

MEMORANDUM  
ON  
GEOLOGIC FEATURES  
OF  
INDIAN POINT NUCLEAR POWER PLANT SITE

by

Thomas W. Fluhr, P.E.  
Engineering Geologist

Consolidated Edison Company of New York, Inc.

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## INTRODUCTION

The Consolidated Edison Company owns a large tract of land in the Village of Buchanan, N. Y. An electric generating station powered by nuclear energy occupies part of the tract.

It is proposed to install a second nuclear-powered unit adjacent to the existing one.

The site has been inspected, records of previous subsurface investigations studied, and three additional test borings are now being made.

The geologic features of the site make it well-adapted to construction of either a conventional or nuclear-powered plant.

## DISCUSSION

The site is located on the east bank of the Hudson River about 35 miles north of New York City. It lies close to good highways and a railroad. It can also be served by water transportation. A natural-gas transmission line crosses the property.

The proposed second unit will be located immediately adjacent to the existing Unit No. 1, and to the northeast of it. The topographic and geologic features of the two unit sites are virtually identical.

### The Topography.

Along this part of the shore of the Hudson River,

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rocky cliffs rise from the river to elevations 80-90 feet above mean sea level. At the site proper, there is a break in the cliffs, forming a basin in which the existing Unit No. 1 is located. To the northeast, the basin is partially rimmed by hills and ridges, reaching to approximate elevation 80-90. To the east and south, the basin is bounded by similar hills and ridges extending to elevations 100-140. A half-mile to the northeast, the topography becomes rugged, with numerous small steep hills and ridges reaching approximate elevations 70-100. The rugged and irregular topography lies east of the highway known as Broadway, and marks a different geologic province from the remainder.

The proposed site for Unit No. 2 lies to the northeast of existing Unit No. 1. At this place the ground is level, about 80 feet above sea level, and is covered with fill. It looks as if it has been leveled artificially. Bedrock lies very close to the existing surface.

#### The Geology.

The property as a whole is underlain by three geologic rock formations. They are:

- (a) A Phyllite or Schist. This is the uppermost formation of sedimentary origin. In some places the rock is a fine-grained phyllite resembling the phyllite of the Hudson River series. In other places it is a muscovite schist resembling the Manhattan schist found

typically in New York City.

(b) Beneath the phyllite or schist, and apparently conformable with it, is a limestone. Most of this is coarsely crystalline white or gray limestone, with some dolomitic and silicious bands, and a few quartz veins. Its original bedding structure has been obscured in part by shearing and jointing.

(c) The schist, in the easterly part of the tract, about a half-mile east of the Hudson River, has been intruded by basic igneous rocks, known as the Cortlandt Series.

The geologic age of the limestone and phyllite or schist has been a subject of dispute among geologists for nearly a hundred years. Some class the formations as Cambro-Ordovician; others as pre-Cambrian. For present purposes the geologic age is immaterial.

The entire tract was not studied, but outcrops were mapped in the area immediately surrounding the power unit sites, and a geologic map prepared, a print of which is attached.

The geologic map shows that existing Unit No. 1 and proposed Unit No. 2 will be located within the limestone belt.

Foundation Conditions.

The top of bedrock is high over most of the site,

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dropping off rapidly in elevation on approach to the river margin.

The limestone has a well-defined layered structure, believed to be original bedding, which strikes N-S to N E and dips easterly at 45 to 65 degrees. This layered structure is marked by shear planes and, rarely, thin shaly layers.

The notable feature of the limestone is its extremely jointed condition. A major joint system extends at about right angles to the bedding structure, but, in addition, there are also many irregular joints. The jointing has an intensity which might almost be described as brecciation. The joints are open, but few display decay. This limestone formation is not cavernous.

The limestone is hard, because of its jointed condition, it is my opinion that its supporting value for foundation purposes should be held to no more than 50 tons per square foot.

The rock cuts existing on both sides of Unit No. 1 show that the rock can be excavated on steep slopes, and that it will remain unsupported without excessive weathering or raveling. A rock slope of 1 horizontal to 4 vertical is judged to be reasonable.

#### Possible Contamination.

In the case of nuclear plants, a question is sometimes

raised in regard to the possibility of contaminating water supplies if a nuclear accident should occur.

Nuclear Unit No. 2 will be situated very close to the Hudson River. It will be located on a bed of jointed limestone which is very permeable. When test borings are made into the limestone there is no return of drill water; it all runs away into the limestone.

The two nuclear units will lie in a basin ringed to north and east by hills. In the hills the ground water table is at a high elevation. The ground water will flow from the hills toward the basin, and into the river. There is no possibility of out flow from the plant, which is at a low elevation, working against the flow of underground water toward the river.

North and east of the plant are hills and ridges of phyllite and schist. These rock formations are very impermeable. East of Broadway, the schist has been intruded by a still more impermeable igneous rock formation, the Cortlandt Series.

All these factors make it an impossibility for any drainage from the plant to go anywhere except into the Hudson River. No problem of contamination of water supplies exists.

#### Rock Stress and Earthquake Hazard.

The highly folded and jointed character of the lime-

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stone indicates that, at one time, it was subjected to high stress of orogenic origin. The fact that it now is intensely jointed shows that any such stresses have been dissipated. Additional stresses cannot accumulate in a rock formation as jointed as this one.

Earthquake shocks have been reported in Westchester County in 1872, 1874, 1878, 1916, and 1926, but none have done appreciable damage. This region is not noted for seismic activity. It appears to be one of the more stable areas of the Earth's crust. The possibility of earthquake damage to this plant is regarded as remote.

#### FINAL STATEMENT

The nuclear reactor with its containment vessel, the heat-exchangers, and the condensers and generating units will be founded on bedrock. The bedrock is sufficiently sound to support any loads which may be anticipated.

In my opinion, no hazard to existing water supplies from nuclear accident is possible.

It is my opinion that no unrelieved stresses exist in this rock formation, which might offer a hazard.

The record of earthquake tremors in this region renders the possibility of damage from earthquakes very remote.

There are no geologic faults of magnitude extending

through the site nor close to it.

In view of these considerations, I regard the site as being well-adapted for construction of the proposed second nuclear-powered generating unit.

*Thomas W. Flinn* P.E.  
Engineering Geologist

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