APPENDIX 2C

GROUND-WATER HYDROLOGY

1 INTRODUCTION

1.1 GENERAL

Three Mile Island Nuclear Station will be located on a large island in the Susquehanna River. Purely from the standpoint of geography, its ground-water conditions are unique, but relatively constant, and predictably controlled by the Susquehanna River, itself. The drainage area of the Susquehanna River extends from its source at Otsego Lake, Cooperstown, New York, for a distance of 444 miles, across the States of Pennsylvania and Maryland, and terminates in the Chesapeake Bay. This major water course collects all surface runoff and ground-water seeps as well as their respective contaminants from a watershed of approximately a 27,000 square mile area. Three Mile Island is located about midway along the course of the river and therefore is influenced by the quantity and quality of that portion of the water from the Susquehanna River watershed upstream from the island. Average annual rainfall at the site is 40 inches.

1.2 MODE OF OCCURRENCE

The bedrock underlying the general area is composed of shales, sandstones, and siltstones belonging to the Gettysburg shale of Triassic Age. A wide range in yields occurs within the formation, with the sandstone facies normally being the best aquifers. However, in closely jointed or fractured shales, relatively high yields can occur. The alluvial deposits are not believed to be a major source of ground-water in this area.

2 SITE STUDIES

Ground-water was studied at the site by means of:

a. Stand pipes to record elevation and fluctuation of water levels

b. A pumping out test to determine permeability of the saturated soil

c. A falling head permeability test to determine permeability of soil above the water table

Ground-water at the proposed station site occurs under water table conditions. The water table reaches its maximum elevation at the highest topographic point in the center of the island and falls off toward both the east and west shores. A variation of only about 5 ft occurs from either side to the center producing a gradient of approximately 0.6 per cent toward the river.

At twenty observation points in and surrounding the plant area, water levels occurred generally at a depth in excess of 15 ft and ranged from 14 to 19 ft. The ground-water level occurred at a maximum of 6.2 ft above the top of rock with less than 1 ft of head existing above the soil-rock interface at one point of observation.

The water level of the Susquehanna River controls Three Mile Island ground-water levels. A rapid rise in the river in response to a heavy rain and thawing of ice jams during January, 1967 was seen to produce significant rises in the water levels of observation wells 200 feet from the water's edge. Since a positive head exists on the island, any movement of ground-water from the plant site would be toward either channel of the river, and would eventually enter the stream. The river would act as a natural boundary, limiting the dispersal of ground-water from the island to the river. Two factors are important in considering the possibility of infiltration of ground-water into the underlying Gettysburg shale and transmission to on shore water supplies:

a. A maximum positive head of 6 feet exists above the impervious (relativ to the soils) Gettysburg formation.

b. Ground-water levels are higher on either shore of the river, with hydraulic gradients sloping toward the River.

In order for ground-water to move from Three Mile Island to the mainland, it would be necessary to reverse the hydraulic gradient on the mainland, which would necessitate partial dewatering of the Susquehanna River.

Further, it is unlikely that river water would ever significantly infiltrate rocks on either shore, except under sustained high capacity pumping, creating induced infiltration. A natural condition of river water flowing into the ground would not be normal to this climate and geography.

The length of time required for the ground-water to move to the river is problematical. Two types of tests have been run to date, in an attempt to establish permeability of the soils overlying the bedrock. A pumping out test was run on the eastern side of the island and the results determined indicated the permeability of the saturated soil zone to be on the order of 10^{-2} cm/sec. A falling head test was run in the center of the island to determine the permeability of unsaturated soil. This test produced a coefficient of approximately 10^{-3} cm/sec. These results confirmed those permeabilities estimated from examining the continuous samples from the test borings. Some change in slope of the water table will occur due to the variations of the river level and temporary minor reversal of ground-water movement will probably result during periods of high water or during periods of extended drought. Any additional impoundment of water in either channel would necessaril have an effect on the direction of ground-water movement and on the slope of the water table but in any event the final discharge point would still be into the river.

3 AREA WATER WELL DATA

Most of the available data on ground-water wells in the Gettysburg shale, at this time, comes directly from the U. S. Geologic Survey water supply paper on the ground-water resources of Olmsted Air Force Base at Middletown. The base is located approximately two and one-half miles north of Three Mile Island.

The average strike of the formation in this area is N 43 with dips at angles varying from 19 to 38 degrees. The rock consists of alternating layers of fine to coarse-grained sandstone, siltstone, and shale.

Ground-water occurs under artesian conditions at the base. In 20 wells ranging from 300 to 800 feet in depth, specific capacities of the aquifers tapped ranged from 0.33 to 15.0 and transmissibilities varied from 1,200 gpd per ft to somewhat less than 50,000 gpd per ft. The pH of wells tested were from 6.6 to 8.1, hardness from 137 to 826 ppm and dissolved solids from 200 to 1,340 ppm. In Hall's "Ground-water in Southeastern Pennsylvania", the Brunswick shale (the name applied to the eastern counterpart of the Gettysburg) and the Gettysbu shale were combined and included together in tabulations. Of 112 wells surveyed the depths ranged from 18 to 500 feet, with an average depth of 157 feet. Yield ranged from 0-300 gallons per minute with an average yield of 41. Six analyses were included showing the range of total dissolved solids to be between 201 and 786 ppm, hardness from 152 to 499 ppm and iron from 0.5 to 4.9 ppm. Since these are fairly deep rock aquifer wells where water chemistry is a function of mineralogy of the reservoir rocks, one should not expect the alluvial ground-water to be of similar chemical makeup.