50-410

JUL 7 1977

MEMORANDUM FOR: J. C. Stepp, Chief, Geosciences Branch, DSE

THRU: R. Hofmann, Leader, Geology and Seismology Section, Geosciences Branch, DSE

FROM: R. McMullen, Geologist, Geo$ogy and Seismology Section, Geosciences Branch, DSE

SUBJECT: SITE VISIT TO NINE MILE POINT

A meeting was held on 21 June, 1977 at the Nine Mile Point Nuclear Plant to review the progress of Niagra Mohawk's investigations of faulting at the site and the rock mechanics characteristics of the site. A list of attendees is included as enclosure 1. A visit was also made to the adjacent James A. Fitzpatrick site to examine a fault discovered there. A brief description of that fault is attached as enclosure 2.

Description of the faults at Nine Mile Point have been given in previous reports and will not be repeated here (see memo's Stepp from Jackson 0 September 22, 1976, Stepp from McMullen Navember 17, 1976, January 4, 1977, and April 27, 1977. New data is available in test pit 1, the cooling tower excavation, trenches 3 and 4, and Trench 5 had not been completed at the time of the last visit.

A line of 10 borings across the fault near Trench 3 to a depth of 180', and a line of 8 borings near Trench 4 have been completed. It is planned that the stratigraphy-fault relationship will be explored to a depth of 400 feet.

The rock mechanics investigations include:

1. 3 wide spaced borings describing a trinagle and encompassing most of the site;

2. overcoring and undercoring and instrumentation of shallow bedrock to measure insitu stress and monitor changes in stress;

3. laboratory test to determine the characteristics of rocks such as Poissons Rationand modulus of elasticity;

4. monitoring core in the laboratory to determine time-dependent deformation;

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5. instrumentation of rock at Trench 5, which includes monuments to measure vertical motion; inclinometers and extensometers to measure horizontal movement; and laboratory testing of cores to measure stress in 3 horizontal directions and the vertical. Several weeks of measurements indicate 1/10" of closure of the top of the slop cut into bedrock in Trench 5.

Several recent observations have been made in Pit 1 and the Cooling Tower excavation. Although there is dip slip movement in the soil above the fault there is no evidence of dip slip along the fault in bedrock, and, conversely, there is strike slip movement in rock, but no indication of strike slip displacement in the overlying soil. Bedrock is gently arched. This arching is also reflected in the soil.

In the cooling tower excavation the strata on the south side of the fault have been rotated. This rotation has not affected the overlying sediments.

In Trench 3 the arching and rotation of rocks is present but the strata flatten with depth. Offset of bedrock strata is noticable at the surface and to a depth of 170 feet, but amount of offset decreases with depth. Within the fault gouge there is evidence of concentric folding and the breccia appears to have been gently rotated.

In Trench 4, the rock strata is rotated slightly on the south side of the fault, and there is separation between bedding. There is no indication of concentric folding in the gouge as in Trench 3. There is evidence for strike slip, normal and reverse displacement on the fault.

Bedrock in Trench 5 is gently arched, and this arching is also present in the overlying till and lakebed deposits. In the other trenches the fault is essentially vertical, however, in Trench 5 it is at an angle of about 60° and shows predominantly normal offset. There is also horizontal translation of rock strata toward the fault, as described in a previous trip report of Trenches 3 and 4. (April 27, 1977).

The minerals collected from the fault have been subjected to laboratory tests to determine an upper limit to the age of last movement along the fault. According to Dames and Moore investigators, three generations of mineralization have been detected. The older set has been affected by strike slip displacement on the fault. A younger set has grown on these and has not been affected by the strike slip movement. These crystals have been dated by the uranium thorium technique as being at least 300,000

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years. The third generation of mineralization occurred along bedding plan€s. Other dating techniques that are being employed in addition to uranium thorium to determine the ages 6f minerals in the fault zone are: fluid inclusions, trace elements, isotopic dating of lead, and fission tract.

The fluid inclusion analyses is being performed by Dr. Barnes of the University of Pittsburg. Preliminary results indicate minimum temperatures of formation of primary inclusions were from 130°C to 160°C with some as high as 180°C; and the temperatures of formation of secondary inclusions were a minimum of 100°C. Tbbse temperatures indicate that the origin of crystals was hydrothermal. The last known hydrothermal event occurred millions of years ago.

The age of the soil over bedrock has been fairly well bracketed by carbon 14 and pollen dating, and by relating to the known Quaternary and Holocene geologic events that have occurred in the region. The base of the lakebeds has been determined to be 12,600 years old and the top of the peat to be 7780. Average age of the peat layer, which is the uppermost soil is 10,500 years.

Considerable data is being gathered from the rock mechanics investigations. These data are being analyzed and it is too early to form any conclusion at this time regarding the in-situ stress of rock at the site. Over Core Boring OC-3 is located near Trench laat the northwest side of the site. Boring OC-1 is one mile south of the plant. Boring OC-2 is located 600 feet southeast of Trench 5. Preliminary results based on isotropic solutions indicate a N 50° to 60°E direction of principal compressive stress with magnitudes of up to 1800 to 2000 psi. Corrections for anistrophy have not been made yet. Also being measured are in-situ stresses in the cooling water intake shaft, the cooling tower area, the rock around the reactor excavation, and Trench 5. In-situ stresses during and after excavation of the cooling water tunnel will be made. Thus far from laboratory testing the time-dependent behavior of monitored core from the site bedrock falls between that shown by Hobbs (1970) for siltstone, and that found by Savage (1976) for sandstone. To determine rock moduli, uniaxial and biaxial compression tests are being performed.

We examined another recently discovered fault exposed in a drainage ditch on the boundary between Niggra Mohawk and PASNY property. The fault is similar to that exposed in the cooling tower excavation and trenches 3 through 5. It $s a high angle reverse fault, steeply dipping to the north. The gouge contains concentric folding as in Trench 3, and kinking and bedding rotation are observable in the rock adjacent to the fault.

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The utility appears is doing a very thorough and competent job of identifying and defining the rock mechanics appects and potential for faulting at the site. A final report on the work, including a report by the geological review panel is expected by the end of this year. We will continue to follow the investigations closely.

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The ability [illegible] a very [illegible] identifying and defining the local [illegible] species and potential habitat at the site. A final report on the work, including [illegible] by the [illegible] review panel is expected by the end of this year. [illegible] will continue to follow the investigation closely.

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