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SHIELDS L. DALTROFF
VICE PRESIDENT
ELECTRIC PRODUCTION

November 30, 1982

Docket Nos. 50-277
50-278

Mr. John F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Stolz:

This letter is in confirmation of telephone conversations between W. M. Alden of my staff and the Peach Bottom Project Manager, M. B. Fairtile, concerning Peach Bottom site geology.

In 1978, during investigations in support of the Fulton project, a previously unreported fault was located in the vicinity of our Peach Bottom site. The analyses performed at that time indicated the fault was of no consequence due to its age. Information regarding this matter was conveyed to the Peach Bottom Project Manager, via telephone, at that time.

In the interest of providing information with regard to this matter for the Peach Bottom dockets, we are attaching the following, which addresses this subject:

1. Letter: E. E. Fricks (Stone & Webster) to G. A. Hunger, Jr., (PECo.) dated January 8, 1979, re: Geological Features Near the Peach Bottom Site Fulton Early Site Review.

A001

2. Letter: E. E. Fricks (Stone & Webster) to G. A. Hunger, Jr., PECo.) dated October 2, 1978, re: Geological Report Fulton Early Site Review.

3. Fulton Site Suitability, Section 2.5.1.2.3, pages 2.5-13 through 15, titled "Supplemental Investigation in the Site Vicinity".

If there are any further questions, please contact us.

Sincerely,

Attachments

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Mr. George A. Hunger, Jr.
Project Engineer
Philadelphia Electric Company
2301 Market Street
Philadelphia, PA 19101

J.O. No. 13150
January 8, 1979
FESR-38

Dear Mr. Hunger:

GEOLOGICAL FEATURES NEAR
THE PEACH BOTTOM SITE
FULTON EARLY SITE REVIEW

In response to your December 13, 1978, telephone request for additional geologic information on the shear zone and the diabase dike at or near the Peach Bottom Nuclear Power Plant exclusion area, we are enclosing a brief discussion on these features.

The shear zone and the diabase dike were mapped by Stone & Webster (S&W) in 1978, during our supplemental studies for the preparation of the Fulton ESSR report, and have been addressed in our Letter No. FESR-21 dated October 2, 1978, as well as in the Fulton ESSR. The descriptions and interpretation of these features are based on field-derived documentation from the time of initial observations, including photographs; subsequent revisits to the site, involving four S&W geologists familiar with conditions in the area; and an extensive search for relevant details in published papers and previous safety analysis reports for the Peach Bottom and Fulton sites.

Our review of pertinent geologic data of the Peach Bottom-Fulton area revealed that the phenomena of tectonic shearing and subsequent diabase intrusions into the Glenarm Series, identical to the features observed at the Peach Bottom site, have been described for the region without specific reference to the Peach Bottom location, except for Stose & Jonas' 1939 geological map of York County, Pennsylvania which shows the diabase dike. All investigators concur that the shearing and diabase intrusions are Paleozoic and Triassic, respectively, thus qualifying them as ancient events. Therefore, the shear zone in the site vicinity is associated with these disturbances and considered incapable and without significance to the safety of either nuclear project.

Very truly yours,

E. E. Fricks

E. E. Fricks
Study Manager

Enclosures

JLW:BAS

ENCLOSURE

Discussion on Recently Detected Geologic Features at the Peach Bottom Nuclear Station Site

INTRODUCTION

A shear zone and a diabase dike were observed by Stone & Webster (S&W) geologists in the course of a supplemental field survey carried out in 1978 for the Fulton ESSR report. Based on the requirements of 10CFR100, Appendix A, the interpretation of these features is approached from the most conservative aspect.

DESCRIPTION OF THE SHEAR ZONE

Shearing of metasedimentary rocks of the Glenarm series was mapped in steeply excavated rock slopes at two locations, one directly behind the Peach Bottom Nuclear Plant (Figures 1 and 2) and another in the railroad spur cut about 3,000 ft southwest from the plant. Both areas of observed shearing are shown on the geologic map enclosed as Figure 3. The rocks are Precambrian to lower Paleozoic (older than 375 million years) geosynclinal deposits that were metamorphosed into schists. They were tectonically transported from an originally horizontal to a nearly vertical position by a regional deformation process resulting in folding and faulting associated with the Appalachian orogenesis (older than 220 million years). All planar structural elements comprising foliation (superimposed on bedding), lithologic contacts, axial planes of isoclinal folds, and shearing surfaces, are consistently parallel, with mutual northeasterly strike and very steep southeasterly dip. Strike and dip values of both foliation and shearing surfaces at the two locations were recorded as N 46° to 54°E and 62° to 85°SE, respectively.

Characteristically, each shear is located within a transitional contact zone between two major lithologic sequences of distinctly different geologic competence. Chloritic schists lie to the southeast, whereas more brittle, predominantly quartzitic schists are to the northwest. Within the contact zone itself, which is several hundred feet wide, rocks of the two lithologies alternate.

At the location behind the plant, shears are exposed on the rock excavation wall in a section about 100 feet long. The shears are confined to several narrow strips, tens of feet apart and up to about two feet wide, occupying space between adjacent foliation planes. Two of these shears are especially prominent because of their greater width and more revealing signs of displacement that occurred along foliation. The widest strip encloses a somewhat pegmatitic quartz vein that is bent into a monoclinal flexure and brecciated, containing small amounts of scattered schist fragments.

Geometry of the flexure indicates a thrust movement upward along the foliation surface. Alternating laminae of quartzite and chloritic schist overlying the shear are crenulated.

Another shear behind the plant is represented by deeply weathered and decomposed rock with a substantial amount of quartz among its constituents. The other shears which are narrow and less conspicuous, also exhibit some disintegration of quartzose schist and deep weathering penetration. At one point within the shear zone behind the plant, a groundwater flow was noted, possibly a manifestation of weakened rock mass along old shear planes.

In the railroad spur exposure only one 2-foot wide strip containing shearing was observed. It is marked by some decomposition and weathering of rock containing quartz and a flexure.

ANALYSIS OF THE SHEAR ZONE

A. Shearing is generally indicated by these characteristics:

1. Decomposition and concomitant weathering of normally competent rock types, confined between closely spaced planes in a medium of relatively fresh and firmly interlocking rock mass.

2. Flexures within narrow strips, which are distinguishable from other folds in the surrounding rock.

3. Brecciated quartz vein in rock where quartz veins are common, but generally not brecciated.

4. Crenulation of rock immediately adjoining a shear plane.

B. Characteristics and observations which indicate a relative age of movement prior to Triassic age are as follows:

1. No topographic indication of surface rupture has been noted.

2. The shear zone is crosscut by an apparently continuous diabase dike of Triassic age.

3. No fresh gouge, clear shear surfaces, slickensides, or other manifestations of brittle deformation occurring near ground surface have been noted in the shear zone.

4. The presence of open joints in the site vicinity indicates no residual compressive stress exists (Figure 4).

C. Based on the geological history of the region, discussed in the Fulton PSAR and ESSR, and other literature, the age of shearing appears to belong to the second major stage of the Paleozoic deformation, D_2, for the following reasons:

1. Shearing of previously foliated rock and quartz veins postdates recrystallization and quartz vein emplacements which occurred in the first and oldest stage of deformation, D_1 (Freedman et al, 1964).

2. Shearing affected the southern limb of the Tucquan anticline formed in the second stage of deformation, D_2, which is characterized by regional refolding of the preexisting isoclinal structures through mechanism of shear folding along second cleavage, S_2 (Freedman et al, 1964).

3. Shearing along a contact between rocks of different competence may represent a single shear event preferred over a multitude of microshears of equivalent cumulative movement which created shear folds elsewhere within more homogeneous rock during D_2.

4. Shear zones coinciding with S_2 may also be interpreted as a result of D_2 because S_2 is consistently parallel in the region and superimposed on S_1 in the area, whereas younger S planes have various attitudes and generally transect foliation (Freedman et al, 1964).

5. Flexures in the shear zone indicate nearly vertical tectonic transport toward the northwest along the steeply-dipping S_2 planes, while subsequently formed S planes are indicative of tectonic transport directed toward the south (D_3), or laterally at right angles with regional strike (D_4), as described by Freedman et al, (1964).

6. Crenulation that was not developed into slip cleavage also is attributed to the D_2 stage, due to relatively viscous behavior of the rock contiguous to a shearing plane, since deformations following D_2 were substantially more brittle.

D. Relationships of the shear zone to geophysical data and postulated regional structures are defined as follows:

1. The shear zone is located on the southwestern trend of the positive linear ground magnetic anomaly determined on the east bank of the Susquehanna River during the Fulton PSAR investigation.

2. The shear zone is located on the NE-SW trending trace of the positive linear aeromagnetic anomaly extending in both directions from the Peach Bottom site.

3. The closest postulated regional faults to the Peach Bottom site are the Peach Bottom fault in Pennsylvania (Agron, 1950) and a queried fault inferred in Maryland by Southwick (1969), who connected these two faults. No evidence has been demonstrated to substantiate either fault, and both are discussed in detail in the Fulton PSAR. The Peach Bottom fault extends parallel to the shear zone at a distance of approximately 4,000 ft to the southeast. Each of the two postulated regional faults was interpreted to be of Paleozoic age.

4. In the broader area surrounding the shear zone, many similar features in the Glenarm Series have been described in the literature as well as in the Fulton PSAR and ESSR, as associated with various stages of Paleozoic deformation.

5. Numerous diabase dikes are present in the Glenarm Series, and some of them were followed for many miles, but none was ever proved to be offset.

DIABASE DIKES AT THE PEACH BOTTOM SITE AREA

Two Triassic diabase dikes were mapped in the area during 1978, both having an approximate thickness of 15 feet. One of these dikes outcrops at two locations in the vicinity of the Peach Bottom nuclear plant site (Figures 5 and 6), and has been known for some time (Stose and Jonas, 1939 - Figure 7). The other dike is located in a single exposure about 21,000 ft southwest of the plant. The two dikes are aligned and may be connected, either on the ground surface in the area lacking outcrops, or in the subsurface.

The dike from the plant vicinity appears to be continuous across the southwest trend of the shear zone since its real position is adequately reconstructed by tracing float locations and connecting them with the two large outcrops that were observed.

CONCLUSIONS

Based on the previous discussion and analysis, particularly the facts indicating association of shearing with an earlier stage of the Paleozoic folding at considerable depth and tectonic stabilization by Triassic time marked by diabase dike emplacement, the shear zone at the Peach Bottom site is considered as a common occurrence for the region, and determined to be noncapable as defined by 10CFR100, Appendix A.

REFERENCES

Agron, S. A. Structure and Petrology of the Peach Bottom Slate, Pennsylvania and Maryland, and Its Environment. Geological Society of America Bulletin. Vol 61, 1950, p 1265-1306.

Final Safety Analysis Report, Peach Bottom Atomic Power Station - Units 2 and 3. Philadelphia Electric Company, Pa, 1971.

Preliminary Safety Analysis Report. Fulton Generating Station - Units 1 and 2. Philadelphia Electric Company, Pa, 1974.

Freedman, J.; Wise, D. U.; and Bentley, R. D. Pattern of Folded Folds in the Appalachian Piedmont Along Susquehanna River: Geological Investigations of the Pennsylvania Piedmont. 1964, p 621-638.

Southwick, D. L. Crystalline Rocks of Harford County. The Geology of Harford County, Maryland. 1969, p 1-76.

Early Site Suitability Review, Safety Report, Fulton Generating Station Philadelphia Electric Company, Pa, 1978.

Stose, G. W. and Jonas, A. I. Geology and Mineral Resources of York County, Pennsylvania. 1939, p 199.

Figure 1 - Shear zone behind the Peach Bottom Plant, with brecciated and flexured quartz vein.

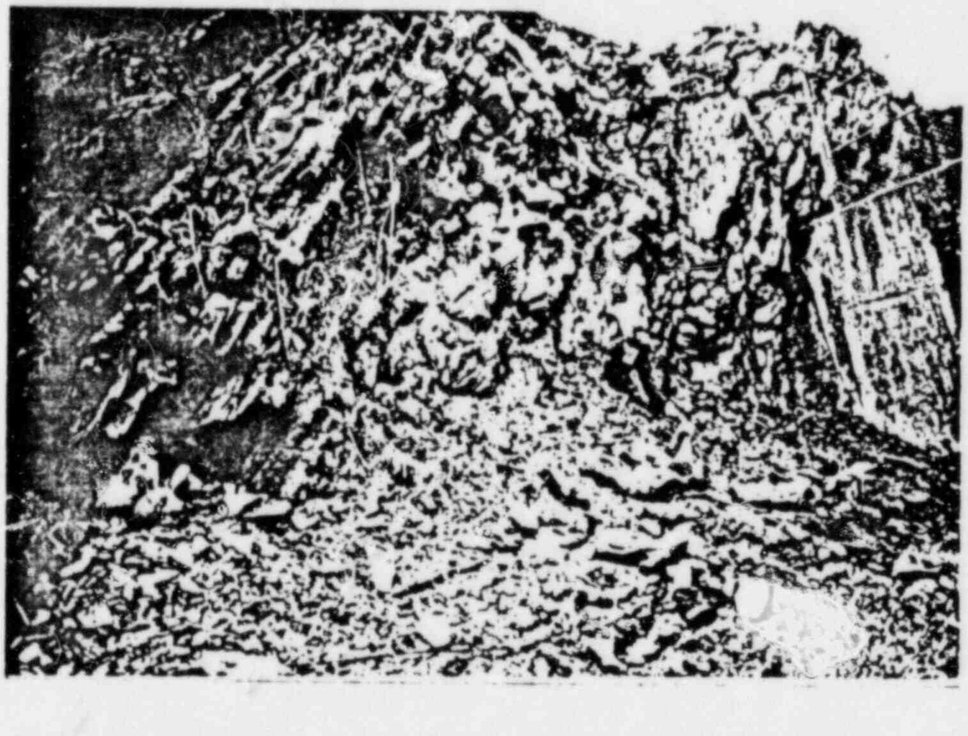

Figure 2 - Shear zone behind the Peach Bottom Plant, with decomposed and weathered rock.

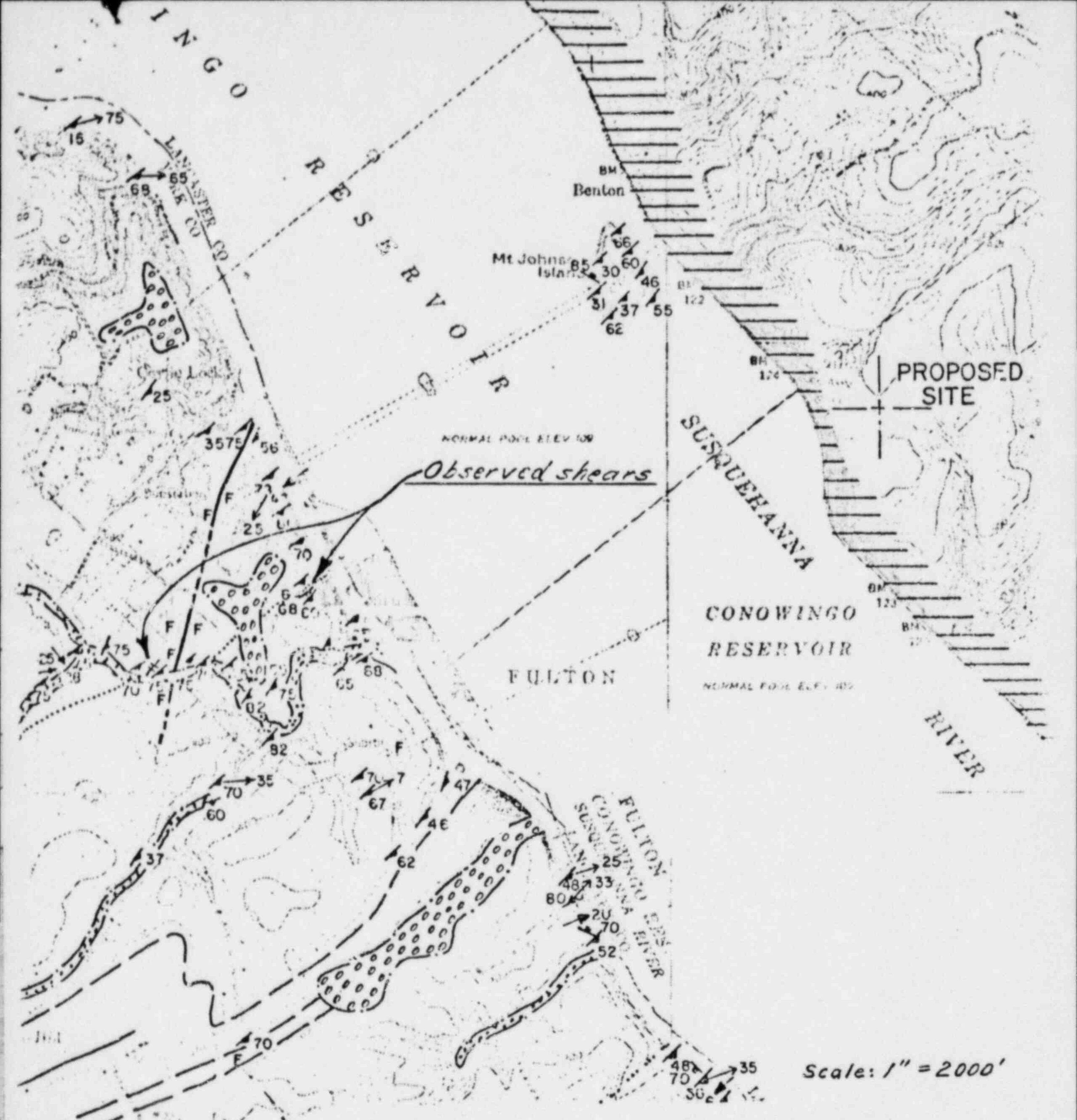

FIGURE 3
SUPPLEMENTAL STRUCTURAL AND SURFACE GEOLOGY WITHIN THE 5-MILE RADIUS
PHILADELPHIA ELECTRIC COMPANY
FULTON GENERATING STATION
EARLY SITE SAFETY REPORT

Figure 4 -- An open joint on the Mount Johnson Island, directly across the Susquehanna River from the Peach Bottom Plant.

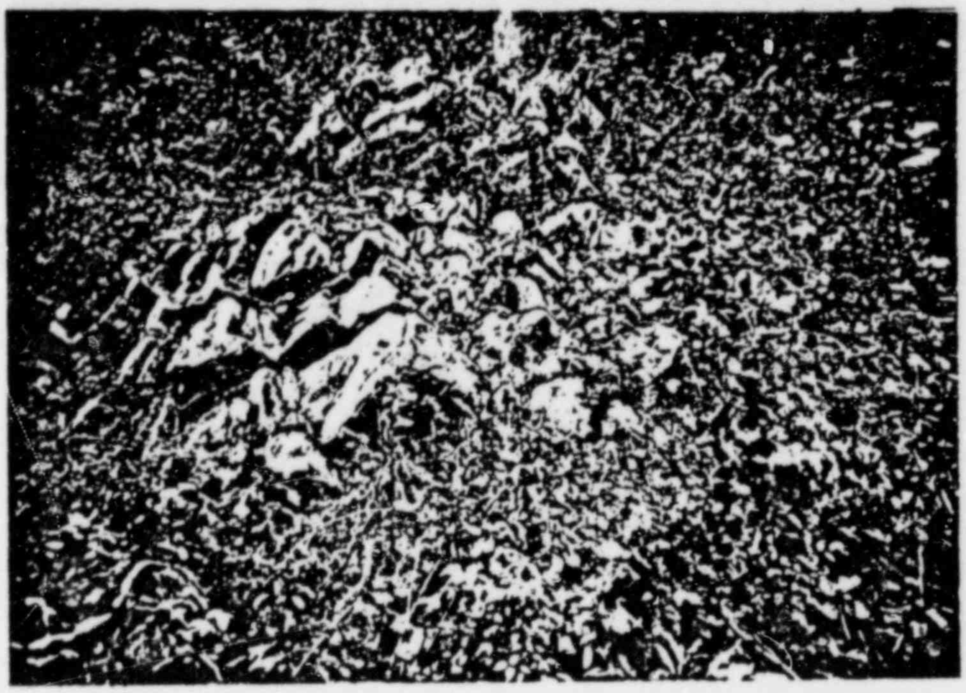

Figure 5 - Diabase dike exposed approximately 2,500 ft to the northwest from the Peach Bottom Plant, on the slope above the Susquehanna River.

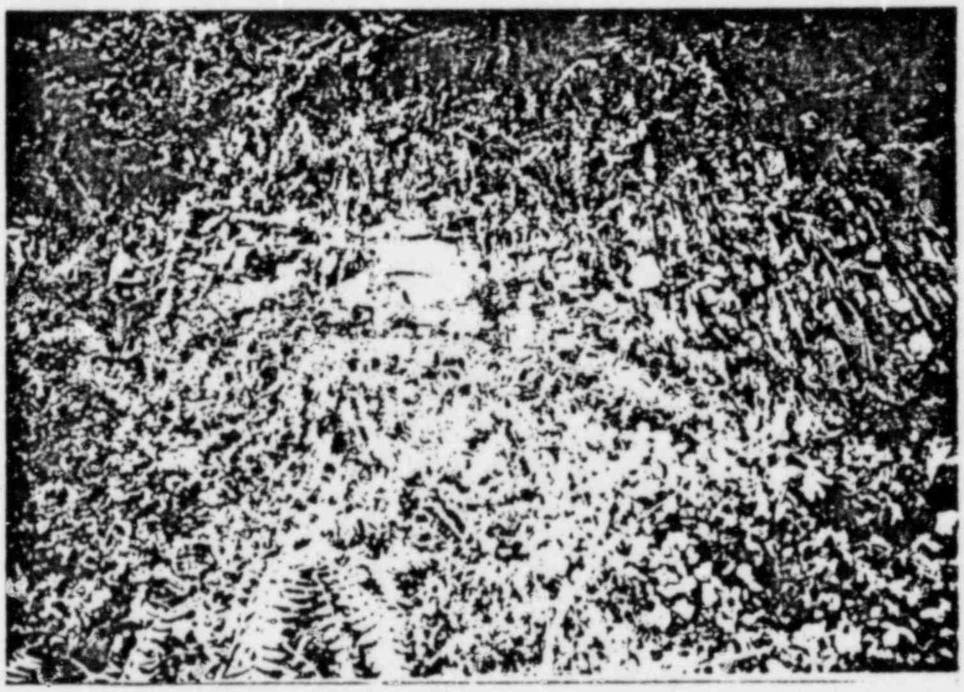

Figure 6 - Diabase dike exposed approximately 2,500 ft to the southwest from the Peach Bottom Plant, in the railroad spur cut.

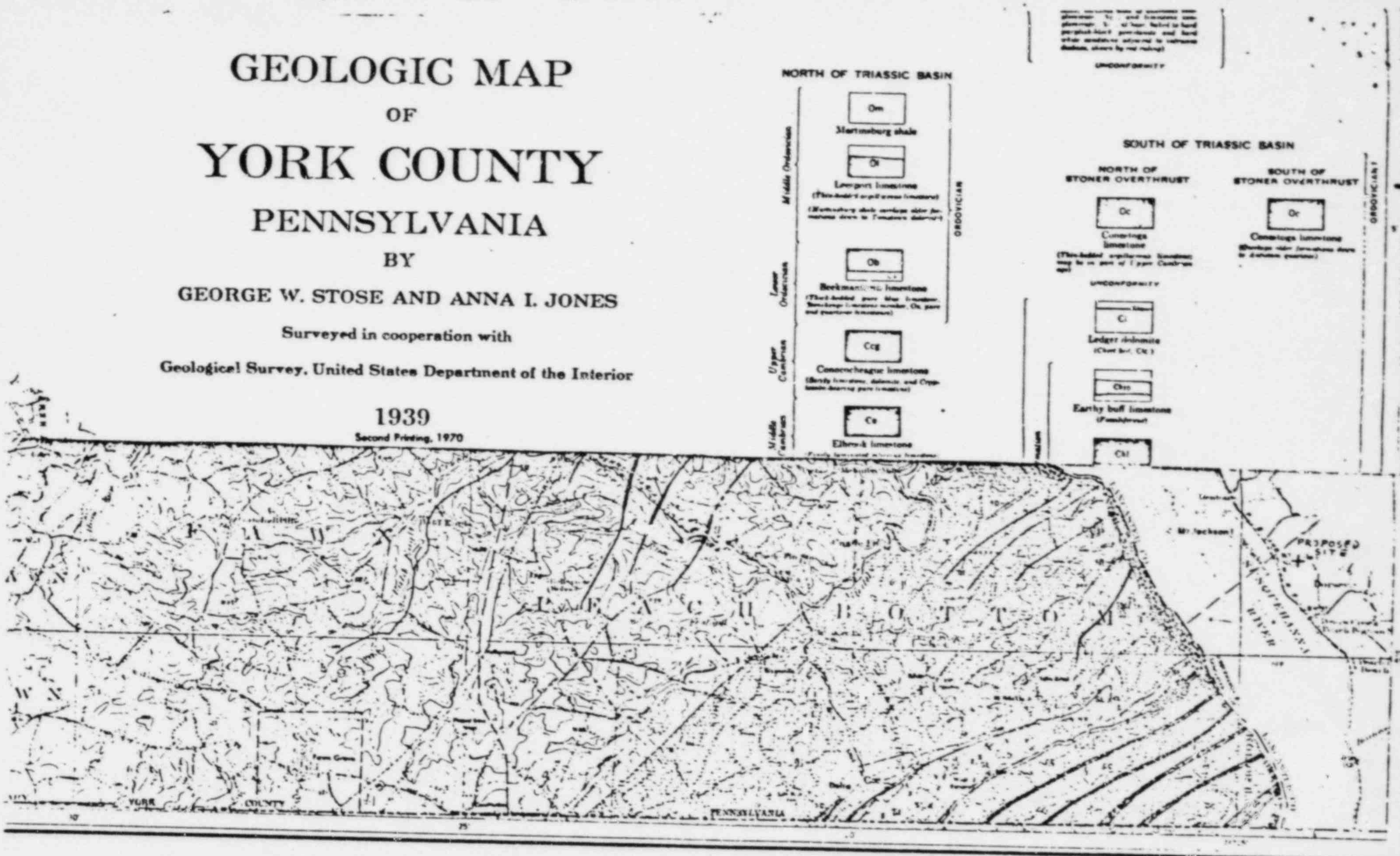
GEOLOGIC MAP
OF
YORK COUNTY
PENNSYLVANIA
BY
GEORGE W. STOSE AND ANNA I. JONES
Surveyed in cooperation with
Geological Survey, United States Department of the Interior
1939
Second Printing, 1970
NORTH OF TRIASSIC BASIN
Martinsburg shale
Lowport limestone
Beekmantown limestone
Conococheague limestone
Elbrook limestone
Middle Ordovician
Lower Ordovician
Upper Cambrian
Middle Cambrian
ORDOVICIAN
SOUTH OF TRIASSIC BASIN
NORTH OF STONER OVERTHRUST
SOUTH OF STONER OVERTHRUST
Conestoga limestone
UNCONFORMITY
Ledger dolomite
Earthy buff limestone
PEACH BOTTOM
PROPOSED SITE
SUSQUEHANNA RIVER
YORK COUNTY
PENNSYLVANIA

Figure 7

STONE & WEBSTER ENGINEERING CORPORATION
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Mr. George A. Hunger, Jr.
Project Engineer
Philadelphia Electric Company
2301 Market Street
Philadelphia, PA 19101

J.O. No. 13150
October 2, 1978
FESR-21

Dear Mr. Hunger:

GEOLOGICAL REPORT
FULTON EARLY SITE REVIEW

In the course of the supplemental geological mapping within the 5 mile radius area surrounding the Fulton site, our geologists recently examined the accessible portion of the rock excavation slope directly behind the Peach Bottom nuclear power plant. This examination revealed an old shear zone within the rock slope, as previously indicated to you during our meeting on September 14, 1978. Since the nature of this shear zone implies rock displacement during past geologic time, we wish to identify some essential details regarding our findings and present our conclusions.

The shear zone essentially parallels the foliation and major cleavage and generally coincides with a lithologic boundary between two members of the same formation. The rocks south of the shear zone consist predominantly of ductile chloritic schist while those to the north are predominantly brittle quartzitic schist. Several shears display some advanced weathering, and one area exhibits a small spring near the toe of the slope. A brecciated and distorted quartz vein within the zone contains cemented fragments of quartz and schist. No slickensides or gouge were observed in the shear zone.

The position of the shear planes along cleavage and foliation at the contact of the chloritic and quartzitic schist and the healed nature of the brecciation indicate that the shear mechanism was associated with the folding that probably occurred, at the latest, during the Allegheny orogeny (approximately 240 million years ago). Furthermore, a diabase dike, which was traced on the surface for nearly a mile along outcrops and float locations, transects the strike of the shear zone one-half mile southwest of the Peach Bottom plant without offset and thus provides evidence that the shearing predates the Triassic diabase intrusion and is not safety related.

The observed shears are similar to features studied and identified in the Safety Analysis Reports for the Peach Bottom and Fulton sites.

Based on these observations and relationships, we have concluded that the shear zone is not capable as defined by Appendix A of 10CFR Part 100.

Very truly yours,

E. E. Fricks

E. E. Fricks
Study Manager

EEF:BAS

2.5.1.2.1 Summary of Site Physiography

The physiography of the site and site vicinity is discussed in Appendix B.9, Attachments B and J, pages B.9-B-1 through B.9-B-15, and pages B.9-J-1 and B.9-J-2, respectively. The discussion of site geology is given in the Safety Evaluation Report under Section 2.5.1.2, pages 2-28 through 2-31.

The site is a topographic high of approximate El +400 ft (msl) which is situated just east of Conowingo Pond on the old Piedmont Upland surface. The site slopes gently downward on all sides except westward where it dips steeply into the Susquehanna River Valley to an elevation of about 120 ft (msl). The Piedmont Upland in the site area is a gently rolling plateau with incised valley drainages. The site is drained predominantly by Peters Creek and its tributaries which flow into the Susquehanna River.

2.5.1.2.2 Site Structure and Geologic Features

Discussions of structure and faulting related to the site are found in PSAR Appendix B.1, pages B.1-13 through B.1-21; in PSAR Appendix B.9, pages B.9-2-I-12 through B.9-2-I-18, B.9-2-III-25 through B.9-2-III-27, B.9-2-IV-7 through B.9-2-IV-26; and Attachment L, pages B.9-L-1 through B.9-L-6.

The dominant structure in the site area is the Peach Bottom fold which has as its core the Peach Bottom slate. This fold is located on the southeastern limb of the larger Drumore fold which formed during the Paleozoic Era as discussed in PSAR Appendix B.9.

Structures in and near the site formed primarily in response to three phases of ductile Paleozoic deformation. Planar and linear elements in the form of schistosities, lineations, fold axes, and folds resulting from each phase of deformation are identified in the near-site area. The general orientation of the foliation is N45°E dipping 70°SE.

Some faults and shear zones were identified in and near the site. The Peach Bottom fault located 1,000 ft north of the site was investigated and it was determined that the last movement along the fault occurred in Late Paleozoic. Shear zones found in the southern part of the site are similar in age, orientation, and attitude to the Peach Bottom fault.

2.5.1.2.3 Supplemental Investigations in the Site Vicinity

The surface geology of the site vicinity was studied in 1971 through 1975 as part of the investigation for the Fulton Generating Station PSAR Section 2.5 with Appendixes B.1

through B.9, and was graphically illustrated on a combined geologic-structural geology map at a scale 1:24,000 in PSAR Appendix B.9 (Fig. B.9-2-II-1). This map represents essentially all lithologic varieties and deformational forms present within the 5-mi radius. Since this previously submitted map does not include the surface geology of the entire 5-mi radius area, subsequent geological mapping was performed in the summer of 1978, and a supplemental geologic-structural geology map at a scale 1:24,000 is presented as Fig. 2.5-2. Due to limited accessibility, surface geology as shown on ESSR Fig. 2.5-2 is inferred for a considerable portion of the 1978 mapped area.

This additional geologic study of the site vicinity is presented with some minor differences in nomenclature and subdivisions of the units representative of the broader regional classification presently in use.[25] The study verifies the extension of all major lithologies and structural characteristics that were determined in the previously mapped area, and confirms earlier conclusions essential to safety-related matters.

As shown on ESSR Fig. 2.5-2, the metasedimentary Glenarm Series (Supergroup) is divided into seven lithologic units trending NE-SW; phyllite in the core of the Peach Bottom syncline; metaconglomerate, chloritic schist, and quartzitic schist on both limbs of the syncline; feldspathized schist in the southernmost portion of the mapped Glenarm Series adjacent to the serpentinite bodies and surrounding them; and albite gneiss and leptynolite, grading into each other in the northern portion of the area, near the crest of the Tucquan Arch. Two of these units, the chloritic schist and the quartzitic schist, which were mapped west of the Conowingo Reservoir, correlate with laterally merging lenses and alternate beds of several phyllite-quartzite varieties which were subdivided in the previously mapped area east of the Conowingo Reservoir. The other five units pass directly into five corresponding previously differentiated lithologies.

Among the igneous intrusives, only serpentinite and diabase dikes are mappable, although gabbroic and granodioritic rocks as well as pegmatite were identified as small, isolated, and not clearly defined bodies within the feldspathized schist. Serpentinite is exposed as a large intrusive on the southern margin of the area, extending from the previously mapped area in a WSW-ENE direction across the Conowingo Reservoir and inland, and also as a series of elongated and mostly concordant intrusives confined to the feldspathized schist in the southeastern portion of the 5-mi radius area and branching out from the main intrusive. Two subvertical diabase dikes were detected in the southwestern part trending NNE-SSW within the metasedimentary rocks.

Structural forms of the Glenarm Series, together with serpentinite, exhibit three major generations of deformation as described in detail in Appendix B.9. Major planar and linear structural elements, seen on outcrops, are shown on the enclosed geologic map, Fig. 2.5-2. They represent small-scale folds and faults, formed during successive stages of the Paleozoic tectonic disturbances synchronously with large-scale structures. The Peach Bottom syncline and the southern limb of the Tucquan Arch were identified as major folds in the mapped area. No large displacements were observed during field mapping, including the postulated Peach Bottom fault. In the course of the field mapping in 1978, a shear zone was noted near the Peach Bottom nuclear power plant. The shear zone, along with other deformations in the Glenarm Series, is healed and ancient, and thus considered to be of Paleozoic age. This is further substantiated by a Triassic diabase dike,[26] which was traced on the surface for nearly a mile along outcrops and float locations and observed to transect the strike of the shear zone without being offset. Consequently, the supplemental geological mapping of the five-mi radius area revealed no indications of any capable faults as defined by Appendix A, 10CFR100.

2.5.1.2.4 Engineering Evaluation of Site Geologic Features

Boring logs for the site are presented in PSAR Appendix B.4. Discussions of foundation conditions and lithologies at the site are presented in the PSAR under Section 2.5.1.3, pages 2.5-1 through 2.5-3; in Appendix B.1, pages B.1-13 through B.1-18; Appendix B.5, pages 4 through 9; and Appendix B.9, pages B.9-2-IV-4 through B.9-2-IV-21. PSAR Appendix B.7 presents the laboratory test results on intact rock. A discussion of the exploratory trenching of deep-weathered zones and to what extent these areas were investigated is presented in response to Question 2.5.1.3-1 (AEC letter dated February 25, 1974). A discussion of engineering properties of the subsurface materials is presented in ESSR Section 2.5.4.2. A detailed joint survey was performed in order to evaluate the stability of the rock slope west of the site. The results of this survey are presented in PSAR Appendix B-8 and discussed in ESSR Section 2.5.5.