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Geological Survey

Nuclear Power Reactor Sites in the Great Lakes Region of the United States

by

Mareta West

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Introduction

This report describes nuclear power reactor sites in the Great Lakes region of the United States. The map indicates the location of all sites as of 1976 in the conterminous United States. The project is one of several in the National Enviornmental Overview Program of the U.S. Geological Survey, which will identify and summarize geologic, hydrologic, and topographic topics associated with future energy, mineral resource, and land use development in the United States.

The increasing use of atomic energy creates a need for the dissemination of information about nuclear reactors. Because power plant safety is related, in part, to the geology and seismology of the plant area and surroundings, this study is focused primarily on that relationship.

Information about the geology and seismology is summarized from reports prepared by consultants to utility companies and submitted by the companies to the U.S. Nuclear Regulatory Commission in support of the application for a construction permit.

Coordinates for site locations were established from descriptive information in the reports. The U.S. Geological Survey 7-1/2 minute topographic maps were used in confirming the geographic location of the sites. The coordinates may in some cases represent the planned location rather than the exact actual location.

Nuclear Power Plants

Conventional power plants burn oil, gas, or coal to heat water which produces steam. The steam drives a turbine generator which produces electricity. In a nuclear power plant, an atomic reaction is the heat source. Nuclear fission is initiated and controlled at a planned rate.

Several kinds of nuclear power plants have been developed. In the boil-water reactor, water boils after coming in contact with the fuel elements. In a pressurized-water reactor, steam is produced from water under pressure without boiling. In a gas-cooled reactor, gas transfers heat to the steam generator. Breeder reactors, which are in the experimental stage, produce more fissionable material than they consume.

The first nuclear power plant in the United States, at Shippingport, Pa., began generating electricity in 1957. The amount of power generated at various plants depends on the design of the plant and the local requirements.

Conventional power plants, if properly designed and built, have withstood earthquakes without experiencing damage. Nuclear power plants are designed to withstand postulated earth tremors of an intensity conservatively expected to occur at the site.

The Safe Shutdown Earthquake (SSE) is the earthquake that in consideration of the regional and local geology and seismology produces the maximum vibratory ground motion at the site for which certain systems, structures, and components are designed to remain functional.

The specified procedure in determining the SSE requires the association of maximum historical earthquakes with tectonic provinces and tectonic structures. These earthquakes are postulated to occur at points of their respective tectonic structures or provinces closest to the site. The SSE is then defined by a response spectrum, in consideration of the maximum sustained vibratory accelerations which would occur at the site in consequence of the postulated earthquakes.

The SSE is stated as a percentage of the Earth's gravitational force (g).

Glossary

Bedrock--A general term for the rock, usually consolidated, that underlies soil or other unconsolidated, surficial material.

Being Built--Reactors for which a construction permit is used by the Nuclear Regulatory Commission (formerly Atomic Energy Commission).

Criticality--The condition of a reactor when the chain reaction has become self-sustaining.

Docket Number--An identification number assigned by NRC (formerly AEC), for each plant unit, when a PSAR is accepted for review.

Net kW(e)--Net kilowatt hours of electricity.

Operable--Reactors in which criticality is achieved. (A reactor shut down because of technical problems, extensive modifications, or refueling continues to be listed as operable.)

Operating Basis Earthquake--The earthquake which produces the vibratory ground motion for which features of the plant necessary for continued operation without undue risk to the health and safety of the public are designed to remain functional.

Planned--Reactors for which a public announcement that includes principal contractor and reactor type is made by the sponsoring organization, or an application for a construction permit is received by NRC.

Safe Shutdown Earthquake--(design basis earthquake) The earthquake which produces the vibratory ground motion for which the plant features which are necessary to shut down the plant in a safe condition without undue risk to the health and safety of the public are designed to remain functional.

Site--The land area where the power plant is located (in this report, generally within 1- to 2-mile radius of the plant structures).

Acronyms

AEC	Atomic Energy Commission (now NRC)
BWR	Boiling water reactor
DBE	(now SSE) Design basis earthquake
FDSA	Facility Description and Safety Analysis Report
FSAR	Final Safety Analysis Report
FHSR	Facility Hazards Safety Report
HTGR	High temperature gas cooled reactor
LMFBR	Liquid metal fast breeder reactor
NRC	Nuclear Regulatory Commission (formerly AEC)
OBE	Operating basis earthquake
PDAR	Plant Design and Analysis Report
PSAR	Preliminary Safety Analysis Report
PWR	Pressurized water reactor
SER	Safety Evaluation Report
SSE	Safe shutdown earthquake (formerly DBE)

Sources of Information

(1) The following items:

1) Classification as operable, being built, or planned; definitions of these categories as they apply to reactors included in this report.

2) Kind of plant

3) Plant power

4) Startup date (actual or scheduled)

are from "Nuclear Reactors Built, Being Built, or Planned in the United States as of Dec. 31, 1975" published by the Energy Research and Development Administration, publication TID-8200-R33.

Included are sites where civilian central-station nuclear power reactors are located. Of these, sites for which applications for construction permits have been docketed are included.

(2) Dates on which operating licenses were issued, construction permits in effect were issued, or applications for construction permits were docketed are from the "Facilities License Application Record" prepared by the U.S. Nuclear Regulatory Commission, OMIPC:NLD, June 30, 1976.

(3) Geology is summarized from the Final Safety Analysis Report, the Preliminary Safety Analysis Report, the Safety Evaluation Report, and the Environmental Report submitted by the utility company to the Nuclear Regulatory Commission in support of the application for a construction permit and facility license. The specific reports available for each site are indicated in the site summaries.

(4) The physiographic provinces are from "Physical Divisions of the United States" by N.M. Fenneman, 1946 edition, published by the U.S. Geological Survey.

For definitions of geologic terms, refer to Glossary of Geology edited by Margaret Gary and others, published by American Geological Institute, 1972.

ILLINOIS

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Braidwood (2 units) 50-456 50-457	lat 41°15' N.; long 88°13' W. Will County; 10 km (6 mi) southwest of Wilmington, Ill.	Essex	Commonwealth Edison Co.	PWR; 1,120,000 each unit	Construction permits, both units, Dec. 31, 1975	Lake and pond	Central Lowland

Geology	SSE	OBE	Startup
Surficial deposits in site area generally thin and locally absent; include alluvium till, outwash (generally in upland areas), thin loess deposits above till, and locally some thin residual soils.	0.20 g	0.10 g	1980 unit 1; 1982 unit 2

Bedrock sedimentary sequence in region, Ordovician and Cambrian strata; 600 to 900 m (200 to 3000 ft) of dolomite, sandstone, and shale. Precambrian basement rocks granite and granodiorite.

Uppermost bedrock in area Dunleith formation of Ordovician age; medium grained dolomite, as much as 35 m (100 ft) thick. Older Ordovician dolomite, sandstone, and sandy dolomite as much as 350 m (1150 ft) thick. Dunleith moderately weathered. Solution along many joints, fractures, and bedding planes. Sparse small sinkholes. Guttenberg formation, below Dunleith, dolomite with shale partings; average thickness 1.7 m (5.5 ft). Quimbys Mill formation, below Guttenberg, dolomite with shale partings and some chert nodules; average thickness 3.6 m (11.7 ft).

Site in region of southward-thickening sedimentary strata subjected to series of vertical crustal movements during Paleozoic and early Mesozoic time that formed broad basins and arches. Arches and basins modified by local folding and faulting.

Geology (continued)

Site in structurally complex area, on northern edge of Illinois basin and on Wisconsin arch-La Salle anticlinal belt. Small flexure, Savanna anticline, west of site. Kankakee arch southeast of site. In site vicinity, strata dip south one degree or less toward Illinois basin.

Two major faults in proximity of site, Sandwich fault and Janesville fault. Numerous small faults in area.

Small faults and several joints discovered during excavation for plant structures. Vertical fault displacement 2.5 to 15 cm (1 to 6 in). Youngest faults more than 70,000 years old.

Major plant structures to be supported on or in Dunleith formation bedrock. Foundation grouting will protect against any possible continuous zones of excessive fracturing, weathered bedding planes, vuggy material, or solution enlarged joints.

PSAR

SER

ILLINOIS

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Byron (2 units) 50-454 50-455	lat 42°05' N.; long 89°17' W. Ogle County; east of Rock River; 6 km (4 mi) south of Byron, Ill.	Oregon 15 minute map (no 7 1/2 minute map)	Commonwealth Edison Co.	PWR; 1,120,000 each unit	Construction permits, both units, Dec. 31, 1975	Rock River	Central Lowland

Geology	SSE	OBE	Startup
Surficial deposits in site area generally thin and locally absent; include alluvium till, outwash (generally in upland areas), thin loess deposits above till, and locally some thin residual soils.	0.20 g	0.10 g	1980 unit 1; 1982 unit 2

Bedrock sedimentary sequence in region, Ordovician and Cambrian strata; 600 to 900 m (200 to 3000 ft) of dolomite, sandstone, and shale. Precambrian basement rocks granite and granodiorite.

Uppermost bedrock in area Dunleith formation of Ordovician age; medium grained dolomite, as much as 35 m (100 ft) thick. Older Ordovician dolomite, sandstone, and sandy dolomite as much as 350 m (1150 ft) thick. Dunleith moderately weathered. Solution along many joints, fractures, and bedding planes. Sparse small sinkholes. Guttenberg formation, below Dunleith, dolomite with shale partings; average thickness 1.7 m (5.5 ft). Quimbys Mill formation, below Guttenberg, dolomite with shale partings and some chert nodules; average thickness 3.6 m (11.7 ft).

Site in region of southward-thickening sedimentary strata subjected to series of vertical crustal movements during Paleozoic and early Mesozoic time that formed broad basins and arches. Arches and basins modified by local folding and faulting.

Geology (continued)

Site in structurally complex area, on northern edge of Illinois basin and on Wisconsin arch-La Salle anticlinal belt. Small flexure, Savanna anticline, west of site. Kankakee arch southeast of site. In site vicinity, strata dip south one degree or less toward Illinois basin.

Two major faults in proximity of site, Sandwich fault and Janesville fault. Numerous small faults in area.

Small faults and several joints discovered during excavation for plant structures. Vertical fault displacement 2.5 to 15 cm (1 to 6 in). Youngest faults more than 70,000 years old.

Major plant structures to be supported on or in Dunleith formation bedrock. Foundation grouting will protect against any possible continuous zones of excessive fracturing, weathered bedding planes, vuggy material, or solution enlarged joints.

PSAR

SER

ILLINOIS

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status
Clinton (2 units) 50-461 50-462	lat 40°10; N.; long 88°50' W. DeWitt County; 10 km (6 mi) east of Clinton, Ill.	Maroa 15 minute map (no 7 1/2 minute map)	Illinois Power Co.	BWR; 933,400 each unit	Construction permits, both units, Feb. 24, 1976

Water Supply	Physiographic Province	Geology	SSE	OBE	Startup
Lake on Salt Creek planned	Central Lowland (Till Plains section)	Surficial deposits in site area include floodplain alluvium and channel deposits up to 9.8 m (32 ft) in principal stream valleys Wisconsian loess and glacial drift in uplands, 73 to 110 m (240 to 330 ft) thick. Underlain by Illinoian till 27 to 43 m (90 to 140 ft) thick. At site, these deposits overlie bedrock Modesto formation of Pennsylvanian age; thinly bedded limestone, coal, shale, and siltstone. Site near nose of Downs anticline, related to La Salle anticlinal belt. Rocks of Devonian age and older involved in fold which is believed to extend upward into Pennsylvanian age bedrock. Other small domes in site vicinity. No known faults associated with these structures. Plant structures to be supported by mat foundations on compacted fill over very dense Illinoian till. PSAR Oct. 1973	0.25 g	0.13 g	1980 unit 1; 1983 unit 2

ILLINOIS

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Dresden (3 units) 50-10 50-237 50-249	lat 41°23' N.; long 88°16' W. Grundy County; south of Illinois River; east of Kankakee River, north of Des Plains River; 23 km (14 mi) southwest of Joliet, Ill.	Minooka	Commonwealth Edison Co.	BWR; 200,000 unit 1; 809,000 units 2 and 3	Operating licens unit 1, Oct. 14, 1960; provisiona operating licens unit 2, Dec. 22, 1969; operating license, unit 3, Jan. 12, 1971.	Illinois River	Central Lowland

Geology	SSE	OBE	Startup
Surface rocks over most of site, Pennsylvanian Pottsville sandstone, overlies Ordovician Divine limestone and Maquoketa shale. Mica present in sandstone and in part concentrated along bedding planes, creating natural planes of weakness. Limestone includes some breccia. Vertical joints in sandstone at site; no evidence of faults. Minor folding and faulting of Pennsylvanian strata in area. Faulting in region may be related to Sandwich fault.	0.20 g	0.10 g	1960 unit 1; 1970 unit 2; 1971 unit 3

ILLINOIS

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
La Salle (2 units) 50-373 50-374	lat 41°15' N.; long 88°40' W. La Salle County; 6 km (4 mi) south of Illinois River; 8 km (5 mi) south of Seneca, Ill.	Odell 15 minute map (no 7 1/2 minute map)	Commonwealth Edison Co.	BWR; 1,078,000 each unit	Construction permits, both units Sept. 10, 1973	Illinois River	Central Lowland

Geology	SSE	OBE	Startup
At site, surficial glacial drift about 52 m (170 ft) thick overlies Pennsylvanian rocks of about the same thickness. Below Pennsylvanian, Cambrian and Ordovician sandstone and dolomite overlie Precambrian basement rocks. Top of Precambrian at about 1370 m (4500 ft). Area of sedimentary basins and eroded domes. Nearest major fault zone, Sandwich fault, about 42 km (26 mi) northwest. Small faults in Pennsylvanian rocks within a few km (mi) of site.	0.20 g	0.10 g	1978 unit 1; 1979 unit 2

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Quad-Cities (2 units) 50-254 50-265	lat 41°44' N.; long 90°19' W. Rock Island County; east side of Mississippi River; 5 km (3 mi) north of Cordova, Ill.	Cordova	Commonwealth Edison Co.	BWR; 800,000 each unit	Operating license unit 1, Oct. 1, 1971; operating license, unit 2, March 31, 1972	Mississippi River	Central Lowland

Geology	SSE	OBE	Startup
Surficial rocks, deposited during Pleistocene glaciation, unconsolidated glacial till, outwash, and lacustrine sediments. Northwest flank of Illinois basin, strata dip gently to southeast. Bedrock, Niagaran dolomite of Silurian age. Dolomite fractured and weathered. No major tectonic deformation in area since end of Mesozoic era. No evidence of major faulting in area. Plant structures founded on Niagaran dolomite bedrock. Cavities filled with structural concrete where needed.	0.24 g	0.12 g	1971 unit 1; 1972 unit 2

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Zion (2 units) 50-295 50-304	lat 42°27' N.; long 87°48' W. Lake County; west shore of Lake Michigan; east side of Zion, Ill.	Zion	Commonwealth Edison Co.	PWR; 1,050,000 each unit	Operating license unit 1, Apr. 6, 1973; operating license, unit 2, Nov. 14, 1973	Lake Michigan	Central Lowland

Geology	SSE	OBE	Startup
Site on band of lake deposits about 8.5 m (28 ft) thick. Below lake deposits, Pleistocene glacial till, and outwash about 35 m (100 ft) thick. Bedrock, below Pleistocene deposits, Niagara dolomite of Silurian age, about 76 m (250 ft) thick. Dolomite moderately fractured; contains vugs and pyrite. Below dolomite, Precambrian crystalline basement rocks.	0.17 g	0.08 g	1973 both units

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Bailly (1 unit) 50-367	lat 41°39' N.; long 87°07' W. Porter County; south-side of Lake Michigan; 8 km (5 mi) northeast of Gary, Ind.	Dune Acres	Northern Indiana Public Service Co.	BWR; 645,300	Construction permit May 1, 1974	Lake Michigan	Central Lowland

Geology	SSE	OBE	Startup
Site on broad Kankakee arch between Illinois basin and Michigan basin. At surface Pleistocene glacial till and lacustrine sand, silt and clay, and eolian sand. Below these deposits, about 1220 m (4000 ft) of Paleozoic sedimentary rocks, Cambrian to Mississippian in age. These Paleozoic rocks overlie Precambrian crystalline granite and rhyolite. Uppermost bedrock, Antrium shale, about 1.5 m (5 ft) thick; Devonian-Mississippian age. Below Antrium, Traverse formation, upper Devonian age. Precambrian crystalline basement rock at depth of 1280 m (4200 ft). Major fault systems in region include fault complex in southern Illinois, and Keweenawan fault zone in northern Michigan. Sandwich fault zone in northeastern ILlinois, Bowling Green fault in northwestern Ohio, Mt. Carmel fault in southern Indiana, small unnamed faults in southeastern Wisconsin, northwestern and central Indiana. Closest known faults, Sandwich fault, about 80 km (50 mi) to west, and unnamed fault about 40 km (25 mi) south. Movement on Sandwich fault after deposition of Silurian dolomites, probably before end of Paleozoic era. Major plant structures to be supported on pile foundations on competent materials. PSAR	0.20 g	0.10 g	?

INDIANA

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status		
Marble Hil (2 units) 50-546 50-547	lat 38°36' N.; long 85°27' W. Jefferson County; west side of Ohio River; 16 km (10 mi) south of Madison, Ind.	Bethleham, Ind.-Ky.	Public Service of Indiana	PWR; 1,130,000 each unit	Application for construction permits, both units docketed Sept. 11, 1975	Ohio River	Central Lowland (Till Plains section)

At site, discontinuous surficial deposits, Atherton formation of Quaternary age, silty clay loess, up to 1 m (3 ft) thick. Below Atherton, Jessup formation of Quaternary age, clayey silt to silty clay till with some sand and gravel; up to 6 m (20 ft) thick. Early Pleistocene to Tertiary residuum up to 10 m (32 ft) thick below Jessup.	0.15 g	0.06 g	1981 unit 1; 1983 unit 2

Uppermost bedrock in southern part of site, Louisville limestone of Silurian age; up to 5.5 m (18 ft) thick. Below Louisville, Waldron shale of Silurian age, up to 2 m (7 ft) thick. Below Waldron, Salamonie dolomite of Silurian age, 9 to 35 m (30 to 100 ft) thick. Below a thin Silurian limestone, Saluda formation of Ordovician age, about 20 m (65 ft) thick.

Fourteen Mile Creek structure and New Harmony Landing structure, two faults about 24 km (15 mi) southeast of site. Middle Silurian age.

Plant structures to be founded on bedrock. Excavation of soil and rock, and backfilling will be required in some areas.

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Big Rock Point (1 unit) 50-155	lat 45°22' N.; long 85°12' W. Charlevoix County; shore of Lake Michigan; 20 km (12 mi) west of Petoskey, Mich.	Bayshore 15 minute map (no 7 1/2 minute map)	Consumers Power Co.	BWR; 75,000	Operating license May 1, 1964	Lake Michigan	Central Lowland

Geology	SSE	OBE	Startup
Bedrock, Lower Paleozoic limestone, exposed at surface or mantled by unconsolidated glacial and lacustrine deposits. Glacial deposits of Pleistocene age. Borings at site to depth of 65 m (40 ft) penetrated gray to black fossiliferous limestone with thin shale partings. Core recovery poor where limestone weathered or highly jointed.	0.05 g	None	1964

MICHIGAN

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Cook (Conald C. Cook) (2 units) 50-315 50-316	lat 41°59' N.; long 86°34' W. Berrien County; east side of Lake Michigan; 16 km (10 mi) southwest of Benton Harbor, Mich.	Bridgman	Indiana and Michigan Electric Co.	PWR; 1,060,000 each unit	Operating license, unit 1, Oct. 25, 1974; construction permit, unit 2, March 25, 1969	Lake Michigan	Central Lowland

Geology

In site vicinity, bedrock about 945 m (3100 ft) thick; primarily shale and sandstone of Devonian and Mississippian age. Thick glacial deposits overlie bedrock.

Deeply buried folds and possible faults, related to ancient crustal movements, present at number of locations. No recent faults; no folds in younger formations. Postulated subsurface fault may be present about 96 km (60 mi) northeast of site.

Major plant structures supported on mat foundations.

SSE	OBE	Startup
0.20 g	0.10 g	1975 unit 1; 1978 unit 2

FSAR

PSAR

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Enrico Fermi (1 unit, unit 2) (Unit 1, a sodium cooled reactor, shut down 1973)	lat 41°58' N; long 83°15' W. Monroe County; shore of Lake Erie; 13 km (8 mi) northeast of Monroe, Mich.	Stony Point	Detroit Edison Co.	BWR; 1,093,000	Construction permit Sept. 26 1972	Lake Erie	Central Lowland

Geology	SSE	OBE	Startup
Large erosional domes and sedimentary basins characteristic of region. Site on Findlay arch between Michigan basin and Appalachian basin.	0.15 g	0.08 g	1980

At site, surficial glacial till and clay, Pleistocene, 4.5 to 9 m (15 to 30 ft) thick mantle bedrock. Precambrian crystalline basement rocks about 950 m (3100 ft) below surface. Bedrock Bass Islands dolomite of Upper Silurian age; about 24 m (80 ft) thick. Salina group interbedded shale, limestone, and dolomite below Bass Islands; about 180 m (590 ft) thick. No faults identified in basement rocks or overlying sedimentary strata in vicinity. Closest fault about 40 km (25 mi) west. Most faults in region believed to have been inactive since late Paleozoic time.

Plant structures to be founded on bedrock.

PSAR unit 2, April, 1969

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Greenwood (2 units, 2 and 3) (Unit 1, fossil-fuel) 50-452 50-453	lat 43°06' N.; long 82°42' W. St. Clair County; 6 km (4 mi) west of Black River; 24 km (15 mi) northwest of Port Huron, Mich.	Avoca	Detroit Edison Co.	PWR; 1,200,000 each unit	Applications for construction permits, both units, docketed Sept. 17, 1973	Lake Huron; 24 km (15 mile) pipeline; onsite cooling impoundment; spray cooling canal	Central Lowland

Geology	SSE	OBE	Startup
Site in area of glacial deposits. Site: surficial glacial drift, 70 m (225 ft) thick, over bedrock sandstone and shale of Mississippian age. Uppermost bedrock Coldwater formation.	0.12 g		1981 unit 2; 1983 unit 3

Site on southeastern slope of Michigan basin. Small anticlinal flexures, believed to have formed during late Paleozoic time, in site vicinity. One flexure, about 97 km (60 mi) southwest of site, has one nearly vertical limb; some authors postulate a fault. If fault present probably formed during late Paleozoic. Some faults mapped 56 to 97 km (35 to 60 mi) southeast of site; probably Paleozoic.

Plant structures to be founded on compacted fill.

PSAR units 2 and 3

Site and Docket Number(s)	Location	USGS 7 1/2 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Midland (2 units) 50-329 50-330	lat 43°35' N.; long 84°13' W. Midland County; south side of Tittabawassee River; about 2.4 km (1.5 mi) south of outskirts of Midland, Mich.	Midland South	Consumers Power Co.	PWR; 492,000 unit 1; 818,000 unit 2	Construction permits, both units, Dec. 15, 1972	Tittabawassee River	Central Lowland

Geology	SSE	OBE	Startup
Glacial drift at surface Pleistocene age; clay, sand, gravel, till; about 180 m (355 ft) thick. Bedrock below drift, Saginaw formation of lower Pennsylvanian age; series of nearly horizontal shale interbedded with sandstone and siltstone; minor quantities of limestone, coal, anhydrite. No faults mapped in surficial deposits of region. Postulated fault about 88 km (55 mi) south of site. Active Keweenaw fault, about 520 km (325 mi) to northwest, unrelated to site geology. Fault zone 390 km (240 mi) northwest apparently inactive.	0.12 g	0.06 g	1982 unit 1; 1981 unit 2

Site and Docket Number(s)	Location	USGS 7 1/1 Minute Topographic Map	Utility Company	Kind of Plant and Net kW(e)	Status	Water Supply	Physiographic Province
Palisades (1 unit) 50-255	lat 42°19' N.; long 86°19' W. Van Buren County; east shore of Lake Michigan; 7 km (4.5 mi) south of city limits of South Haven	South Haven 15 minute map (no 7 1/2 minute map)	Consumers Power Co. of Michigan	PWR; 700,000	Provisional operating license March 24, 1971	Lake Michigan	Central Lowland

Geology	SSE	OBE	Startup
Sand dunes at surface overlie glacial till and lacustrine deposits; till compact, silty gravel and sand; lacustrine deposits compact, silty sand. Top of bedrock, Coldwater shale of Mississippian age, about 46 m (150 ft) below surface. No faults mapped in site vicinity. Plant structures founded on compact glacial deposits.	0.20 g	0.10 g	1971