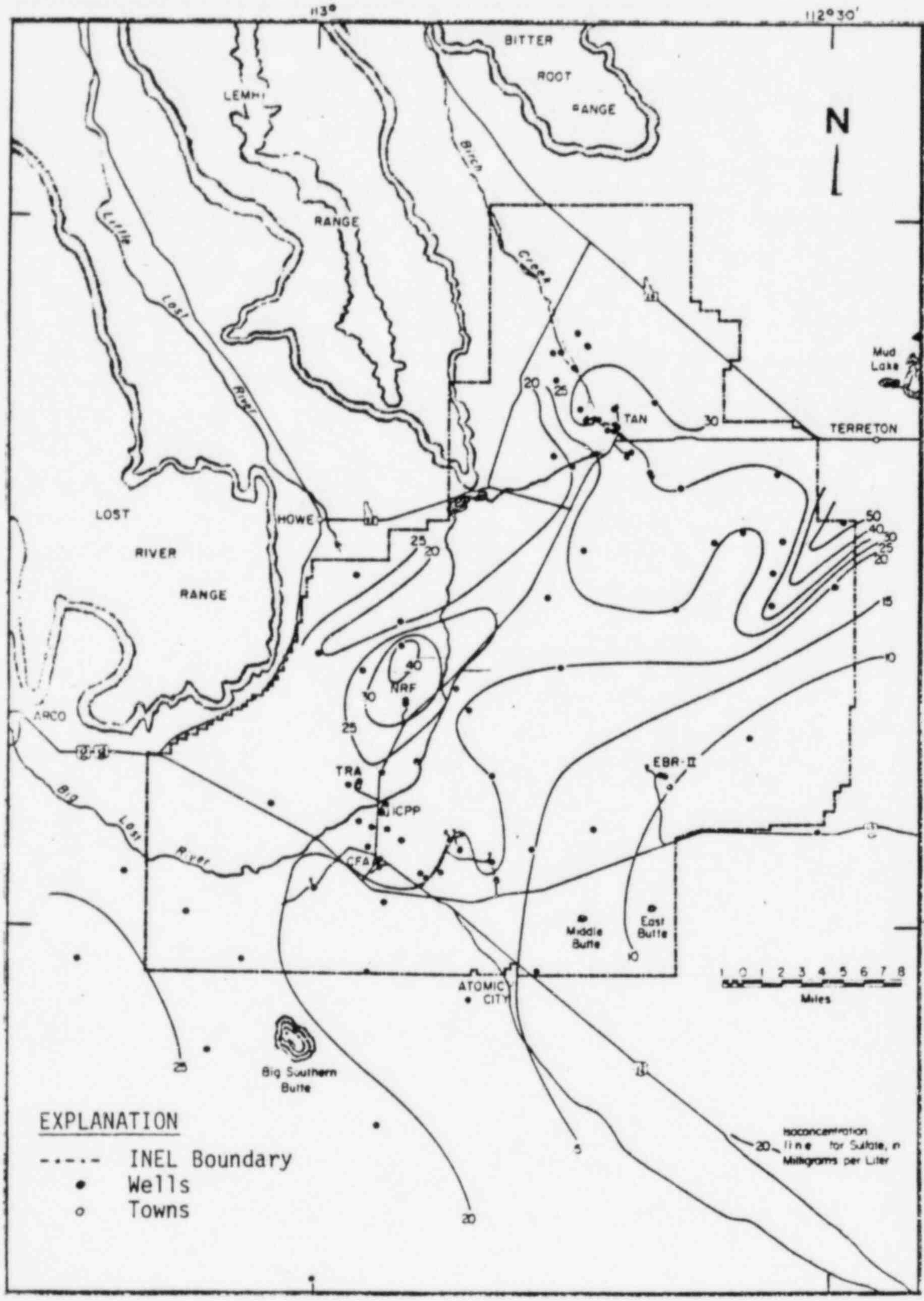
Map of the INEL vicinity showing the natural distribution of dissolved calcium in the Snake River Plain aquifer water.

Fig. 4.6



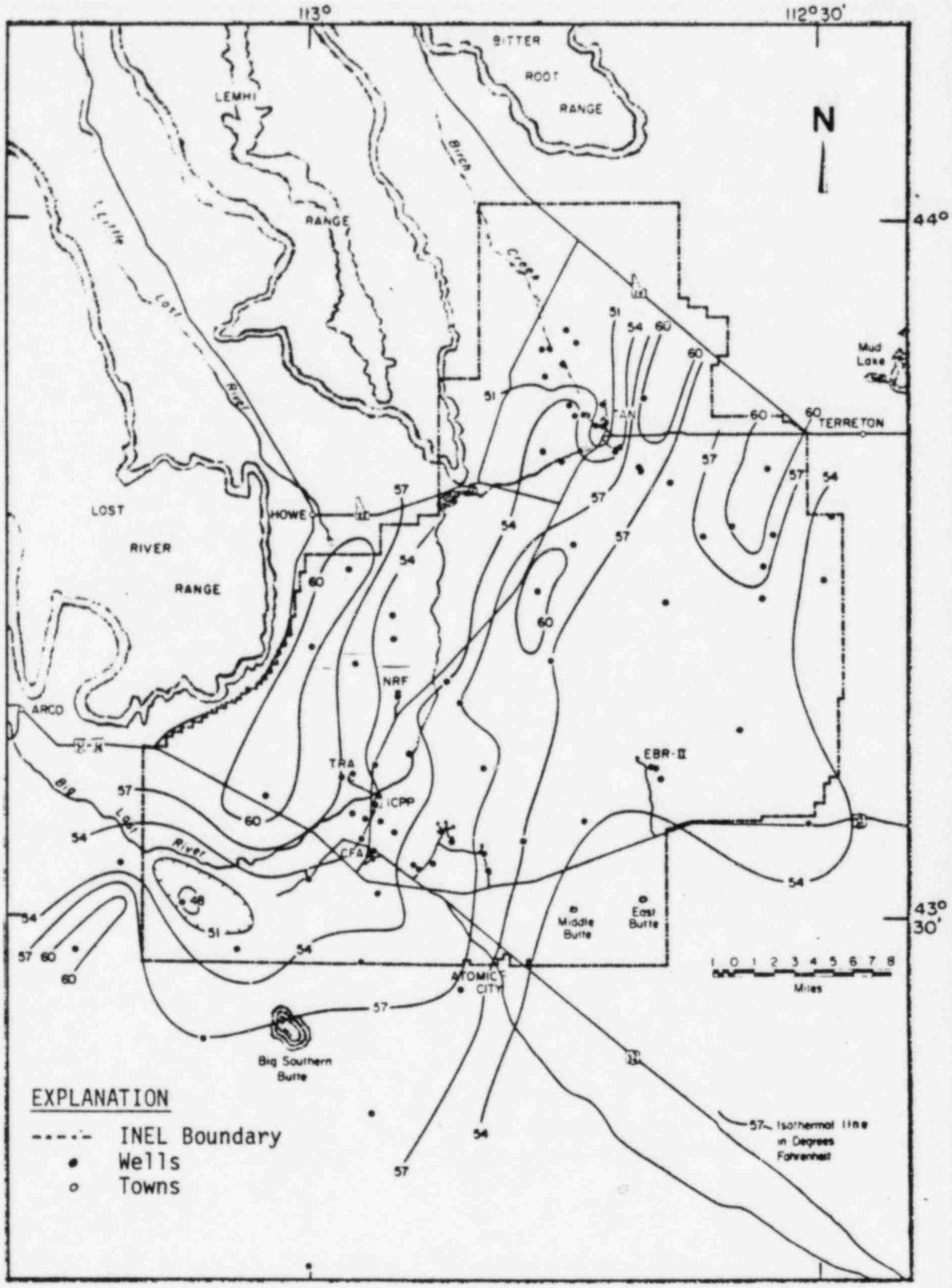
Map of the INEL vicinity showing the natural distribution of dissolved sodium in the Snake River Plain aquifer water.

Fig. 4.7



Map of the INEL vicinity showing the natural distribution of dissolved sulfate in the Snake River Plain aquifer water.

Fig. 4.8



Map of INEL vicinity showing natural temperature distribution in the Snake River Plain aquifer (after Olmstead 1962)

Fig. 4.9

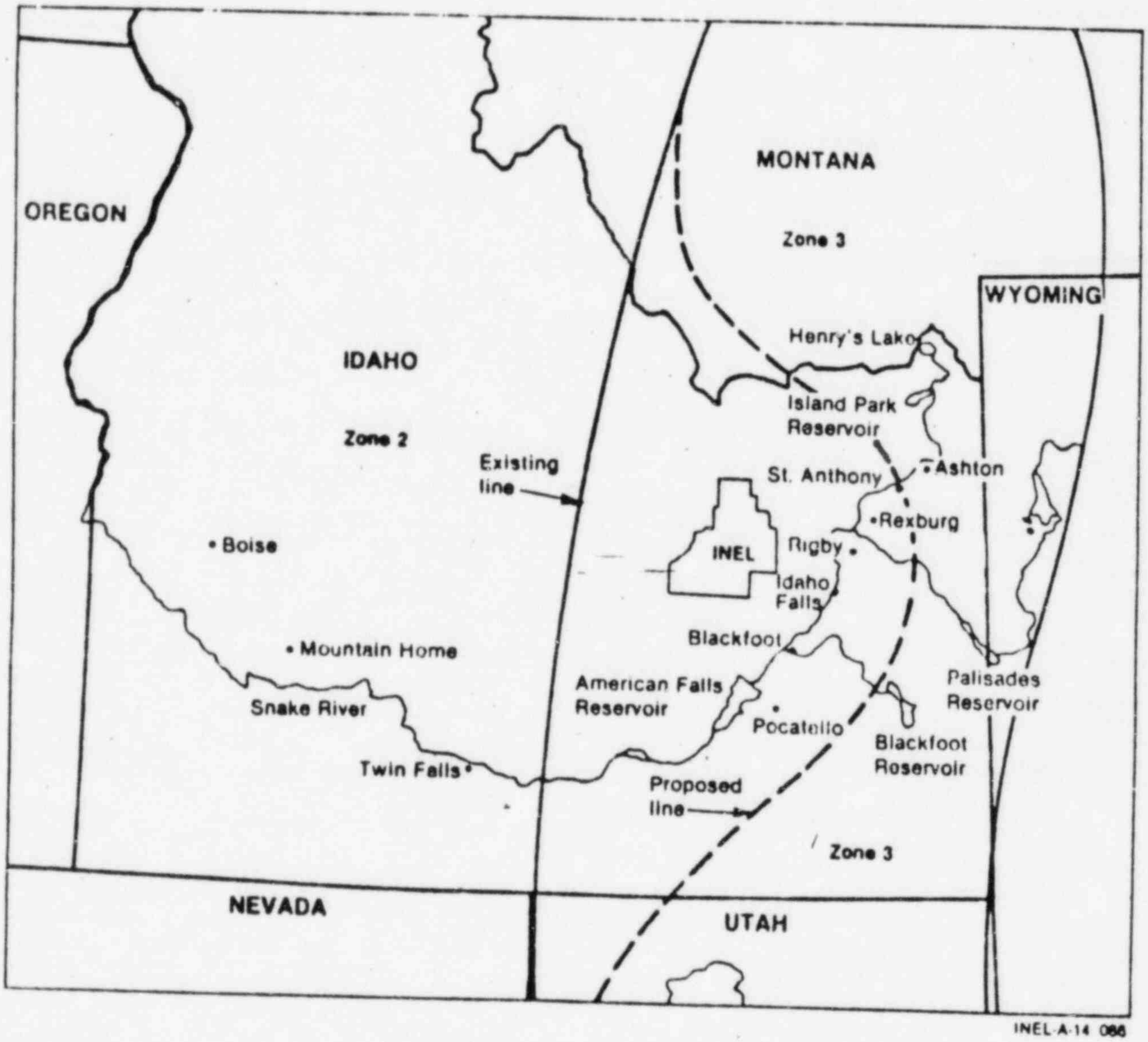
deeper aquifers, 2) wells influenced by recharge of surface waters on the Plain, or 3) wells within the waste plumes of INEL disposal facilities.

4.3 Seismological Considerations

4.3.1 Seismology of the INEL

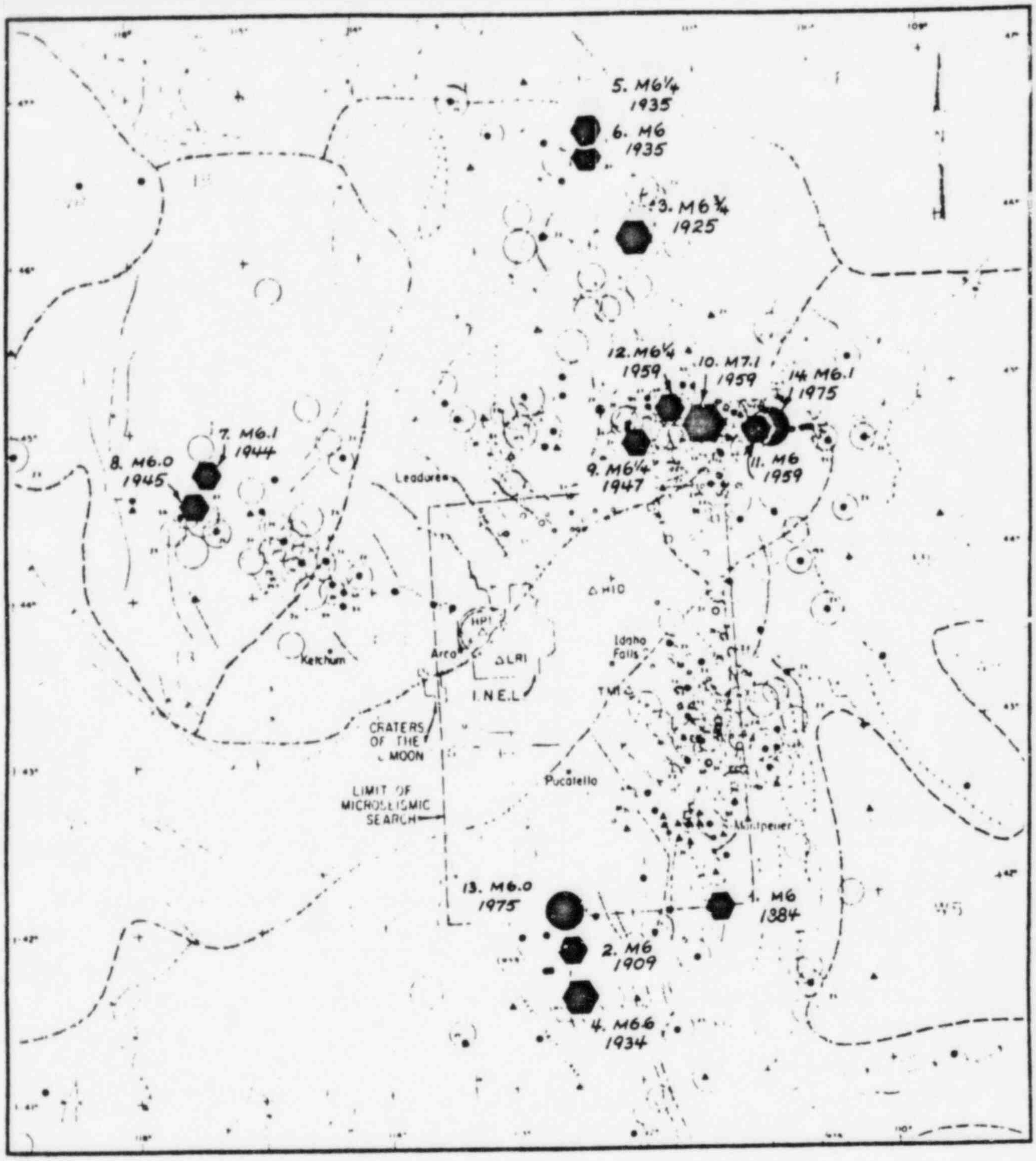
Prior to 1970, the INEL was classified as a Seismic Zone 2 under the Uniform Building Code of the International Conference of Building Officials (ICBO). Following a 1969 report by Algermissen, a new classification of Zone 3 was established for the intermountain seismic belt which enclosed (inadvertently, it is believed) a major portion of southeastern Idaho including the INEL. In August, 1980, the ICBO Seismology Subcommittee recommended changes in seismic zoning that would return the INEL to a class 2 seismic zone. The recommended changes are illustrated in Fig. 4.10. The recommendations of the Seismology Subcommittee will be reviewed by the ICBO Code Changes Committee on April 1, 1981. After a 60-day period (to allow for public comment) the revision could be approved for implementation during the September 1981 meeting of the ICBO.

Between 1884 and September 16, 1963, 53 earthquakes equivalent to Modified Mercalli intensity (MMI) V or greater were recorded in Idaho. Of these, 29 are listed by the U.S. Coast and Geodetic Survey as having originated (epicentered) in Idaho. Another 14 earthquakes of this MMI range are recorded in the NOAA's Hypocenter Data File as having epicenters in Idaho since September 16, 1963. No destructive quake has been recorded to date in the eastern part of the Snake River Plain (Fig. 4.11).



Proposed Seismic Zone Map of Southeastern Idaho
(taken from Arendts *et al.*, 1979)

Fig. 4.10



Epicenters Keyed to Table 4.1.
(Base map from Woodward-Clyde [1975].)

Fig. 4.11

NOTE: This Figure is included to show the relationship between Recognized Faults and current seismic activity. It shows the Snake River Plain is generally Aseismic.

The most recent regional earthquake that was accompanied by severe surface faulting occurred August 17, 1959, near Hebgen Lake, Montana, about 100 miles northeast of the INEL. This quake produced an intensity of V to VI within the INEL, but caused no damage to facilities.

Two faults along mountain fronts north of Arco and Howe, a few miles from the INEL boundary, are relatively recent (within the last 1 million yrs) and are evidenced by fault scarps. Based on the guidelines of 10CFR100, these faults must be classified as active, probably having been formed in the last 30,000 years.

A nine-month study of microearthquakes in the vicinity of the INEL was conducted by the USGS in 1968-1969 to determine whether the Arco-Howe faults, or possibly others in the region, are sources of microearthquakes. No seismic activity was detected in the vicinity of the INEL. The study concluded that the eastern Snake River Plain in the vicinity of the INEL is currently aseismic, however, the absence of microearthquakes does not eliminate the possibility that the earth's crust in this region contains stored elastic strain that might be released, by slippage along a dormant fault, to produce an earthquake.

Since October 1972, DOE-ID has operated a network of three vertical motion recording seismographs: one located at the INEL and the other two off the plain -- one at Howe Peak (northwest of the INEL) and the other on Taylor Mountain (southeast of Idaho Falls); designated LRI, HPI and TMI in Fig. 4.11. The resulting data tend to indicate that the Snake River Plain is aseismic. It appears, at least preliminarily, that damaging seismic waves may be rapidly attenuated in the geologic structures of the plain. The present seismographic network is capable of detecting microseisms from strain accumulation along faults in the mountains. It also will detect any microseisms on the eastern Snake River Plain which would precede a resumption of volcanism.

A graphic depiction of earthquake activity surrounding the INEL in relationship to recognized faults is given in Fig. 4.11. A compilation of information that pertains to the largest earthquakes recorded in the general region surround the Snake River Plains is given in Table 4.1.

4.3.2 Relative Seismic Risks

The results of studies published by the U. S. Geological Survey in 1976 on relative seismic risks throughout the nation are depicted for the western states in Fig. 4.12. Plotted in contour form are factors which give the horizontal accelerations (expressed as percentages of one gravitational unit) with 90% probability of not being exceeded is 50 years. In a very real sense the contours are figures of merit that reflect historical seismicity, quake intensity, and implied structural damage. For example, the information of Fig. 4.12 indicates that the INEL lies within the "4" isoline. This means that for the next 50 years at the INEL it is 90% probable that the horizontal acceleration from an earthquake will not exceed 0.04g. To place this in proper perspective,

TABLE 4.1

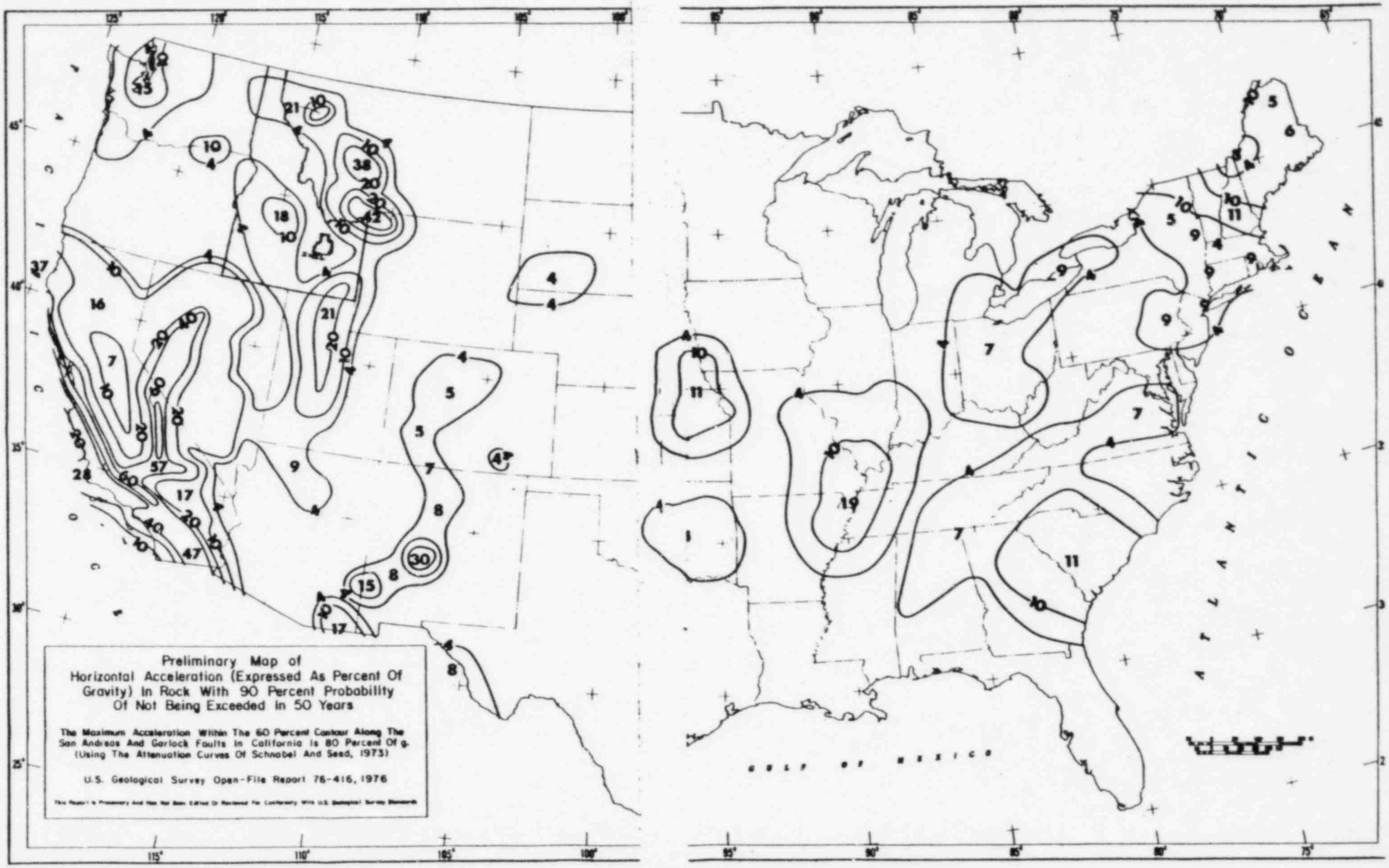
LARGEST HISTORICAL EARTHQUAKES* IN GENERAL REGION SURROUNDING THE EASTERN SNAKE RIVER PLAIN (41°-47°N, 109°-117°W)

No.	Local Date	Lat (°N)	Long (°W)	I_o	Mag.	Location	Source**
1.	1884 Nov. 10	42.0	111.3	8	~6	Bear Lake Valley Id.-Ut. border	(2)
2.	1909 Oct. 05	41.8	112.7	8	~6	Hansel Valley, Ut.	(2)
3.	1925 Jun. 27	46.0	112.2	8	6-3/4	East of Helena, Mont.	(1)
4.	1934 Mar. 12	41.7	112.8	9	6.6(M_s)	Hansel Valley, Ut.	(2)
5.	1935 Oct. 18	46.6	112.0	8	6-1/4	Helena, Mont.	(1)
6.	1935 Oct. 31	46.6	112.0	8	6	Helena, Mont.	(1)
7.	1944 Jul. 12	44.7	115.2	7	6.1	Seafoam, Id.	(1,3)
8.	1945 Feb. 13	44.7	115.4	6	6.0	Near Clayton, Id.	(1,3)
9.	1947 Nov. 23	44.8	112.0	8	6-1/4	Southwestern, Mont.	(1)
10.	1959 Aug. 17	44.8	111.1	10	7.1	Hebgen Lake, Mont.	(1)
11.	1959 Aug. 18	44.8	110.7	6	6	Yellowstone Park, Wyo.	(1,3)***
12.	1959 Aug. 18	44.9	111.6	5	6-1/4	Southwestern, Mont.	(1,3)***
13.	1975 Mar. 27	42.1	112.5	8	6.1(m_b) 6.0(ML,M_s)	Pocatello Valley, Id.-Ut. border	(2)
14.	1975 Jun. 30	44.8	110.6	7	6.1(ML) 5.9(M_s)	Yellowstone Park, Wyo.	(4.5)

* Tabulation includes mainshocks (or largest swarm events) of magnitude 6.0 or greater (or M.M. intensity > VIII for preinstrumental shocks) from 1852 through July 1980.

** Numbered sources indicate the following references: 1. Coffman and von Hake (1973; 2. Arabasz *et al*. 1979; 3. Dewey *et al*. (1972); 4. Pitt *et al*. (1979); 5. Coffman and Stover (1977).

***Part of 1959 Hebgen Lake earthquake sequence.



Seismicity factors for the Western States

Fig. 4.12

horizontal accelerations of 0.09g may crack weak plaster and masonry in residential structures.

The information depicted in Fig. 4.12 tends strongly to confirm the conclusion that the INEL is an "island" of aseismicity. Prevalent throughout the West are regions where greater seismic risks are indicated. In southern California, for example, horizontal accelerations up to 0.60g are indicated. For regions east of the Mississippi River, horizontal accelerations range from a high of 0.11g in northern New England and Central South Carolina to a low of 0.04g throughout much of the remaining region.

4.3.5 Safe Shutdown Earthquake (SSE) Considerations

The SSE criterion is defined by the NRC as "that quake which is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake which produces the maximum vibratory ground motion for which certain structures, systems, and components are designed to remain functional." A comparison of the SSE value for the INEL with SSE values for other existing nuclear sites is essentially a comparison of relative seismic risks for various locations. Such information for various eastern and western nuclear sites (exclusive of the INEL) has been compiled in the "Journal of the Energy Division, Proceedings of the American Society of Civil Engineers," January 1979 (see Table 4.2). The SSE value for the

TABLE 4.2

SSE Horizontal Ground Accelerations for Representative Nuclear Sites*

Site	Safe Shutdown Earthquake g Level
Sites East of Rocky Mountains	
Browns Ferry	0.20
Brunswick	0.16
Calvert Cliffs	0.15
Connecticut Yankee	0.17
Davis-Besse	0.15
Dresden	0.20
Fermi	0.15
Fort St. Vrain	0.10
Indian Point	0.15
Kewaunee	0.12
Nine Mile Point	0.15
Oyster Creek	0.22
Peach Bottom	0.12
Phipps Bend	0.25
Quad Cities	0.24
Salem	0.20
Susquehanna	0.10
Three Mile Island	0.12
Turkey Point	0.15
Vermont Yankee	0.14
Zion	0.17
Sites West of Rocky Mountains	
Diablo Canyon	0.40
Humboldt Bay	0.40
Rancho Seco	0.25
San Onofre	0.67
Trojan	0.25
WPPSS (Hanford)	0.25
Sites of Particular Interest	
INEL**	0.22
Clinch River Tenn***	0.25

*Journal of the Energy Division, Proceedings of the American Society of Chemical Engineers, January, 1979.

**Recent value established by the Woodward-Clyde Consulting Firm.

***Value established by the Nuclear Regulatory Commission, May 27, 1976.

INEL (ANL-W), i.e., 0.22g, is that recently established by the Woodward-Clyde Consultants.*

On the basis of this information (Table 4.2) and that presented in Fig. 4.12 it is reasonable to conclude that the seismic risks of locating a large LMFBR at the INEL are comparable to those for typical eastern and midwestern locations and less than those for existing or proposed reactor sites in the West.

4.4 Power Transmission and Utilization

Power to and from the INEL is transmitted by two medium-sized privately-owned utilities which are tied into the northwest and southwest regional power grids. With the ability to export power to the northwest and southwest, the two utilities, Idaho Power and Utah Power and Light (UP&L), have expressed the opinion that power-pooling arrangments will permit the absorption of 1000 MWe of somewhat interruptible power in the time frame of interest, i.e., 1990 and beyond.

At one time the Pacific Northwest was in an enviable position with its ability to generate large quantities of electricity from dams along the Snake and Columbia Rivers. Industrial development, pumped irrigation demands, and a higher-than-average population growth have significantly altered the power situation. Power shortages during the next decade or two seem inevitable. As cited in "Power Outlook, May 1980

*Woodward-Clyde Consultants
Three Embarcadero Center
San Francisco, California 94111

through 1920-1991" by the Bonneville Power Administration, there is a 100% certainty that there will be a power shortage in the Pacific Northwest during the next decade.

The demand projection for both Idaho Power and UP&L is currently increasing at an annual rate of 8-11%. Although power imports may help to alleviate shortages on a near term basis, a water-short year would seriously affect the ability of satisfying local demand from hydroelectric facilities along the Columbia River. As much as 2000-4000 MW of hydroelectric capacity would vanish under severe drought conditions in the Snake-Columbia watersheds.

Further complicating the demand-supply picture is the possible, perhaps even likely, development of synfuels industries in Utah and Western Colorado. Such industries would be large electric power consumers. The possible expansion of regional industries based on the processing of phosphate would also significantly increase near-term and long-term power demands.

The effect of the recently-passed Pacific Northwest Power Bill on the marketing of INEL-produced power is not clear at this time. The bill, known as the Pacific Northwest Electric Power Planning and Conservation Act, addresses the coming mismatch between power availability and supply in the northwest.

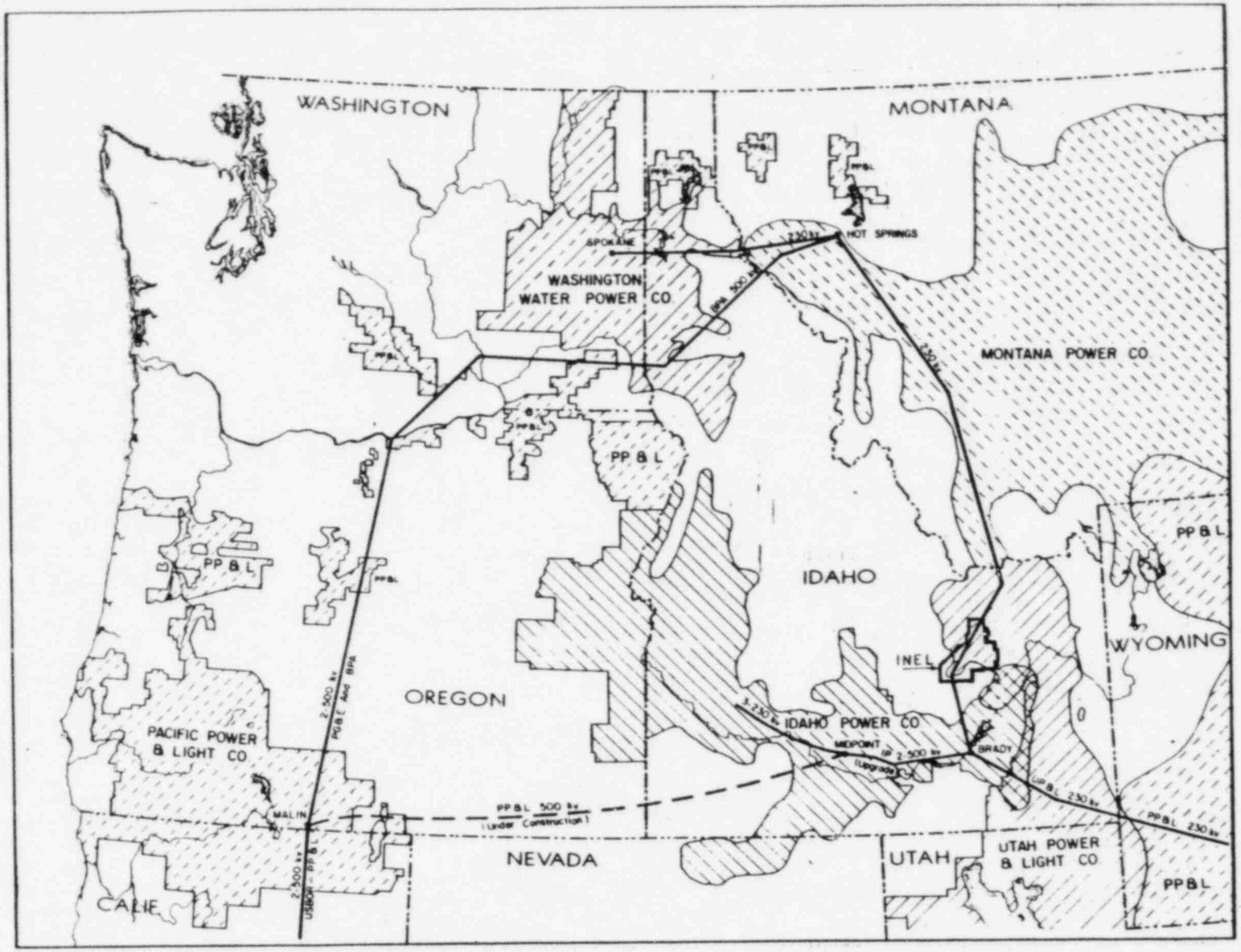
4.4.1 Existing Transmission Lines

Five investor-owned utilities which make up the Association of Rocky Mountain Power Systems share ownership of the 230 KV transmission line which delivers the major portion of power to the INEL as shown in Fig. 4.13. Each utility owns the line segment that is within its service area. This feature enhances the capabilities of the various utilities to upgrade their facilities to accommodate 1000 MWe of electric power from the INEL.

Pacific Power and Light (PP&L) owns the eastern leg of the line in Wyoming. Ownership is passed in succession to UP&L, Idaho Power, back to UP&L, to Montana Power and to Washington Water Power which carries the line into central Washington State. The Bonneville Power Administration (BPA) ties into the line at Hot Springs, Montana with a 230 KV line of its own and also a 500 KV line.

4.4.2 Future Transmission Upgrades

A service 500 KV tie point to the Association's systems is projected to be completed by the 1990s. Idaho Power plans to upgrade to 500 KV its two lines west from Borah, Idaho (near the Brady-INEL tie point) to Midpoint, Idaho, where the lines will be tied into a 500 KV PP&L line now under construction. PP&L's new line will terminate at Malin substation near Klamath Falls, Oregon, thereby establishing a tiein with PP&L's 500 KV California line and through other 500 KV lines of Portland General Electric, BPA, and the Bureau of Reclamation.



MAJOR TRANSMISSION FACILITIES SERVING THE INEL

(APPROXIMATE ROUTES)

Fig. 4.13

4.4.3 The INEL Site Power System

Power is transmitted by Idaho Power from its Brady substation 60 miles to the south to the UP&L-owned Antelope substation on the INEL site over the 230 kV line, while UP&L delivers from the north on the same line. UP&L also transmits 161 kV power between Antelope and its Goshen substation 45 miles to the east. At Antelope 230 kV power is stepped down to 161 kV, fed to a line connected with UP&L's 161 kV Goshen line, and further stepped down to 138 kV. The 138 kV is transmitted to the INEL Scoville substation and there to a loop that serves the INEL. A map that shows the various transmission lines serving the INEL is given in Fig. 4.14.

4.4.4 Projected Power Demand

UP&L had a peak capacity of 2950 MWe in 1980, approximately 95% generated from coal fired plants. The utility projects a capacity of 5500 MWe in 1990. Idaho Power generates most of its power from hydro plants and the rest from a coal fired plant. The one-hour peak capacity is approximately 1784 MWe. A forecast made by Idaho Power (in early 1980) projects a peak load of 2932 MWe in 1990.

As the results of discussions with utility management and a review of regional power forecasts, it is clear that 1000 MW of electrical power from a large LMFBR will help to serve the growing needs of the entire region after a 1990 startup. Both of the area utilities which directly serve the INEL have been growing at rates from eight to eleven percent annually and are but two of five regional utilities which

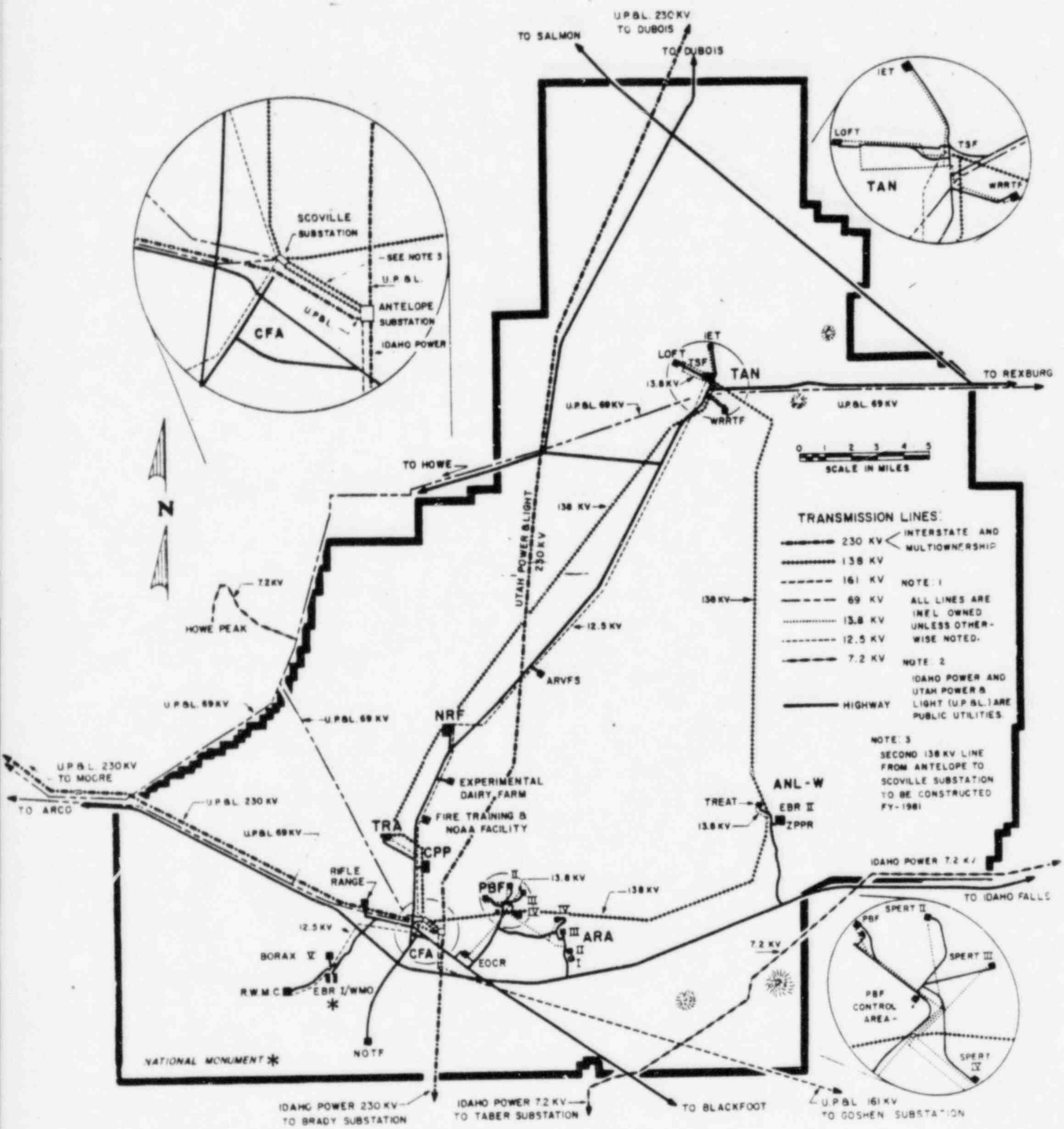


Fig. 4.14
Transmission Lines that Service the INEL

own segments of a 230 KV transmission line crossing the INEL from eastern Wyoming north and west to Central Washington. Scheduled upgrades of transmission lines tying Idaho into the regional grids will provide 500 KV capacity by 1990.

4.5 The Shipment of Large Components to the INEL

The results of studies concerned with the shipment of large components to the INEL clearly show that most materials and components specified for the plant, regardless of their size and weight, can be shipped to the INEL. The results of the studies also show that even the largest components specified for the plant can be barged up the Columbia and Snake Rivers to Lewiston, Idaho, and transferred to over-the-road vehicles for shipment to the INEL.

The identification, dimensions and weight of all major plant components associated with the CDS are given in Table 4.3. In some cases components can be shipped directly by rail or truck. In other cases components may be shipped in pieces via rail or truck and assembled on site. In a few cases the component must be shipped as a complete unit from the vendor's plant. The information summarized in Table 4.3 identifies those items recommended for either field or shop assembly and those that must be assembled by the vendor. Also specified in Table 4.3 are the recommended modes of transportation for shop-assembled and field-assembled items.

TABLE 4.3

SHIPMENT OF LARGE COMPONENTS

Number of Components	Component	Length ft.	Dia., ft.	Dry Weight Ea., T	Fabrication Location	Method of Transportation for Shop Fab. & Assy. One Piece)	Method of Transportation for Shop Fab. & Field Assy. (Several Pieces)
1	Reactor Vessel (RV)	66	42**	310	Field*	B&T	RR or T
1	Reactor Guard Vessel (RGV)	51	44.5	215	Field*	B&T	RR or T
1	Reactor Vessel Internals	?	?	?	Field*	--	RR or T
1	Reactor Vessel Cover (RVC)	8	42	?	Field*	B&T	RR or T
1	Large Rotating Plug (LRP)	10	30.8	?	Shop	B&T	--
1	Intermediate Rot. Plug (IRP)	11	21.2	?	Shop	B&T	--
1	Small Rot. Plug (SRP)	1	8.4	?	Shop	RR or T	--
4	Int. Heat Exchanger (IHX)	65	12.6**	364	Shop*	B&T	--
4	IHX Guard Vessel (IHXGV)	46	22	?	Field	B&T	RR or T
4	Pri. Coolant Pump and Motor Stand (RCP)	42.9	9.3	215	Shop*	--	RR or T
4	Pri. Coolant Pump Motor	25.7	16.7	75	Shop*	--	Truck
4	RCP Guard Vessel	32	22	?	Field	B&T	RR or T
4	Intermediate Heat Transfer System Pump (IHTSP)	37.8	11	138	Shop*	RR or T	--
4	IHTSP Guard Vessel	?	?	?	Field	--	RR or T

TABLE 4.3 (Cont'd)

SHIPMENT OF LARGE COMPONENTS

Number of Components	Component	Length ft.	Dia., ft.	Dry Weight Ea., T	Fabrication Location	Method of Transportation for Shop Fab. & Assy. One Piece)	Method of Transportation for Shop Fab. & Field Assy. (Several Pieces)
4	Evaporators				Shop*		
	AI	81.3	7.7**	290		B&T	--
	B&W	79	12.3**	455		B&T	--
	W	85	11.7	350		B&T	--
4	Superheaters				Shop*		
	AI	62.6	6.8**	175		B&T	--
	B&W	57.4	12.5**	309		B&T	--
	W	64.6	9.6	160		B&T	--
4	B&W Steam Drum	68.8	11	~400	Shop*	B&T	--
1	Ex Vessel (Fuel) Storage Tank (EVST)	59	30**	296	Field	B&T	RR or T
1	EVST Head	7	29.7	406	Field	B&T	RR or T
1	EVST Guard Vessel	48	33	188	Field	B&T	RR or T
4	Large Sodium Water Reactions Products Tank (SWRP)	76	19	?	Field	B&T	RR or T
4	Small SWRP Tank	31.5'	?	?	Field	B&T	RR or T
8	Pri. Sodium Drain Tanks	?	?	?	?	B&T	RR or T

B & T Barge and Truck
RR or T Railroad or Truck
* Per CDS Task 23.7 recommendations November 1980.
** Shell diameter only. Does not include nozzles or support structure.
? Information unavailable.

The recommended plans for shop and field assembly are not peculiar to an INEL siting. Similar studies by other agencies have been carried out for other potential sites. The results of these studies show the same recommendations for shop and field assembly and for mode of transportation.

4.5.1 Shipment by Barge

The results of a recent study by the Stan Jones Transportation Company indicate that the best means of shipping the larger and heavier items identified in Table 4.3 would involve barging the component(s) up the Columbia and Snake Rivers to Lewiston, Idaho, transferring the component(s) to a multi-axled tractor-trailer rig, and traveling over the existing highway system to the INEL.

A survey of crane capacity and availability at Lewiston was made. The survey revealed that the largest cranes available were two 50-ton truck-mounted cranes and one 20-ton barge mounted crane. Clearly, these would be inadequate for transferring heavy components from the barge to the multi-axled tractor-trailer rig. The need for crane-lifts, however, can be avoided by lifting a given component with hydraulic jacks and backing the tractor-trailer rig under the load on the barge and driving off.

A cost estimate for moving a typical large component (the B&W evaporator) from Lewiston to the INEL was made by the Stan Jones Transportation Company. An estimate, based on the use of a 20-axled trailer (specified by Idaho law) amounted to approximately $240,000/trip.

There are at least three barge lines on the Columbia-Snake waterway. All of these can transport the largest and heaviest components identified in Table 4.3. Barge size is limited by the 800-foot width and 650-foot length of the smallest lock on the waterway. The average channel depth is 13 feet. Regardless of their configuration all components identified in Table 4.3 can be barged to Lewiston.

4.5.2 Shipment by Rail

The size limits on rail shipments restrict loads to 15.5 feet in height and 10.7 feet in width. There are essentially no weight and length restrictions. Accordingly, many of the smaller components and pieces for field assembly could be shipped directly to the INEL from the suppliers. A railroad spur from the Blackfoot-Mackay branch of the Union Pacific Railroad services the central facilities area and the Naval Reactor Facilities. A 160-ton gantry crane with a span 6 feet wider than a standard rail car and with a 23-foot lift, is available at the central facilities area. Two 75-ton mobile cranes are also available. Components could be off-loaded at INEL railheads and trucked to the construction site or the INEL spur could be extended. The preferred option will depend, in large part, on economic considerations.

4.5.3 Shipment by Truck

The INEL is served by U.S. Highway 20 which connects with I-15 at Idaho Falls and Blackfoot. Western access to US-20 begins at Mountain Home and Boise. Idaho State highways 33 and 22 service the northern portions of the site.

Idaho law specifies a weight limit of 16,000 lb/axle, a height limit of 15.5 feet and an overall length limit (tractor included) of 105 feet. Special permits may be obtained from the Idaho State Highway Department to accommodate loads that exceed the limits cited above. All of the components identified in Table 4.3 can be carried by truck under special Idaho permits.

4.5.4 Air Transportation

Republic and Western Airlines provide major passenger and air freight service to the Idaho Falls Municipal Airport. Runways have usable lengths of 10,000 feet for takeoff and 9000 feet for landing. The airport can accommodate the following aircraft:

- Boeing 707 320-C (payload of 94,500 pounds and a capacity of 8000 cubic feet).
- McDonnel-Douglas DC-8 (payload of 88,910 pounds and a capacity of 12,170 cubic feet).

The airport is currently in the final stage of a major expansion program which will provide additional passenger and freight-handling facilities. Helicopters and small aircraft are available for charter service.

5.0 DEMOGRAPHIC CONSIDERATIONS

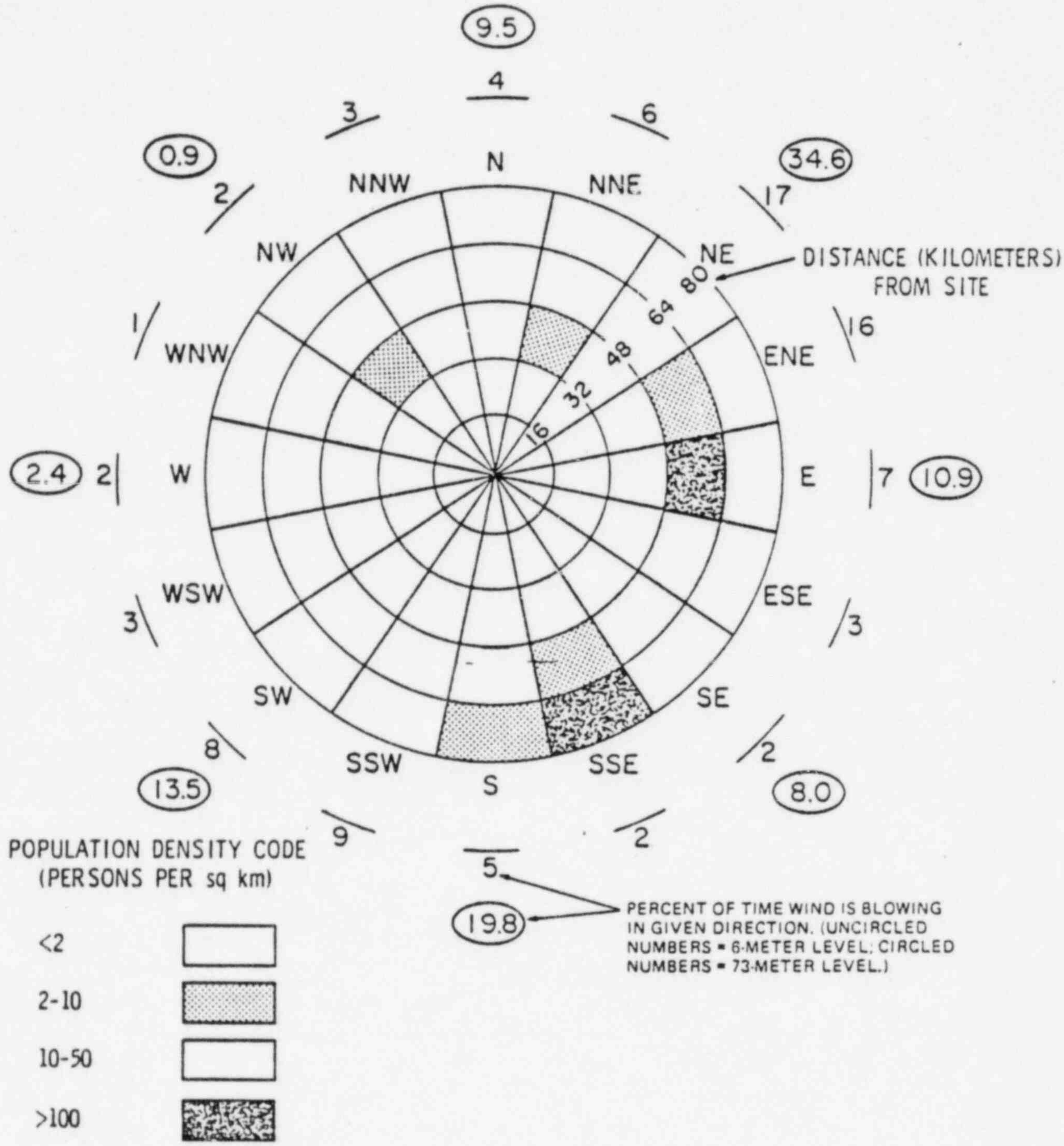
5.1 Population Patterns

Important criteria in the siting of a large fast breeder reactor are the remoteness of the site with respect to population centers and the existence of wind flow patterns towards sparsely populated areas. Demographic features of the INEL and its environs are entirely compatible with these criteria.

Private residences are not permitted on the INEL. The nearest populated off-site area is Atomic City (population 24) located just outside the southern boundary of the site (see Fig. 3.1). Only three other towns are located within a few miles of the site boundary. These are Howe to the west (population 23) and the Mud Lake-Terreton area to the northeast with a combined population of 200-300.

Information that pertains to population density, wind direction and wind duration is combined and illustrated in wind-rose form in Fig. 5.1. Although the rose is centered at the ANL-W location (southeastern portion of the site) the information presented is reasonably typical of other areas of the site. If anything, the information given in Fig. 5.1 is conservative since the ANL-W area is in that portion of the INEL closest to the largest population centers.

In the band 20-30 miles from wind-rose center (Fig. 5.1) there are approximately 15,000 inhabitants; in the band 30-40 miles, 73,000;



Population Density and Wind Direction
Wind-Rose Center Located at ANL-West, Southeastern Portion of the INEL

Fig. 5.1

and in the band 40-50 miles, 55,000. In total, approximately 143,000 live within a 50 mile radius of the wind-rose center (ANL-W).

Census information (1970) for the five counties that border the INEL is given in Table 5.1.

TABLE 5.1

1970 Population for the Five Counties Surrounding the INEL

County	1970 Population
Bingham	29,167
Bonneville	52,457
Butte	2,925
Clark	741
Jefferson	11,740
TOTAL	97,030

Population information for the nine cities in these counties with populations over 1000 is given in Table 5.2. Similar information for 11 cities in the five counties with population less than 1000 is given in Table 5.3.

TABLE 5.2

Population of the Largest Cities

Around the INEL

City	County	Distance from Wind Rose Center Fig 5.1 (Miles)	1970 Population
Aberdeen	Bingham	50	1,542
Ammon	Bonneville	37	2,553
Arco	Butte	30	1,244
Blackfoot	Bingham	32	8,716
Chubbuck	Bannock	50	2,972
Idaho Falls	Bonneville	30	35,776
Pocatello	Bannock	53	38,826
Rigby	Jefferson	46	2,311
Shelley	Bingham	30	2,674
		TOTAL	96,614

TABLE 5.3

Population of Cities of Less than 1000

Around the INEL

City	County	Distance from Wind Rose Center (Fig. 5.1) (Miles)	1970 Population
Atomic City	Bingham	17	24
Basalt	Bingham	34	349
Firth	Bingham	34	362
Hamer	Jefferson	30	81
Lewisville	Jefferson	31	468
Lost River	Butte	48	---
Mackay	Butte	53	539
Menan	Jefferson	34	545
Moore	Butte	38	156
Mud Lake	Jefferson	20	194
Roberts	Jefferson	27	393
		Total	3,111

5.2 Population Growth

The results of nationwide growth-rate studies (U.S. Census Bureau) indicate that Idaho has the seventh fastest growing population. Larger than average growth rates are expected in the west, whereas lower-than-average rates are projected for the northeastern, north-central and southern areas of the nation. On a more local level urban areas in Idaho are tending to gain population at the expense of the rural areas. Idaho Falls and Pocatello, the two largest cities near the INEL, are typical examples of disproportionate growth patterns. Fortunately, neither of these cities is located at strong downwind vectors with respect to the INEL.

Age, income, and other related information for the INEL area, State of Idaho and the nation are compared in Table 5.4. All data are based on the 1970 census studies.

TABLE 5.4
Population Statistics
INEL Area, Idaho, and the Nation

Item	Within a radius of 50 miles from Wind-Rose Center (Fig. 5.1)	Idaho	United States
Median age of population	23.1 yrs.	-	28.1 yrs.
Median annual family income	$9,243	$8,380	$9,586
Average family size	3.8 people	-	3.58 people
Education (> 25 years of age)			
12 years-%	35.9	-	35.8
13 years-%	16.9	-	11.4
16+years-%	11.9	10.9	12.6
Sex (Male-female) ratio	100/100	-	94/100
Race--% other than white	1.8	2.0	12.5
Population	143,139	713,000	203,213,300

The information of Table 5.4 suggests that the populace in the vicinity of the INEL compared with state and national averages is younger, enjoys approximately the same degree of affluence, and has larger families.

5.3 Labor Availability

The availability of an adequate supply of construction labor in the Idaho Falls area has never been a problem. Many major facilities have been built at the INEL by workers recruited from the local work force and by various craft and trade unions. Among the many major facilities built at the INEL are the following: ANP Project (Aircraft Nuclear Propulsion), NRF (Naval Reactors Facility), MTR (Materials Testing Reactor), ATR (Advanced Test Reactor), ICPP (Idaho Chemical Processing Plant), EBR-II (Experimental Breeder Reactor-II), and HFEF-N (Hot Fuel Examination Facility North). Numercus smaller facilities requiring the services of highly skilled craft workers have also been built.

At the present time and for the foreseeable future, no major construction activity at the INEL is envisioned. This likelihood, coupled with the closure of local factories (potato processing plants, sugar factories, farm machinery, etc.) has caused a labor surplus that is somewhat immobilized by family ties and a reluctance to leave an area that offers much from the viewpoints of recreation, family life, and western living. The recruiting of additional construction workers should, if history serves as an adequate guide, be no problem.

5.4 Labor and Construction Costs

A comparison of recent labor costs in various regions of the United States is given in Table 5.5. Although data are unavailable for the Idaho Falls area a reasonable estimate of prevailing wage rates may be inferred from the data given for Boise.

TABLE 5.5

LABOR COST COMPARISON*

(Total Hourly Wage Rates including Fringe Benefits)

	Knoxv.	Albuq.	D.C.	Boise	Chicago	Spokane	Seattle	Las Vegas	New York	Los Angeles	San Francisco
Boilermaker	12.87	13.86	15.79	16.88	16.18	17.08	17.08	18.67	16.77	18.78	15.47
Bricklayer	10.62	13.93	15.62	14.00	15.00	14.96	15.89	15.43	17.46	16.45	18.40
Carpenter	9.46	15.40	13.56	14.35	14.94	14.15	14.15	16.26	17.27	16.44	18.26
Concrete Finisher	8.28	11.34	13.65	14.01	15.00	14.53	13.75	15.23	14.35	13.34	15.18
Electrician	11.98	15.98	15.23	14.97	16.74	17.70	19.50	19.76	16.67	16.73	19.85
Ironworker	9.88	13.98	14.53	14.16	16.21	16.39	16.39	18.68	19.91	17.48	18.68
Labor (Building Construction)	6.81	9.50	11.21	12.93	12.11	12.75	13.71	13.42	13.49	14.18	15.35
Millwright	10.12	16.15	14.13	14.64	14.94	13.80	13.80	18.67	17.27	16.95	18.78
Operating Engineer (Heavy Equipmt)	9.07	12.85	14.69	15.21	16.10	14.48	16.67	17.25	17.96	16.63	19.42
Operating Engineer (Oiler)	6.62	10.33	10.62	13.66	12.40	14.03	15.66	16.29	14.73	15.69	16.76
Painter	9.70	10.62	14.54	11.50	12.09	13.34	14.50	15.80	12.12	16.69	16.87
Pipefitter/Plumber	12.45	16.76	14.64	15.56	15.57	19.22	20.30	19.58	17.84	19.50	22.52
Plaster	10.10	12.44	13.51	12.81	13.74	13.33	14.92	15.72	13.70	15.24	18.24
Sheetmetal Worker	**	14.80	15.45	14.49	15.15	17.54	18.11	18.93	18.12	18.92	18.32
Truck Driver (Bldg. Constr.)	5.88	11.45	10.42	14.36	12.84	15.25	16.14	13.32	11.98	13.33	14.31

Second Quarter 1980

* Richardson Construction Cost Trend Reporter

A comparison of construction costs in typical large American cities is given in Table 5.6. The indices given include the following costs: sitework; concrete; masonry; metals; wood and plastics; moisture protection; doors; windows; finishers; mechanical; electrical; and materials and installational.

TABLE 5.6

CONSTRUCTION COSTS*

(From Means, 1980 Edition)

City	Weighted Averages: Materials	Installation	Total
Columbia, S.C.	97.0	68.8	82.1
Knoxville, TN	99.6	79.2	88.8
Washington, D.C.	99.8	93.9	96.7
Salt Lake City, UT	97.8	96.0	96.9
Boise, ID	100.6	94.7	97.5
Albuquerque, NM	103.7	92.6	97.8
Chicago, IL	101.6	100.2	100.9
Spokane, WN	105.1	104.7	104.9
Seattle, WN	105.0	109.8	107.5
Las Vegas, NV	100.7	113.6	107.5
New York City, NY	101.3	113.7	107.8
Los Angeles, CA	99.5	115.3	107.9
San Francisco, CA	103.2	129.5	117.1

* Means; 1980 Edition

*The indices consider the costs for the following types of work: site preparation, concrete, metals, wood, plastic, moisture protection, doors, windows, finishing, mechanical, electrical and installation.

6.0 SUPPORT FACILITIES

Comprehensive and sophisticated support facilities, staffed with highly trained professionals, are in operation at the INEL. The services of some of these could very likely be made available during the planning, design, construction, and operation of a large fast breeder reactor.

Of particular interest are the facilities at Argonne-West since these are specifically tailored to meet the needs of liquid metal cooled fast breeder systems. As the results of nearly thirty years of experience in essentially all phases of fast reactor technology the cadre at Argonne-West is highly trained and qualified to assist with the development, deployment and operation of a large fast breeder.

Other nuclear facilities located at INEL are of significant interest and importance because they represent a large pool of talent and experience, even though the physical facilities, per se, might have little or no direct application.

Brief descriptions of some of the more important facilities are given below.

6.1 EBR-II (Experimental Breeder Reactor-II)

EBR-II is a metal-fueled, sodium-cooled, pool-type fast reactor located at the Argonne-West site. It operates with a plant capacity factor of approximately 70%, has a thermal output of 57.25 MW, and an electric output of 17.0 MW. The reactor, orginally designed as an engineering demonstration plant, is now serving as the nation's only operating facility for the irradiation-testing of LMFBR fuels, structural, and absorber materials. During sixteen years of operation over one billion kilowatt-hours of electricity have been generated and distributed over the INEL grid. Over 10,000 specimens of fuel, structural, and absorber materials have been irradiated in EBR-II since its startup in 1964.

6.2 HFEF/N (Hot Fuels Examination Facility-North)

The HFEF/N facility provides the capability for assembling, disassembling, and examining irradiation experiments that have been irradiated in EBR-II, TREAT and the SLSF loop in the ETR. The facility consists of two heavily shielded cells; one air filled and the other argon filled. All operations on components and specimens that are adversely affected by oxygen, e.g., exposed fuel and elemental sodium are carried out in the argon filled cell. Among the many capabilities for specimen examination are the following: neutron radiography, precision gamma scanning, visual inspection (augmented with magnifying periscopes), profilometry, eddy current testing, precision weighing, precision milling and specimen preparation and sampling. The HFEF/N complex is also administered by ANL-W.

6.3 HFEF/S (Hot Fuels Examination Facility-South)

HFEF/S was formerly used as an on-site fuel reprocessing facility for EBR-II. It, too, consists of two heavily shielded cells; one filled with air and the other with argon. Fuel subassemblies discharged from EBR-II were disassembled in air cell, transferred through an air lock into the argon cell, and pyrometallurgically reprocessed for recycle to the reactor. During the period 1964-1969 approximately five full core loadings of fuel were reprocessed.

The argon cell of HFEF/S has not been used since its shutdown in 1969. As the result of recent decontamination activities the cell is available for human access. It could, accordingly, be refurbished as a facility for demonstrating the feasibility of advanced on-site reprocessing techniques. HFEF/S is administered by ANL-W.

6.4 TREAT (Transient Reactor Test Facility)

TREAT, also administered by ANL-W, is an air-cooled, graphite-moderated, enriched uranium reactor designed for low power steady-state operation at 100 kW and a transient capability for periods as short as 23 milliseconds. TREAT is extensively used to study the behaviors of various fuel materials under transient overpower and under-cooling conditions. The use of TREAT as a vehicle for performing safety related experiments has contributed heavily to the national breeder program.

6.5 ZPPR (Zero Power Plutonium Reactor)

The ZPPR is the nation's largest and most modern facility for simulating the configurations and compositions of large fast breeder systems. Experiments conducted on simulated systems consist of two principal types: those in which experimental information is used to establish the validity of computational models, and those that provide proof-test information for specific reactor designs, e.g., the Clinch River Fast Breeder Reactor.

6.6 Idaho Chemical Processing Plant (ICPP)

The ICPP is operated by ENICO, a subsidiary of EXXON Corp. The principal activity conducted at the ICPP consists of recovering ^{235}U from spent reactor fuel. Other activities include the reduction of large volumes of highly radioactive liquid wastes into low volumes of impervious solids. Research and developmental programs at the ICPP address short, interim and long-term storage problems, improved processing methods for zirconium and stainless steel-clad fuels, and improved analytical and accountability techniques.

6.7 Facilities of EG&G Idaho, Inc.

Four major reactor-based programs are administered by EG&G. One, the ATR (Advanced Test Reactor), is used primarily for the irradiation testing of advanced thermal reactor fuels under extremely high neutron flux conditions. A companion facility, the ETR (Engineering Test Reactor), is now used exclusively as a vehicle for performing safety oriented experiments under the national breeder reactor program.

A third facility, the PBF (Power Burst Facility), is used to establish the behaviors of light water reactor fuels under loss-of-cooling and transient overpower conditions.

The fourth major reactor project administered by EG&G is the LOFT facility. The LOFT program is concerned primarily with evaluating the consequences of loss-of-coolant accidents in pressurized water reactors and the effectiveness of various emergency core cooling systems. Information derived from the test program is used to verify and improve the accuracy of computer modeling codes used extensively in the national light water reactor safety program.

6.8 (RTF) Reactor Training Facility

The RTF, administered by EG&G, provides a capability for training and qualifying nuclear power plant operators. The training program includes formal coursework, reactor simulator manipulation, and hands-on experience at the ETR and ATR. Such facilities, in conjunction with those at ANL-W could be used to train operating personnel for a large fast breeder system.

6.9 TAN (Test Area North)

TAN was originally the site of the Aircraft Nuclear Propulsion Project. Its principal facilities today consist of LOFT (see Sec. 6.7) and the TSF (Technical Service Facility). The TSF consists of several large service shops, including a high bay area that has the capabilities for remotely handling high level radioactive materials. The facilities permit the handling of delicate precision work as well as carrying out massive industrial-size operations.

6.10 FET (Field Engineering Test Facility)

The FET, also located at TAN, is a large hangerlike arched structure that is now essentially unused. FET was built during the early 1950's to carry out fitup, maintenance and inspection activities on the nuclear airplane.

The building is a reinforced concrete hanger-type structure with a reinforced concrete floor which has an area of 75,000 ft^2 (234 x 320 feet). Two massive telescoping doors form the northern and southern sides. Both doors are 62 feet high. The southern door is 320 feet wide, the northern door, 240 feet wide. The building contains an unusually large volume of unimpeded space. There are no columns or partitions. The distance between floor level and ceiling height at the highest point is 98 feet. It is conceivable that the FET could be modified and used as a facility for the on-site fabrication and assembly of large fast reactor components.

7.0 ON-SITE SERVICES

Many conventional and specialized services are available at the INEL. The more important of these are cited below:

7.1 Conventional Services

7.1.1 Communications

Telephone System. The INEL has an integrated Centrex II Electronic Switching System (ESS). The ESS provides touch tone dialing, and direct inward and outward dialing capabilities on local service, commercial, long distance, and Federal Telecommunications System (FTS).

Mail System. There are several mail points in Idaho Falls and on the INEL Site. Mail is delivered twice daily in town facilities and four times a day on site.

7.1.2 Medical Services

Dispensaries. Major INEL dispensaries are located in Idaho Falls and at the Central Facilities Area (CFA). Staffing includes 5 physicians, 17 registered nurses, 3 medical technologists, 2 technicians, and 4 medical record personnel. Specialized services consist of 2 medical laboratories (one in Idaho Falls; one at CFA), a surgery room at CFA, and 3 separate x-ray facilities at Idaho Falls, CFA and ANL-W. Medical personnel also are stationed at the Test Area North and the Idaho Chemical Processing Plant (ICPP).

Hospitals. There are two fully staffed and equipped regional hospitals in the City of Idaho Falls. Smaller hospitals are located in Arco, Blackfoot and Rexburg.

7.1.3 Fire Protection

The INEL operates a fully equipped Fire Department with highly trained professional firemen. Staffing includes a Fire Chief, Deputy Fire Chief and 40 firemen. Specially trained Fire Brigades support the firemen in Site areas.

Four ambulances are operated by the Fire Department (one at each fire station and one on standby).

7.1.4 Cafeterias

Four cafeterias located on the INEL Site serve an average of more than 1,000 people daily. Between 200 and 250 evening meals generally are served in CFA, ICPP, and TAN cafeterias.

The CFA cafeteria stores sufficient food supplies to serve 2,500 people four meals each (10,000 meals total) during emergencies without being replenished.

7.1.5 Security

Barriers, including alarms and CCTV surveillance

All facilities at the INEL are protected to various degrees by a broad range of security barriers and alarms. CCTV is used to assess alarms at the key facilities. Primary alarms are sent to the facility guardstation and secondary alarms to the Central Station in CFA. Where there is no facility guardstation, the alarms are sent direct to the Central Station. The concept is one of mutual support and security in depth. There is an aggressive security upgrade program underway across the INEL.

Access Controls

All facilities at the INEL require various levels of access controls. These range from guard/receptionist check of access authorization badges to a full equipment assessment (metal, SNM, explosive and X-ray). The latter assessment is supervised by DOE-ID or Contract Guard Security Inspectors.

Security Guard Service

DOE-ID and Contract Guard personnel are deployed throughout the Site and in Idaho Falls. The majority are armed security inspectors that have met the substantial standards prescribed by DOE regulation. Major facilities have 24 hour protection provided and the remaining facilities are protected by random patrols. The facility security inspectors are backed-up by mobile patrols and an armed vehicle reaction force equipped with automatic weapons. The reaction force recently has undergone specialized training (SWAT) with the FBI.

7.1.6 Library

The INEL's Technical Library system and services include:

- 32,000 books
- Subscriptions to 800 different technical journals
- 15,000 back volumes of journals
- 566,000 technical reports including:
  - 390,000 on microfiche,
  - 73,000 on micro cards, and
  - 103,000 full size copies
- Reference collection (2,000 books)
- Major indexing and abstracting services
- Copies of codes, regulations, specifications, and standards
- Computerized literature searches using
  - Lockheed dialog services
  - DOE Re Con Service
  - System Development Corporation (SDC)
- Manual Literature searches

7.1.7 Warehousing

The INEL has covered and enclosed warehousing in Idaho Falls and on the INEL Site as follows:

- Idaho Falls - 15,500 square feet
- INEL Site - 252,000 square feet in 24 buildings

In addition, 200,000 square feet of outside fenced yard spaces are located throughout the INEL.

7.1.8 Machine Shops

There are 10 machine shops located at the INEL. The total area of the shops is approximately 45,000 square feet. The main shop with an area of 25,000 ft^2 is located at TAN. It can provide services for all INEL contractors and programs. The shop is equipped for work with radioactive materials on a non-routine basis.

Major equipment includes:

- o NC numerically controlled lathe hooked to commercial computer system
- o Giding Lewis Boring Mill, 6" spindle, 12' travel and 10" rotary
- o Ohio Boring Machine with 6" spindle
- c Metal spray set up
- o Planer with 12' stroke
- o 13 lathes
- o 11 milling machines.

7.2 Special Services

7.2.1 Waste Storage Facilities

Facilities for the storage of low-level radioactive wastes are available at the INEL. Interim storage for packaged transuranic solid wastes is available at pit and ground level (earth-mounded) facilities.

Facilities for the calcination of high level liquid radioactive wastes and their subsequent storage are also available. Considerable experience with the packaging, handling, transport, and storage of radioactive wastes has been accumulated since the startup of nuclear facilities in the early 1950's.

7.2.2 Radiological Assistance Program

This program provides assistance in the form of specially selected teams which can be dispatched to points in the mountain states in cases of incidents involving readioactive materials. The teams consist of trained medical and radiological monitoring personnel. As a part of a national system the teams are capable of evaluating emergency situations and recommending measures for the control of radiation hazards.

7.2.3 Computer Science Center

The computational needs of the INEL are serviced by a centralized computer complex located in Idaho Falls and administered by EG&G. The complex centers around two principal computer systems: a CDC-7600 computer which is used for scientific data processing, and an IBM-360/75 which is used for business, accounting and planning activities. The center is staffed with a cadre of approximately 120.

7.2.4 (RESL) Radiological and Environmental Sciences Laboratory

The US DOE-administered RESL (formerly the Health Services Laboratory) enjoys an international reputation for its pioneering effort in the fields of radiation monitoring equipment, radiochemical analyses and radiation safety research and development. Aside from continuing efforts in these areas the RESL provides the necessary services for bioassaying (plant and animal specimens), and environmental monitoring (both on-site and off-site).

7.2.5 Other Services

Other facilities and services that are either available or could be made available include the following: photographic services, printing facilities, vehicle pools, craft and maintenance shops, contaminated clothing laundry, storage yards, mobile cranes and heavy construction equipment, instrumentation laboratories, etc.

8.0 ENVIRONMENTAL MONITORING

During the normal operation of nuclear facilities radioactivity is released to the environment. Possible pathways from the site to off-site populations are by atmospheric transport, water from the aquifer, and indirectly through soils, foodstuffs and animals. Each of these pathways is carefully monitored to assure compliance with state and federal regulations.

The environmental effects of facility operation at the INEL are monitored under a program that began in the early 1950's. Agencies involved in the monitoring program include the USDOE Radiological and Environmental Sciences Laboratory (RESL), the U.S. Geological Survey Office, and the National Oceanographic and Atmospheric Administration. Of principal importance are the meteorological and radiological monitoring programs.

8.1 Meteorological Monitoring

RESL administers a comprehensive weather monitoring network that includes not only the INEL but locations scattered throughout the Snake River Plain. Principal facilities consist of 26 towers, all equipped to record wind speed and direction. Tower heights range from 20 to 240 feet depending on location. Although all monitor wind information some are also equipped to measure radiation levels, temperature and dewpoint. All transmit information by radiotelemetry to a computerized system at RESL.

Of the 26 towers, eight are located on the INEL. The remaining 18 are deployed at various locations along the edges of the Snake River Plain. Although the responsibility for administering the program comes under the purview of RESL the responsibility for data accumulation, compilation, analysis and dissemination belongs to the National Atmospheric and Oceanographic Administration. The objectives of the meteorological monitoring program are three-fold: to accumulate weather information of a statistical nature, to advise facility operators under planned radioactivity release conditions, and to provide warning and guidance services under extreme weather conditions, e.g., icing, blowing snow, high winds, severe thunderstorm activity, etc..

8.2 Radiological Monitoring

Radiological monitoring includes the periodic analyses of air, water, soil and foodstuff samples. Cumulative doses from penetrating radiation (gammas) are also periodically measured.

8.2.1 Air Samples

Levels of airborne radioactivity are monitored off-site by a network of 10 continuous air samplers, all capable of a 99% retention of radioactive particulates. Three locations are equipped to monitor the presence of tritium in water vapor. Noble gases (argon, krypton, and xenon) are monitored at onsite release points only.

Samples located near site boundaries at downwind locations provide information on two radioactive components: natural background and that crossing the site boundary. Samples located at distant points and cross wind to the site provide a measure of the natural radioactive background. Through the strategic deployment of samplers, the effects of site releases may be separated from overall background effects (worldwide fallout included).

Filters from the samplers are collected and analyzed weekly. Every three months the filters are composited according to location and analyzed for longer lived nuclides.

8.2.2 Water Samples

About one-half of the water pumped at the INEL is returned to the earth in waste disposal operations, principally via sewage systems and seepage from waste ponds. The remainder disappears through evaporation in evaporative cooling towers.

Groundwater from 22 onsite producing wells is sampled by the USGS and analyzed on a monthly basis by personnel of RESL. Twice each year samples from as many as 100 off-site wells are taken and analyzed. Gross alpha, gross beta and tritium analyses are routinely conducted.

8.2.3 Soil Samples

Soil samples are taken and analyzed at undisturbed boundary and distant locations. All are analyzed for natural radioactive decay products and for man-made species, viz. Cs-137, Sr-90, Pu-238, Pu-239 and Am-241. The results of the analyses clearly indicate that any radioactivity resulting from normal INEL operations is exceeded by a worldwide low-level fallout component.

8.2.4 Food Samples

Milk, wheat and potatoes produced in the farming areas of southeastern Idaho are routinely sampled by RESL to establish their radioactivity contents and to identify, if possible, any component of site origin. Samples are taken on a monthly basis from farm locations that surround the site at distances as far away as Ashton (to the North). Principal species of interest are I-131, Sr-90 and tritium. As for air, water and soil samples no evidence of site-originated radioactivity has been noted.

8.2.5 Gamma Analyses

Thermoluminescent dosimeters (TLD's) are used to measure penetrating (i.e., gamma) radiation at seven boundary and five distant community locations. Measurements are made every six months. For a typical year, 1976, no difference in the cumulative dose rates for boundary and distant communities was noted.

9.0 PUBLIC ACCEPTANCE OF THE NUCLEAR OPTION

Unlike many areas of the United States the reaction to the local siting of a large fast breeder reactor would be overwhelmingly positive. Thirty years of living along the periphery of one of the largest nuclear installations in the world have convinced the indigenous portion of the community that nuclear power is safe, clean, economical and vitally needed. The economic benefits of siting a large fast breeder reactor at the INEL would be immediately recognized and appreciated.

With few, if any, exceptions the populace in eastern Idaho has acquired a level of nuclear understanding unsurpassed elsewhere. Sophistication in matters of nuclear oriented activities has not been passively achieved. A sympathetic press, effective public relations activities conducted by contractor and DOE personnel, site-supplied speakers at civic functions, and comprehensive site visitation programs, have been extremely effective in creating acceptance of nuclear facilities by the indigenous population. Social contacts between site personnel and the off-site community at civic affairs, churches, schools, club meetings, etc., have led to a mutual respect between the two communities.

At the state level Idaho belongs in a category that is aggressively pro-nuclear. All governors, since the INEL began, have publicly and repeatedly reaffirmed their support for the INEL and a strong national program of nuclear development. At the national level all members of the Idaho Congressional delegation, i.e., Senators Steve Symms and James

McClure and Congressmen Larry Craig and George Hansen have been and still remain aggressive advocates of the nuclear option.

The state legislature has been and still is overwhelmingly pro-nuclear. When the question of chartering, authorizing and funding a state nuclear energy commission arose during the mid 1960's both houses of the legislature voted unanimously in favor. As one of the direct consequences of this action Idaho joined the WINC (Western Interstate Nuclear Compact), a regional organization dedicated to the orderly development of nuclear related activities in the western states.

The Idaho legislature continues to maintain a strong interest in nuclear matters. The legislature is frequently briefed by bipartisan and bicameral committees comprised of regional legislators selected from all portions of the state. Frequent visits by legislative committees to various facilities at the INEL have helped to maintain a strong pro-nuclear position at the state level. A striking example of the support given to the nuclear option by the Idaho Legislature appeared in the form of a bicameral resolution* that urged the construction and location of a fast power-producing breeder reactor at the INEL.

Idaho, too, has its share of environmentally-oriented groups. But some of these, unlike those in other areas, tend to support rather than condemn the construction of nuclear plants. Certain environmentally-

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* Senate Joint Memorial No. 111, Second Session, Forty-fifth Legislature.

oriented groups in Idaho have focused their attentions on the preservation of wilderness tracts, free flowing streams, and undeveloped canyon areas. They see in nuclear power a means to obviate the need for dams and coal-fired plants both of which pose more serious threats to their interests. A few cases of organized anti-nuclear activities, however, have recently been noted. Nevertheless the groups (three) are small, appear to be poorly organized, and seem to be largely ignored by the surrounding communities.