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March 26, 1982

Mr. Paul O'Connor, Project Manager
Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden 2
SEP Topic: II-4.D, Stability of Slopes and
II-4.F, Settlement of Foundations
and Buried Equipment

Reference: Telecopy from G. Cwalina (NRC) to S. Powers
(SNED) dated 1-19-82.

NRC Docket 50-237

Dear Mr. O'Connor:

Mr. Tom Cheng requested additional information on the above referenced SEP topics. The following responses were addressed to questions in the above referenced telecopy to enable the staff to complete their review of Stability of Slopes and Settlement of Foundations and Buried Equipment.

TOPIC II-4.D - STABILITY OF SLOPES

Question 1: A site plot plan showing the location of safety related structures and undergound piping and ductwork. The plan should include contours of the site, preferably at 5 feet intervals.

Response: The terrain at the site of the Dresden Station is relatively level and varies from elevation 513 to 518 feet (USGS datum). Adjacent to the river bank the terrain

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slopes to the normal pool elevation of 505 feet. In the area where the plant structures, buried piping and ductwork are located, the natural terrain varies from elevation 517 to 518 feet. Final plant grade elevation has been established at 517 feet.

The following Dresden 2 drawings are attached showing structures, underground pipelines, and ductwork.

M-193, (Rev. K, dated 11/14/66) Outdoor Piping, Sheet 1
M-194, (Rev. P, dated 8/23/76) Outdoor Piping, Sheet 2
M-195, (Rev. U, dated 5/4/73) Outdoor Piping, Sheet 3
M-196, (Rev. T, dated 4/3/74) Outdoor Piping, Sheet 4
M-197, (Rev. N. dated 2/5/73) Outdoor Piping, Sheet 5
M-198, (Rev. J, dated 4/3/74) Outdoor Piping, Sheet 6
M-199, (Rev. L, dated 2/5/73) Outdoor Piping, Sheet 7
M-207, (Rev. E, dated 3/21/79) Outdoor Piping, Sheet 8
M-208, (Rev. E, dated 2/5/73) Outdoor Piping, Sheet 9
M-209, (Rev. B, dated 10/30/81) Outdoor Piping, Sheet 10
B-83, (Rev. D, dated 12/9/67) Discharge & Ice Melting System Plans
B-39, (Rev. E, dated 8/24/67) Crib House & Forebay Excavation Sections & Details
B-40, (Rev. D, dated 12/9/67) Crib-House & Forebay Excabation Sections
B-41, (Rev. G, dated 1/10/74) Crib House, Plan El. 517'-6" West Area

B-42, (Rev. R, dated 1/10/74) Crib House, Plan El. 517'-6" East Area

B-47, (Rev. F, dated 9/18/70) Crib House, Section C-C

B-66, (Rev. P, dated 7/6/78) Radwaste Building Foundation Plan El. 507'-0" East Area

B-74, (Rev. T, dated 3/23/77) Radwaste Building Foundation Section G-G

B-86, (Rev. P, dated 12/26/72) Turbine Building Foundation Plan El. 512'-0" N.W. Area

B-87, (Rev. E, dated 11/23/66) Turbine Building Foundation Plan El. 512'-0" S.W. Area

B-88, (Rev. N, dated 12/26/72) Turbine Building Foundation Plan El. 512'-0" N.E. Area

B-89, (Rev. E, dated 11/23/66) Turbine Building Foundation Plan El. 512'-0" S.E. Area

B-90, (Rev. G, dated 4/17/67) Turbine Building Foundation Plan El. 512'-0" Control Room Area

B-91, (Rev. E, dated 11/23/66) Turbine Building Foundation Plan El. 481'-0" N.W. Area

B-92, (Rev. E, dated 6/13/66) Trubine Building Foundation Plan El. 481'-0" S.W. Area

B-93, (Rev. D, dated 11/23/66) Turbine Building Foundation Plan El. 481'-0" N.E. Area

B-94, (Rev. F, dated 9/15/66) Turbine Building Foundation Plan El. 481'-0" S.E. Area

B-95, (Rev. P, dated 11/29/72) Turbine Building Foundation Section A-A West Area

B-96, (Rev. L, dated 11/27/78) Turbine Building Foundation Section A-A East Area

B-97, (Rev. J, dated 12/9/69) Turbine Building Foundation Section B-B

B-98, (Rev. F, dated 11/23/66) Turbine Building Foundation Section C-C

B-100, (Rev. H, dated 11/23/66) Turbine Building Foundation Section E-E North Area

B-101, (Rev. G, dated 4/7/67) Turbine Building Foundation Section E-E South Area

B-102, (Rev. K, dated 6/9/67) Turbine Building Foundation Section G-G

B-103, (Rev. E, dated 11/26/72) Turbine Building Foundation Section H-H North Area

B-104, (Rev. G, dated 5/19/67) Turbine Building Foundation Section H-H South Area

B-105, (Rev. H, dated 11/23/66) Turbine Building Foundation Section J-J

B-106, (Rev. F, dated 6/22/67) Turbine Building Foundation Section K-K West Area

B-107, (Rev. M, dated 1/5/73) Turbine Building Foundation Section K-K East Area

B-108, (Rev. E, dated 11/23/66) Turbine Building Foundation Section L-L

B-109, (Rev. M, dated 1/17/67) Turbine Building Foundation Sections and Details

12E-2001, (Rev. 0, dated 9/22/78) Electrical Installation Fire Protection Warehouse & Outdoor Area

12E-2002, (Rev. C, dated 2/25/81) Relocation of UN.1 Duct Run In Unit 2 Area Plan & Sections

12E-2003, (Rev. K, dated 8/18/78) Duct Runs, Outdoor Area North Plan & Section

12E-2005, (Rev. J, dated 9/3/81) Elect. Install. Cathodic Protection, Plan & Sections Part-1

12E-2006, (Rev. F, dated 5/25/79) Elect. Install. Cathodic Protection, Plan & Sections Part-2

12E-2009, (Rev. AJ, dated 4/30/80) General Arrangement Outdoor Area Grounding - Plans & Sections

12E-2010, (Rev. H, dated 4/30/80) Construction Layout Electrical Facilities - Part-2

12E-2011, (Rev. J, dated 8/11/81) Construction Layout Electrical Facilities - Part-2

12E-2011A, (Rev. C, dated 8/11/81) Elect. Install. Grounding Sections and Details, Sewage Treatment Building

12E-5004, (Rev. G, dated 11/26/79) Cooling Lake

12E-5005, (Rev. H, dated 11/26/79) Cooling Lake

12E-5008, (Rev. K, dated 2/20/80) Cooling Lake

12E-5010, (Rev. H, dated 2/20/80) Cooling Lake

12E-6000, (Rev. C, dated 11/5/76) Off-Gas System Electrical Duct Runs - Plan & Sections

12E-6001, (Rev. C, dated 12/11/80) Electrical Concrete Duct Runs, Plan - Sections & Details, Off-Gas Filter Bldg.

12E-6002, (Rev. C, dated 12/11/80) Off-Gas System Electrical Duct Runs, Sections.

Question 2: An evaluation of the potential for liquefaction of the overburden soils under the SSE, particularly with respect to possible blockage of the intake and discharge canals and structures.

Response: The overburden soils which overlay the rock along the intake and discharge canals are entirely above elevation 507 feet. The normal water level in the canals is the Dresden Lock and Dam pool elevation 505 feet and the maximum historic pool elevation was 506.4 feet. Under these water level conditions, the overburden soils adjacent to the canals are not saturated and therefore are not potentially liquefiable.

The maximum depth of overburden soils adjacent to the canals in 6 feet. If it is postulated that the slopes in the overburden may liquefy during flood conditions and simultaneous earthquake when the slopes are submerged, the volume of material that could displace into the canals would not be great enough to cause blockage.

Question 3: A summary of the field and laboratory test results for the overburden soils and rock and, if applicable, test results of any structural fill used in construction.

Response: The overburden soils are sand and gravel grading to weathered sandstone. These materials are overlain by a thin layer of topsoil.

The following are results of tests made on three samples of the overburden materials:

Sample No.	1	2	3
Field dry density (pcf)	98.5	99.3	98.8
Natural moisture content (%)	22.4	20.2	20.4
Field void ratio	0.665	0.642	0.650
Specific gravity	2.61	2.61	2.61
Coefficient of Permeability (ft/day)		1.11 Horizontal	
		0.93 Vertical	

Tests on rock consisted of up-hole velocity tests conducted in the field to measure compressional wave velocity and laboratory tests to measure wave propagative velocity, compressive strength and density.

The following are the results of tests made on the rock materials:

ELEVATION (FT)	ROCK TYPE	COMPRESSIONAL WAVE VELOCITY	DENSITY (pcf)	COMPRESSIVE STRENGTH (psi)
493	Sandstone	4,700	138	3820
483	Sandstone	4,300	135	3010-3500
476	Limestone	13,300	163	7000
462	Limestone	15,300	172	12.730-15,280

ELEVATION (FT)	ROCK TYPE	COMPRESSIONAL VALVE VELOCITY	DENSITY (pcf)	COMPRESSIVE STRENGTH (psi)
440	Agrillaceous Dolomite	9,800	171	9290
438	Limestone	9,400	167	-
437	Dolomitic Shale	8,500	150	5660
424	Agrillaceous	8,500	167	2330
419	Dolomitic Shale	8,500	166	7640

Question 4: A discussion on the structural integrity of the sandstone rock formation and the occurrence or otherwise of joints, fractures, faults, etc. This aspect is important in the light of the applicant's position that "the sandstone rock is sound and of adequate strength to maintain stable vertical cuts" (Ref. 1).

Response: A discussion of the Pottsville sandstone is contained in the Plant Design and Analysis Report (PDAR), Vol. III - Site and Environs, Section 2 - Geology (Ref. 2). The Pottsville sandstone is composed predominantly of cemented sub-angular fine to medium grains of quartz containing varying amounts of mica. The amount of cementation varies in both vertical and horizontal directions and the cementing agent is, at best in part, calcium carbonate. Exposures of the sandstone in the intake and discharge canals for Unit 1 and in the drainage ditch west of the site showed no evidence of faulting, but there were occasional vertical joints.

Minor folding and faulting of the Pennsylvania strata in the general vicinity of the site have been observed. The observed folding is local, laterally affecting perhaps a few yards of strata, and the amount of displacement along faults is small, commonly one to two feet.

Question 5: A brief description of the method or methods used for the Slope Stability Analyses.

Response: The "sliding wedge" method of anaysis as outlined in Figures 7-5 and 7-6 of Design Manual DM-7, Soil Mechanics, Foundations and Earth Structures, NAVFAC, Department of the Navy, March 1971, was used to analyze the slopes.

REFERENCES

1. Preliminary Foundation Investigation for Dresden Generating Station, Pittsburgh Testing Laboratory, San Francisco, California, Order No. SF-2778, August 1965.

2. Plant Design and Analysis Report (PDAR), Dresden Unit 2, Vol. III - Site and Environs, Section 2 - Geology.

TOPIC II-4.F - SETTLEMENT OF FOUNDATIONS AND BURIED EQUIPMENT

Question 1: A listing of the principal structures, their depths below final and original grade, foundation sizes and their spatial relationships to each other, foundation loads.

Response:

Principal Structures	Approximate* Foundation Elevation	Approximate** Foundation Size Direction N-S - E-W	Approximate Average Foundation Load
Reactor Building	472'-480'	120' - 300'	9.3 KSF) See Note 1
Turbine Building	466'-483'	170' - 600'	7.9 KSF) See Note 1
Crib House	475'-480'	80' - 180'	2.7 KSF
Ventilation Stack	500'	28'-6"	9.9 KSF

* Grade Elev. 517'-0"
** Includes Units 2 & 3
Note 1 - Foundations are connected. For relative locations see drawing M-1D

Question 2: A summary of field and laboratory tests performed in the overburden soils, rock and backfill materials.

Response: See response to Question 3 SEP Topic II-4.D.

Question 3: Field explorations conducted at the site, including borings, sampling, field tests and geophysical surveys.

Response: Boring logs at the Dresden Station are contained in the following reports and drawings:

1. Preliminary Foundation Investigation, Dresden Generating Staion (Unit 1), Pittsburgh Testing Laboratory, San Francisco, Order No. SF-2778, August 1955.

2. Additional Core Drilling at Dresden N.P. Station Site, Pittsburgh Testing Laboratory, December 1955.

3. Core Drilling and Probings at Dresden N.P. Station Site, Pittsburg Laboratory, November 1956.
4. Plant Design and Analysis Report (PDAR), Dresden Unit 2, Vol. III - Site and Environs, Section 2 - Geology.
5. Structural Drawings:

   B-1 - Boring Location Plan - Units 2 & 3

   B-2 - Sections - Boring Logs - Unit 2

   B-3 - Sections - Boring Logs - Unit 2

   B-3A - Sections - Boring Logs - Unit 3
   Off Gas Filter Building

   B-501 - Log of Borings - Unit 3

Up-hole velocity surveys were conducted in two of the borings. The results of these tests are contained in the PDAR (Item 4 above).

Question 4: Groundwater levels and design groundwater level.

Response: The preliminary foundation investigation boring conducted June 9 - 16, 1955 showed groundwater levels within 1 to 3 feet of the ground surface. The original calculations have been done using a groundwater level El. 514'0". As part of the Mark I Long-Term Program, the reactor building structure has been reevaluated and found to be adequate for a groundwater level of 517'0".

Question 5: Dewatering before, during and after construction.

Response: Dewatering during construction was done by ditching and sumps in bottom of excavation to collect minor seepage, so grouted walls and dewatering wells were not needed. The structural integrity of the sandstone rock formation is composed predominantly of cemented sub-angular fine to medium grains of quartz containing varying amounts of mica with the cementing agent being calcuim carbonate.

Question 6: A summary of laboratory and field density testing of backfill materials and properties of backfill materials used in design.

Response: Where concrete was not used for backfill, backfill was specified to be a sand material placed in accordance with Articel 6 - S&L Standard Form 1714 for Class 1 - RCFI fill. The following soil properties and static earth pressures were used for the design of rigid and cantilever walls.

Soil Type - Sand

Total = 125 pcf

' = 62.6 pcf

ϕ = 34

Ko = 1-sin ϕ = 0.44

Ka = $\tan^2 (45-\phi/2)$ = 0.28

Lateral pressure on rigid walls (based on earth pressure at rest - Ko):

Above water table	55 psf/ft
Below water level	90 psf/ft (including hydrostatic pressure)

Lateral pressure in cantilever wall (based on active earth pressure - Ka):

Above water table	35 psf/ft
Below water table	80 psf/ft (including hydrostatic pressure)

The work was done and deemed adequate but no record of field density tests of backfill materials are available.

Question 7: Potential for liquefaction of backfill materials that support underground piping and/or ductwork.

Response: S&L Specification K-2181 - Intake and Discharge Canals and Miscellaneous Substructures Work refers to Article 7 of S&L Standard Form 1714 for backfill which specifies clean crushed stone or gravel for bedding under pipes and backfill up to the centerline of the pipe. In addition, Articel 3-03.D of Specification K-2181 specifies concrete fill around circulating water and ice melting pipes.

Neither of these pipe supporting materials, clean crushed stone or gravel and concrete, have a potential for liquefaction.

Please address any questions concerning this matter to this office.

One (1) signed original and thirty-nine (39) copies of this transmittal are provided for your use.

Very truly yours,

Thomas J. Rausch
Nuclear Licensing Administrator

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cc: Region III Inspector - Dresden

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