

(NRC 1975) ✓

Final

272084

PB 244 993

NUREG-75/078

environmental statement

related to construction of

PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2 and 3

ARIZONA PUBLIC SERVICE COMPANY

SEPTEMBER 1975

**Docket Nos. STN 50-528, STN 50-529
and STN 50-530**

Reproduced by
**NATIONAL TECHNICAL
INFORMATION SERVICE**
US Department of Commerce
Springfield, VA 22151

U. S. Nuclear Regulatory Commission

**Office of Nuclear
Reactor Regulation**

030

2. THE SITE



2.1 STATION LOCATION AND SITE DESCRIPTION

2.1.1 Location

The site of the Palo Verde Nuclear Generating Station (PVNGS) is in Maricopa County, Arizona, roughly 15 miles west of Buckeye, and about 50 miles west of downtown Phoenix. An approximately rectangular area, four miles (N-S) by two miles (E-W) in its maximum dimensions, comprises the site property. Its northern edge is just south of the Buckeye-Salome Road and about 1-1/2 miles south of Wintersburg. Coordinates of the three reactors, which are to be situated somewhat north of the exact center of the property, are 33.39° N Latitude and 112.86° W Longitude. Approximately 3800 acres are enclosed by the site boundary. The exclusion area is coincident with the site boundaries except at the south end, where 320 acres of the property are classified as being outside of the exclusion area boundary. The location of the site in southwestern Arizona is shown in Figure 2.1. A larger scale depiction, showing roads and towns within about 15 miles and the outline of the site boundary, is given in Figure 2.2.

2.1.2 Description of Site Area

The terrain in the site area is relatively flat desert with elevations ranging from about 900 to 1000 feet above mean sea level (MSL). Scattered about the vicinity are small hills and buttes. The topography of the immediately surrounding area, the site and exclusion area boundaries, and the proposed plant layout are portrayed in Figure 2.3.

Northwest of the site are the Palo Verde Hills, rising fairly abruptly to nearly 2200 feet MSL about six miles west-northwest of the reactor locations. Centennial Wash is an intermittent stream about six miles south of the reactor sites, beyond which the land rises gradually, but includes isolated, steeply sloped hills. Buckeye Valley, through which the Gila River flows, is east and southeast of the site. The desert is flat north and northeast of the site and is traversed by many intermittent streams (ER, Sec. 2.1.1).

Agricultural production is currently the principal use of about 2200 acres of the site (ER, Supp. 1, p. S1-2.1-3). A road now traverses the site from north to south, but will later be relocated along the western boundary. No railroads are present on the site.

2.2 REGIONAL DEMOGRAPHY, LAND USE, WATER USE

2.2.1 Regional Demography

The desert area in the immediate vicinity of the site is very sparsely inhabited. The nearest community is Wintersburg, at a road intersection about 1-1/2 miles north of the site boundary. Several buildings make up the community, for which no specific census data exists. Of the communities shown in Figure 2.2, only Buckeye is given as a census unit with a 1970 population of 2599.¹ For the same year, the applicant estimates that about 210 persons were living within a five-mile radius of the site, and about 1900 within ten miles. The former number was estimated from house counts determined from aerial photographs and ground surveys, the latter from house counts and from 1970 census data apportioned to the fractions of Maricopa Census County Divisions occupied by corresponding portions of the population circle (ER, Sec. 2.2.1.1.1).

There is said to be a proposed residential development on the west side of the White Tank Mountains, some 15 miles north of the PVNGS Site.⁴¹

The population center distance, i.e., the distance to the nearest boundary of a densely populated center containing more than about 25,000 residents, is about 36 miles east from the site to the nearest corporate limits of Phoenix (ER, Sec. 2.2.1.4).

The 1970 population of Phoenix proper was 591,562. There are two Standard Metropolitan Statistical Areas (SMSA) in Arizona; viz., Phoenix and Tucson. The area within 50 miles of the site is mostly within the Phoenix SMSA which had a population of 967,522 in 1970. However, the population

of this SMSA (coincident with Maricopa County) is primarily concentrated in the Phoenix urbanized area, which had a 1970 population of 863,357. The Buckeye Census Division of Maricopa County, in which the site is located, had a population of 7807. Adjoining this division in Maricopa County, and partially within a 50-mile radius, is the Gila Bend Division with a 1970 population of 3469 and the Wickenburg Division with 5106. Parts of other census divisions in Pinal, Yavapai, and Yuma Counties are within 50 miles, but they likewise contribute very small increments to the total population in the circle described by that radius.¹

The area around the plant site to ten miles is segmented in Figure 2.4. Similar segmentation to 50 miles is shown in Figure 2.1. As provided by the applicant, population distribution for the sectored annuli shown in these figures is given for 1970 in Figure 2.5. Also provided by the applicant are population estimates for census years of 1980 to 2020 (ER, Figs 2.2-4 through 2.2-8 and ER, Supp. 3, Figs. 2.2-4 through 2.2-8). In all of the estimates, two sectors of the 40- to 50-mile annulus, E and ENE, contain more than 82% of the population within the 50-mile radius because they include a part of the Phoenix urbanized area. A summary of present and projected populations as provided by the applicant is presented in Table 2.1.

Table 2.1. Present and Projected Populations around the PVNGS Site

Radius, miles	Year					
	1970	1980	1990	2000	2010	2020
0-5	211	322	473	553	894	1,228
0-10	1,899	2,987	4,408	6,085	8,392	11,574
0-20	9,634	15,205	22,448	30,982	42,748	58,988
0-30	20,046	31,654	46,732	64,493	88,996	122,814
0-40	108,514	171,422	253,063	349,245	481,962	665,132
0-50	629,721	994,588	1,467,713	2,025,044	2,793,998	3,855,112

Derived from ER, Supp. 3, Figs. 2.2-3 through 2.2-8.

There are two proposed residential developments southeast of the site within two and four miles from the site boundary. The applicant reports the ultimate size of the development to be over 4500 acres for one tract and 1200 acres for the other. The former has a design population of 14,000; none is specified for the latter (ER, Sec. 2.2.2.3). During aerial reconnaissance of the plant site and vicinity in September 1974, members of the staff observed the relatively undeveloped extent of these intended residential areas. Rural areas in the arid southwest have for the most part remained generally unoccupied and undeveloped.² In any event, the success of the developments is speculative at this time. The population data provided by the applicant, and summarized in Table 2.1, do not reflect the possibility of several thousand people residing within about five miles of the site, as a result of the two residential developments.

Migrant farm workers within five miles of the site add a small variable increment to the resident population. This contribution is expected to lessen in proportion to an expected decrease in the amount of area cropland.

2.2.2. Land Use

Most of the land within ten miles of the site is open desert. About 10% of it is currently irrigated for agricultural purposes. This includes an estimated 16,000 acres of the main crop, cotton, plus some sugar beets, wheat, alfalfa, and barley. Three dairy farms are located about ten miles east of the site, with a total of about 850 cattle. Near Wintersburg are four milk cows, these being the nearest to the site. Some goats (not milked for human consumption) are two miles north and three miles northwest of the reactor locations (ER, Sec. 2.2.2.1). On the site, 2200 acres now devoted to agricultural production produce a profit of about \$100 per acre at 1974 prices. There are no permanent residents on the site, but a few migrant labor families live there at present (ER, Supp. 1, p. S1-2.1-3).

River Segment B includes a proposed natural area along the Salt River and segments of the Fred J. Weiler Green Belt. The riparian communities associated with the river provide shelter, food, breeding grounds, etc. for a wide variety of wildlife species typical of the Lower Sonoran desert scrub region. The proposed Salt River Natural Area serves as a wildlife refuge because of its riparian woodland diversity and wet marshes. This area is more typical of native riparian communities along the Salt and Gila Rivers in that it is dominated by cottonwoods and willows rather than salt cedar. The proposed natural area also supports breeding bird species such as the least bittern (*Ixobrychus exilis*), ruddy duck (*Oxyura jamaicensis*), Virginia rail (*Rallus limicola*), and long-billed marsh wren (*Telmatoelytes palustris*), which are known to breed in only a few other areas of the state. Preliminary inventories of the flora and fauna of the proposed natural area are given in the ER (Appendixes 2F and 2G).

River Segment C (Fig. 2.8) is a nine-mile portion of the Gila River below the Buckeye diversion canal which extends to the discharge point of the south extension canal. This area is practically devoid of streamside vegetation with the exception of two small segments of the Fred J. Weiler Green Belt.

River Segment D (Fig. 2.8) is a continuous 17-mile segment of riparian habitat from the discharge point of the south extension canal to Gillespie Dam. It is characterized by extensive growth of salt cedar and other plant species which are highly dependent on groundwater. The Bureau of Land Management has established the Fred J. Weiler Green Belt along the Gila River from Liberty, Arizona, southwest of Phoenix, to Yuma County. It is composed of 62,735 acres of public land scattered along the Gila River. Two small segments of the Green Belt are found along the Gila River between 91st Avenue and the Buckeye diversion canal. According to the Arizona Game and Fish Department, the area represents the nation's best nesting habitat for the whitewing dove (*Zenaida asiatica*) with up to 100 nests per acre in some areas (ER, Sec. 2.7.1.2.4).

2.7.2 Terrestrial

2.7.2.1 Microorganisms

In desert ecosystems, the importance of soil microorganisms is often overlooked, especially the decomposers and nitrogen-fixers.²¹ These organisms, (i.e., fungi, bacteria, algae, protozoa, etc.) provide most of the primary litter breakdown, transport, and chemical decomposition in desert soils.

No specific data are available on soil microorganisms of the PVNGS site, although unidentified blue-green algae and lichens were observed by the staff in September 1974. In general, however, desert soil nitrogen levels are often so low as to be a limiting factor for plant growth.²² Nitrogen fixation by autotrophic algae, free-living soil bacteria and the symbiotic bacteria in the root nodules of desert legumes is the major source of available nitrogen. These microorganisms are most abundant in the upper soil layers after the summer rains. Fungi, bacteria, and protozoans are responsible for most of the chemical decomposition in deserts, and are also found in upper soil layers. Since desert ecosystems are relatively unproductive and the amount of available litter is small, such decomposer population levels are generally low compared to other ecosystems and are apparently heavily dependent upon soil moisture.^{23,25}

2.7.2.2 Vegetation

The salinity and alkalinity of desert soils have an influence on the types of vegetation that are found. Analyses of soluble salts and exchangeable sodium in the soils of the PVNGS site show a wide range of salinities and alkalinities (ER, Table 2.7-10); lowest levels were found in the creosote bush plain and mesquite wash samples. Soil pH ranges from 8.3 to 9.6, and the organic content is consistently low. Soil texture onsite ranges from a loamy sand to silty loam.

The perennial vegetation of the lower Colorado Valley subdivision of the Sonoran Desert usually occurs in low, open stands distributed over extensive areas. Creosote bush (*Larrea divaricata*) and bursage (*Amarantus duroni*) are by far the most common species. Saltbush (*Atriplex* spp.) is widespread in bottomlands that are periodically flooded and have relatively high alkalinity. The cactus flora of the lower Colorado subdivision is depauperate in numbers of species and individuals compared to other subdivisions.²⁶

Vegetation on the 3800-acre site is divided into five major native plant communities: creosote bush plains, 15%; saltbush plains, 14%; mesquite washes, 5%; creosote bush-saltbush plains, 3%; and creosote bush-cacti hills, 2%. Sixty percent of the site is presently under irrigated cultivation or in old fields. Approximately 1% of the site acreage is occupied by buildings and roads.

Approximately one half of the 115 uncultivated vascular plant species known to occur at the PVNGS site are annual or biennial herbs and grasses, most of which appear only in early spring after the winter rains (ER, Sec. 2.7.1.2.2 and Supp. 2, and Ref. 27). In years characterized by heavy rainfall the herbaceous vegetation can be relatively abundant, with over 50% ground coverage. Vegetation surveys for the site and the surrounding area, based on quadrat samples, field surveys and low-level aerial photographs, were prepared by the applicant using a preliminary version of Brown and Lowe's classification method (ER, Sec. 2.7.1.2.2, and Ref. 28). Also provided is a partial listing of information on palatable, edible, medicinal, and noxious plant species.

Native plant species found in the site region, including members of the cactus family, ocotillo (*Pouqieria splendens*) and crucifixion thorn (*Holacantha emoryi*), are state-protected plants.²⁹ State-protected plants in Arizona may not be collected or transported; however, they may be destroyed on private property during preparation of the land for construction, farming, or other purposes.

Most perennial plants in the Sonoran Desert grow very slowly. Thus, it is difficult to identify specific successional sequences in the desert scrub communities. Often when such communities are disturbed or destroyed, individuals of the former dominant species are the first to reappear. When changes in vegetation do occur, they are in direct response to environmental variables such as a change in precipitation patterns, soil salinity, or grazing.

2.7.2.3 Arthropods

Arthropods (including insects) comprise a major portion of the diets of many of the vertebrates known to exist at the PVNGS site (i.e., reptiles, birds, bats) (ER, Sec. 2.7). Some species of insects may have the potential to limit plant species distribution by removing seeds from a germinable position in the soil (e.g., harvester ants)³⁰ or by heavily attacking the vegetation of a host plant (e.g., grasshoppers on creosote bush).³¹ Termites, and symbiotic protozoa in their alimentary canals, are responsible for much of the primary litter breakdown and transport in desert soils.³² In addition, insects are necessary pollinators for seed production in some native and cultivated plants (e.g., bees on alfalfa).³³

2.7.2.4 Vertebrates

In order to acquire ecological information concerning vertebrates at PVNGS, the applicant established sampling stations both on and in the immediate vicinity of the site. Due to the close proximity of the offsite sampling stations and the continuity of the vegetational communities, species recorded at the outlying stations are also expected to occur in similar habitats on the site proper.

Amphibians and Reptiles

The applicant lists 35 reptiles and eight amphibians as possible residents of the PVNGS site (ER, Table 2.7-24 and Supp. 1). However, the literature leads the staff to believe that three additional species, the western ground snake (*Sonora semiannulata*), western shovel-nosed snake (*Chionactis occipitalis*) and the western spadefoot (*Scaphiopus hammondi*) could possibly occur on the site or in the vicinity of the site.^{34,35}

Desert wash areas support the greatest diversity and density of reptiles. The side-blotched lizard (*Uta stansburiana*), western whiptail lizard (*Cnemidophorus tigris*), and spiny lizard (*Sceloporus magister*) are likely to be the most abundant reptiles in wash areas on the site or in its vicinity.

Other reptiles likely to inhabit or be in the vicinity of the site, and protected under State of Arizona Game and Fish Commission's Order No. 43 (March 3, 1973), include: chuckwalla (*Sauromalus obesus*), desert tortoise (*Gopherus agassizii*), horned lizards (*Phrynosoma* spp.), and the Gila monster (*Heloderma suspectum*). The chuckwalla is a rock-dwelling herbivorous lizard common in creosote bush and desert scrub areas, and has been observed on the site on a lava-strewn hillside dominated by creosote bush. Crevices in rocks are used as protection against predation while deeper crevices are important as hibernating sites. If chuckwallas are present on the site it is likely that their diets would consist of spring annuals such as *Oenothera elaeagnifolia* (an ephemeral) and perennials such as bur sage and creosote bush since such dietary habits have been observed in the Mojave Desert,³⁶ which is somewhat similar to the Sonoran.

The desert tortoise (*G. agassizii*) is an herbivorous species found in creosote bush communities, washes, oases and riverbanks.³⁵ It has not yet been observed on the site. Horned lizards prefer

sandy areas near washes in desert plains. Their diet consists mainly of ants and other invertebrates. Horned lizards were heavily collected and sold as pets but are now protected under Arizona law. The Gila monster, a venomous lizard, inhabits heavily vegetated areas on the lower slopes of mountains and desert washes. One specimen has been observed on the site. Its diet consists of small mammals, bird and reptile eggs.³⁵ The U. S. Bureau of Sport Fisheries and Wildlife lists the Gila monster's status as undetermined.³⁷

No threatened or endangered amphibian or reptilian species are known to the staff to be present on or near the plant site.

Birds

A total of 67 bird species were observed in the vicinity of the PVNGS site during a January-July 1974 census period (ER, Supp. 1, Table 6): Census data gathered in the five principal plant community types indicated that desert wash areas (channels lined with palo verde, ironwood, and mesquite trees) supported a greater species diversity and density than did agricultural or saltbush communities in interwash areas. The mourning dove (*Zenaidura macroura*), white-winged dove (*Zenaidura asiatica*), and Gambel's quail (*Lophortyx gambelii*) are important game species inhabiting wash areas on the PVNGS site. The most abundant species of the saltbush interwash areas on the site are Brewer's sparrow (*Spylla breweri*), mourning doves and Gambel's quail. The white-crowned sparrow (*Zonotrichia leucophrys*) and Brewer's sparrow are also abundant in desert washes, and are probably abundant in similar habitats in the site vicinity.

Two species recorded for Maricopa County, the prairie falcon (*Falco mexicanus*) and peregrine falcon (*Falco peregrinus*), are included on the threatened and endangered list by the U. S. Bureau of Sport Fisheries and Wildlife.³⁷ One prairie falcon was observed on the site in a saltbush flat during November 1973, but peregrine falcons have not been observed. Five additional species (marsh hawk, *Circus cyaneus*; sparrow hawk, *Falco sparverius*; Cooper's hawk, *Accipiter cooperi*; burrowing owl, *Speotyto cunicularia*; loggerhead shrike, *Lanius ludovicianus*) observed on the site are on the Audubon "blue list" of threatened species.³⁸

Mammals

Forty-nine mammalian species are known to inhabit desert scrub regions similar to those characterizing the PVNGS site (ER, Sec. 2.7.2.2 and Table 2.7-11) and are possible residents of the site proper (ER, Table 2.7-11). The Arizona Game and Fish Commission classifies the following species of the area as game mammals: mule deer (*Odocoileus hemionus*), desert cottontail (*Sylvilagus auduboni*), raccoon (*Procyon lotor*), badger (*Taxidea taxus*), coyote (*Canis latrans*), grey fox (*Urocyon cinereargenteus*), striped skunk (*Mephitis mephitis*), and bobcat (*Lynx rufus*). Of these, only the mule deer and grey fox have not been observed on the site. The desert cottontail is the most abundant game mammalian species on the site; an average of 1.5 rabbits per linear mile of habitat were observed during a survey in March 1974.

One species, the spotted bat (*Euderma maculatum*) which may possibly occur on the PVNGS site is considered threatened.³⁷ The spotted bat may frequent crevices of limestone cliffs in the Palo Verde Hills, which are contiguous with the site boundary. If such is the case it is likely that this bat may visit the site proper, attracted by insects which are associated with existing irrigation canals and cultivated fields. The desert kit fox (*Vulpes macrotis*), considered rare throughout Arizona (ER, Sec. 2.7.2.2.8), is known to inhabit the Palo Verde Hills. It is highly likely that this mammal visits the site on forays for small rodents, which constitute the majority of its diet.

2.8 NATURAL RADIATION BACKGROUND

The Environmental Protection Agency has estimated the average annual background radiation to be 130 mrem/yr in Arizona.³⁹ This dose results from cosmic radiation, natural terrestrial radioactivity, internal radiation and all other naturally occurring sources of radiation.