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Vogtle Project

April 30, 1985

Director of Nuclear Reactor Regulation
Attention: Ms. Elinor G. Adensam, Chief
Licensing Branch #4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

File: X3BC35
Log: GN-593

REF: GN-545 Bailey to Denton, Dated 3/12/85, DSER Open Item 112, Groundwater

NRC DOCKET NUMBERS 50-424 AND 50-425
CONSTRUCTION PERMIT NUMBERS CPPR-108 AND CPPR-109
VOGTLE ELECTRIC GENERATING PLANT - UNITS 1 AND 2
REQUEST FOR SUPPLEMENTAL INFORMATION
DSER OPEN ITEM 112 - GROUNDWATER

Dear Mr. Denton:

Your staff has made requests for additional information and clarifications related to the ground water data submitted by enclosure to the referenced letter as the Ground Water Suplement. Some of the staff's requests have required revisions to the Supplement. The sources of these requests include:

1) Telephone conference, March 29, 1985,
2) Letter from E. Adensam to D. Foster, April 11, 1985, and
3) Telephone conference, April 17, 1985.

Attached for your staff's review are three sets of staff-requested information and three sets of revisions to the Ground Water Supplement.

If your staff requires any additional information, please do not hesitate to contact me.

Sincerely,

J. A. Bailey

J. A. Bailey
Project Licensing Manager

JAB/msp

Enclosure
xc List Attached

Accntg Card Dist
B001 1/4
Document Control Desk
To: Reg File - 1
M. Miller - B
LB#4

xc: D. O. Foster
R. A. Thomas
J. E. Joiner, Esq.
B. W. Churchill, Esq.
M. A. Miller
B. Jones, Esq. (w/o enc.)
L. T. Gucwa
G. Bockhold, Jr.
T. Johnson (w/o Enc.)
D. C. Teper (w/o Enc.)
L. Fowler
Project File

0254A

1. Specifications for drilling observation wells 42A, B, C, and D (Telecon April 17)

These wells were drilled and constructed by Law Engineering Testing Co. under contract to Georgia Power Co. during 1971. Contracts are not kept for more than five years, therefore the specification for drilling and constructing wells 42A, 42B, 42C, and 42D are not available. Copies of Law Engineering Testing Co. Test Boring Field Reports (drillers logs) are available and have been reviewed. These reports, dated May 19-27 and July 22-28, 1971, document the drilling and installation procedures used in constructing wells 42A thru 42D.

The following procedure was used:

- Drill to top of design monitoring interval with 3 7/8-inch or larger tricone bit
- Install and seal 2-inch diameter PVC casing in boring by pumping cement grout down through PVC pipe and up into annulus
- Drill out grout in 2-inch PVC casing and advance boring 10 feet into native material (design monitoring interval)
- Install 1-inch diameter PVC screen and pipe for observation well.

2. Information and/or specifications on drilling procedures relevant to influence of drilling fluid on permeability test holes and observation wells (Letter April 11)

All permeability test holes and most observation wells (except for the LT, ST and 800 series) were drilled more than five years ago. As stated above, the drilling contractor specifications for those wells have been destroyed. The technical specifications for drilling and installation of the observation wells (piezometers) installed since 1976 are included as

Attachment A. Geologic logs, drillers logs, and daily field reports of the test holes and older observation wells have been reviewed. These data show that the holes were drilled as follows:

Permeability Test Holes

1) No data on drilling fluid used at hole 107A.

2) Hole 157 was drilled with bentonite. After drilling, hole was flushed with clean water before permeability testing.

3) Hole 170 was drilled with bentonite to top of marl and cased. After casing, the hole was flushed and then cored using Revert. The Revert was broken down with fast-break before testing.

4) Hole 180 was drilled with bentonite. After drilling, the bentonite was displaced with Revert. The Revert was broken down with fast-break before testing.

5) Holes 183 and 184 were drilled with bentonite to depth to be tested. PVC pipe and screen were installed and the holes flushed with clean water.

6) The "P" series holes were drilled with clean water obtained from the concrete batch plant.

The remaining holes were drilled with bentonite to the top of the Blue Bluff marl where casing was set. The holes were then flushed out and cored with clear water. Permeability tests were conducted after drilling was complete.

Observation wells drilled 1971-1972

Holes completed as observation wells in the confined aquifer were drilled by the following method:

Drill to top of interval to be monitored with bentonite. Install and grout 2-inch PVC casing. After grout has set-up, drill out grout (using clear water) and approximately 10 feet into monitoring zone. Install 1-inch PVC screen and riser pipe. Install gravel pack and seal.

Holes completed as observation wells in the water table aquifer were drilled as follows:

1) Hole drilled to top of marl with bentonite and 2-inch diameter PVC screen and casing installed. Hole flushed with clean water as gravel pack was being installed.

2) Hole drilled through marl (originally drilled as exploratory hole). Hole filled with cement grout to top of marl. PVC screen and casing, 2-inch diameter, installed. Hole flushed with clean water as gravel pack was being installed.

Bail-testing observation wells

Observation wells were monitored by Law Engineering Testing Co. from date of installation (1971-1972) thru April 1973, using the following procedure.

1) measure water level
2) bail well at least 5 times or until dry
3) measure water level recovery

Bailing the wells not only provide a measure of assurance that they respond properly but also serve to develop the wells by removing any drilling fluid that might be present.

Dewatering Test Wells (W-1 and W-2)

These test wells and the eight observation wells were drilled with bentonite. The test wells were cleaned of drilling fluid when developed by pumping. We believe the observation wells were flushed with clean water following installation of casing, although there is no record.

Some bentonite could have remained on the wall of the hole following flushing. However, we do not believe that this partial plugging of the formation (if it occurred) had any detrimental effect on the test results, for the following reasons.

1) As discussed in the Ground Water Supplement, the pumping test at well W-1 was run for 97 hours. The data obtained from this test are considered valid because the test was sufficiently long and the rate of water level drawdown in the observation wells during most of the test was slow enough to be unaffected by residual bentonite in the observation wells. Formation invasion of bentonite does not extend great distances from the bore hole, and the test data represent the permeability of the materials between the test well and the observation well, not just materials adjacent to the bore hole.

2) These tests were to obtain data for design of a dewatering system for the powerblock excavation. Although W-1 suggests high permeability, the tests at W-2 indicate markedly variable, low, permeability. Based on these data, it was concluded that inflow of ground water would be small; the Utley limestone would not be a major source of inflow, and the excavation could be dewatered with ditches and sumps. Actual experience of the excavation demonstrates this to be a correct analysis. The excavation was dewatered and maintained for four years by use of ditches and sumps. Water level data from observation wells outside the excavation show that the effects of dewatering did not extend large distances. This indicates, from the excavation, that although in limited areas permeability of the Utley limestone is high (solution cavities), the effective, or average permeability is low. The cavities are poorly connected and the limestone does not act as a high permeable drain.

3. Omission of initial water level measurements on data sheet of Well 42A in Ground Water Supplement (Telecon April 17)

The omission of the first seven water level measurements made in well 42A on the data sheet in the Ground Water Supplement was an error. It was intended not to include them on the hydrograph as they are not representative of aquifer water levels, but are influenced by water used in construction and development. The data sheet and the hydrograph have been revised and copies are enclosed.

4. The staff requested the Geologic log of well 176 (Telecon March 29)

The hole was drilled to a depth of 80 feet (top of marl) and constructed as an observation well to monitor the water table aquifer. Because the hole was not intended as an exploratory hole there was no geologic log prepared.

5. Reported water levels in drill hole 157 (Telecon April 17)

Quarterly water levels were erroneously measured and reported for drill hole 157 from July 1979 until March 1981. A review of records revealed these levels were taken in the 4-inch surface casing of hole 508, which had been sealed with grout to within 30 feet of ground surface following completion of drilling in 1973. It had apparently been assumed that because of the 4-inch steel casing, it was an observation well, and water levels were measured. To compound the error, it was mistakenly identified as 157, located 15 feet from 508, similarly grouted but without surface casing. The water level data sheet for hole 157 should be removed from the Supplement. Figure 2-1 of the Supplement has been revised to remove 157.

6. Drill hole location map (letter, April 11)

A map showing locations of holes 181, 236, 237, 334, 28, 30, 34, 35A, 36A, 36B, 120, 123, 401, 402, 403, 404, 405, 406, 407, OD-1 and RH-1 was requested.

The requested map is enclosed with the following modifications. Because the list of holes is essentially those holes that penetrate the marl and have no closure record, hole 239 is also shown on the map. Hole 334 is not shown on map because there is a closure record for this hole.

ATTACHMENT A

DRILLING SPECIFICATIONS

C2.18.13 CONSTRUCTION OF PIEZOMETERS

A. GENERAL

1. Piezometers abandoned due to construction activities may require replacement in order to continue the monitoring program. Results of the monitoring program may determine the need for additional piezometers. Locations and depths of additional piezometers, as required, shall be determined by Engineering. Surveying shall be provided by the Owner. Reference Sketches SK-2-C-289 and SK-2-C-291.

B. DRILLING THE HOLE

1. The Contractor may use any method of drilling which, in the opinion of the Owner or his representative, will provide a suitable hole. The drilling machine or machines shall be in good working condition and capable of providing a vertically plumb hole of the required diameter at the maximum drilling depth. Equipment and accessories for drilling, such as casing, drill rods, drill bits, pipe, pumps, meters, gages, tools, power, and other materials or supplies which are, in the opinion of the Owner or his representative, necessary for the work shall be furnished by the Contractor.

2. No piezometer hole shall be abandoned before reaching the specified depth without the prior written approval of the Owner of his representative. Piezometer holes abandoned before reaching the specified depth because of mechanical failure of drilling equipment, negligence on the part of the Contractor or other such preventable causes, and rejected by the Owner or his representative, will not be paid for. Any holes rejected shall be supplemented by another hole adjacent to the first. In the event the supplementary hole is lost, it in turn shall be supplemented by another. Regardless of the reason for abandoning a hole, no payment will be made for a move and setup in order to drill a new hole from the same location. The Contractor shall abandon holes in accordance with Paragraph C2.18.16.

3. For piezometers extending beneath the marl, drilling shall be performed in two stages. The first stage will be for the purpose of installing a permanent casing in the marl confining layer and shall be terminated 10 feet below the top of the marl, or as directed by the Owner. After the casing has been set and cemented in place, the Contractor shall proceed with the second and final stage of drilling which will extend to the design depth of the piezometer. For piezometers which terminate above the marl a one stage drilling operation using a temporary casing shall be implemented.

4. Water used for drilling shall be clean and free of contaminants. (Clean water from site supply is available.) Contractor shall furnish a water truck, portable tanks, or other equipment necessary to transport water from its source to the rig. Where a drilling fluid viscosifier is required, a biodegradable product, such as Johnson's "Revert" or Baroid's "E-Z Mud" shall be used. Manufacturer's instructions shall be followed in the mixing and breakdown of the additive.

C. PERMANENT CASING (For Use with Piezometers Extending Beneath the Marl)

1. Unless otherwise directed by the Owner or his representative a permanent casing shall be set and cemented in place to a minimum depth of 10 feet into the marl confining layer. The cementing of the casing shall be in accordance with the following steps:

   a. Centering guides shall be attached to the outside of the casing to insure uniformity of annular space between the casing and hole wall. Spacing between each set of centering guides shall be approximately 20 feet for the entire length of the casing. Design and attachment of the guides will be subject to approval by the Owner.

   b. The casing shall be cemented in place using a neat cement grout consisting of one part water to one part cement by volume e.g., one 94-pound sack of cement to 7-1/2 gallons of water.

   c. The annular space shall be filled by inserting a tremie pipe into the annulus to a depth of one to two feet off the bottom of the hole and pumping the cement grout under pressure until grout is returned at the surface. To compensate for settling and shrinkage, the Contractor shall add additional grout as needed to maintain the grout column at ground level. Alternative methods of grout sealing shall be subject to approval by the Owner.

   d. The cement grout shall be allowed to cure for a minimum of 12 hours before proceeding with further drilling.

2. The permanent casing shall be 6 inch minimum diameter Schedule 40 PVC or steel pipe, shall be approved by the Owner or his representative and shall: (1) receive the piezometer riser pipe and screen assembly without binding or distortion and (2) allow sufficient clearance for a tremie pipe between the casing and piezometer riser for placing sand pack, and cement grout seals within this annular space.

D. TEMPORARY CASING (For Use with Piezometers Terminating above the Marl)

1. Unless otherwise directed by the Owner or his representative temporary casing shall be installed to prevent caving of the hole wall during drilling and subsequent operations.

2. Temporary casing used to prevent caving of the hole wall during placement of the well screen and sand envelope shall be removed before completing the well.

3. Temporary casing above the sand envelope may be removed or left in place at the option of the Contractor, unless specifically directed by the Owner or his representative.

4. Temporary casing shall be minimum 6 inch diameter Schedule 40 PVC or steel pipe, shall be approved by the Owner or his representative and shall: (1) receive the permanent casing and screen assembly without binding or distortion; (2) provide an annular space opposite the well screens with a minimum thickness of 2 inches for a sand envelope; and (3) allow sufficient clearance for a tremie pipe between the casing and piezometer riser for placing sand filter packs, bentonite and cement grout seals within this annular space.

E. SCREENS

1. Between 10 and 20 feet of 2 inch minimum diameter screen shall be required for each piezometer. The length and location of well screen shall be determined by the Owner or his representative. The shapes or opening or slots shall be designed to prevent clogging and shall be free from jagged edges and irregularities that will accelerate clogging or corrosion. The screen shall have adequate strength to resist the external forces that will be applied after it is installed and to minimize the likelihood of damage during the installation. The size of the screen openings shall be 0.04 inch unless otherwise approved by the Owner or his representative. The screen shall be joined to the PVC riser pipe with appropriate watertight couplings and shall have true alignment at its joints after installation. Screen shall be stainless steel or PVC, as approved by the Owner or his representative. |9

2. Setting the piezometer riser pipe and screen assembly

   a. The piezometer shall be equipped with a sump, which shall be made by coupling a minimum 5-foot section of blank 2 inch minimum diameter pipe to the bottom of the screen. The bottom of the sump shall be sealed with an appropriate cap or plug to prevent in-filling while the piezometer assembly is being lowered into the hole. |9

b. Centering devices shall be installed in the piezometer to aid in the placement of sand in the annular space surrounding the screen. Design and placement of the centering devices shall be subject to approval by the Owner.

c. The Contractor shall exercise all care required to insure that the screen is not damaged during the lowering of the piezometer riser pipe and screen assembly. The assembly shall be lowered to design depth by a sand line, or other Owner approved method, and suspended off the bottom of the hole a distance of 3-6 inches while the sand pack is being placed in the annular space. This step shall be performed so that the weight of the piezometer riser does not place undue pressure on the screen.

d. Piezometer riser pipe shall be minimum 2-inch diameter Schedule 40 PVC unless otherwise approved by the Owner or his representative, and shall protrude a minimum of 1 foot and maximum of 2 feet above ground surface. |9

F. INSTALLATION OF SAND ENVELOPE

1. After the assembled riser pipe and screen have been placed in proper position and aligned within the drilled hole and with the bottom end sealed, the sand envelope shall be placed. The sand filter pack shall be placed by tremie pipe, or other methods approved by the Owner, in the annular space between the casing-screen and the wall of the hole and shall extend from the bottom of the hole to an elevation above the screen determined by the Owner. The Contractor shall pump clean water down the riser pipe with returns from the annulus to remove excess drilling fluid prior to placement of the sand filter pack. Circulation shall be controlled such that the hole does not cave-in before or during placement of filter pack and grout seal. Care shall be taken to insure that the entire annular space between the screen and the wall of the hole shall be completely filled with sand. |9

2. The sand envelope shall consist of clean, well graded sand, maximum size 1/8 inch, with less than 5 percent passing the No. 100 sieve.

G. CLEANING

1. Immediately after the riser pipe-screen assembly has been installed, and the sand envelope placed in the annular space, the piezometer shall be cleaned of residual drilling fluids. Cleaning of the well shall be in accordance with the following steps:

a. Only clean water from the site water supply shall be used. The Owner will provide the Contractor with a water source. |9

b. After the water source has been established, clean water shall be pumped through the riser until a flow is returned through the annulus to ground surface. A steady flow shall be maintained until all drilling mud, fine-grained materials, and visible discoloration have been eliminated. A small amount of chlorine may be added to the water to assist in the breakdown of the biodegradable drilling mud. This shall be done only as necessary and shall be at the direction of the Owner or his representative.

c. Diversion, impoundment, and disposal of discharge water shall be as directed by the Owner.

H. BACKFILLING

1. An impermeable seal a minimum of 2 feet in thickness shall be provided in the annular space immediately above the filter pack. The seal shall consist of a highly viscous mix of bentonite and water, barite and water or a combination of the two. Bentonite pellets may also be used. |9

2. The annular space above the bentonite seal shall be filled with a neat cement grout mix of one part cement to one part water by volume. Grout shall be pumped through a tremie pipe which shall be placed to a level 1-2 feet above the bentonite seal before pumping begins. Pumping shall continue until grout is returned to ground level. The Contractor shall add additional grout as required to maintain grout column at ground level. |9

I. SURFACE SEAL AND PROTECTION

1. A protective steel pipe enclosing the piezometer riser shall be provided. The protective pipe shall extend at least 3 feet below the ground surface and shall be set in concrete or grouted. When steel is used as the permanent casing, the protective casing may be provided by extending the permanent casing. This extender casing shall be attached by welding or threaded coupling. The protective casing shall extend a minimum of 1-inch and a maximum of 6-inches above the top of the PVC riser, and shall be provided with a cap, pin, and lock.

2. Four permanent guard posts shall be provided. Reference SK-2-C-108.

J. CONCRETE

1. Concrete shall be in accordance with Division C3 of this specification. Grout shall be in accordance with Division C3 of this specification and shall be placed in accordance with Section 1.5 of AWWA A100-66, Standard for Deep Wells.

C2.18.14 PIEZOMETERS PLACED IN CATEGORY 1 BACKFILL

A. GENERAL

1. Piezometers shall be located in Category 1 backfill as required by Engineering. 9

B. CONSTRUCTION OF PIEZOMETERS IN CATEGORY 1 BACKFILL

1. Piezometers shall be constructed in Category 1 backfill in accordance with Paragraph C2.18.13 of this specification and the following:

   a. Driller may use any conventional drilling technique except jetting.

   b. Drive casing, if used, shall be steel, flush-joint (preferred) or steel threaded collars. 9

   c. Screens shall be 10 feet long with openings of .040 inch or less. Bottom of screen shall be placed from 2.0 feet (maximum) above the top of the marl, with the drilled hole extending to the top of the marl. The piezometer shall be equipped with a sump, 2.0 feet in length, coupled to the bottom of the screen. 9

   d. Riser pipe shall be schedule 40 PVC.

   e. Piezometers placed in Category 1 backfill and selected for permanent use shall be protected in accordance with Paragraph C2.18.13,I when final grade has been reached. Interim protection for all piezometers placed in Category 1 backfill shall be provided by a removable protective barrier. Each barrier shall be large enough to be plainly visible from vehicles and heavy equipment and shall be of a configuration approved by the Owner. The barrier shall be of sufficient strength to resist deformation and to protect the piezometers from inadvertent damage during the construction period. Anchoring devices may be used to resist lateral displacement but in no case shall anchoring devices penetrate further than 6 inches into existing backfill material. The barrier shall be painted white unless otherwise approved by the Owner.

   f. Reference attached Sketch SK-2-C-113, Piezometer for Cat. 1 backfill.

C2.18.15 DEVELOPING AND TESTING NEW PIEZOMETER INSTALLATIONS

A. DEVELOPMENT

1. Upon completion of piezometer installations (except short term piezometers), the screen shall be developed to remove residual fines and produce maximum efficiency of the piezometer. Development shall be performed in accordance with the following steps.

   a. Allow the grout seal to cure for a minimum of 24 hours.

   b. Attach a horizontal jetting device to the end of the lead drill rod and insert rods into piezometer to the top of the screened section. 9

   c. Using a clean water source turn on mud pump and slowly move drill string down into the screen and back up again with the rig draw works while rotating rotary table at its slowest speed. All water returned to the surface shall be diverted to waste (i.e. return water shall not be recirculated). The objective of this step is to repeatedly move the jetting device through the total length of the screen until all fine-grained material surrounding the screen is loosened and allowed to flow into the piezometer. The jetting operation shall be continued for a minimum of one hour. The Owner may specify longer periods if fine-grained particles are still visible after the minimum period. Upon completion of this step, residual sediments shall be removed by placing an air line to the bottom of the piezometer and air lifting until return water is clear and free of fine-grained materials. 9

   d. In the event that the total length of the screen is greater than the total travel length of the rig draw works, then the screen shall be jetted in increments equalling the length of the rig draw works. When incremental jetting is necessary, the jetting shall begin in the upper section first and progress downward until all screen sections have been developed a minimum of one hour each.

B. TESTING

1. After development operations are complete, the piezometer shall be tested to insure that it is performing satisfactorily. The following procedure shall be used.

   a. After airlifting the piezometer, allow water level to stabilize to a static level by allowing the piezometer to sit overnight or as determined by the Owner's representative.

   b. Fill the riser pipe to the top with clean water.

c. From a container of known volume, pour enough clean water into the riser pipe to maintain the water level at the top of the riser.

d. Record the time required to empty the known-volume container.

2. If the piezometer accepts water from the container at a constant rate, the piezometer will be considered to be operative. The time-volume relationships will be formally documented and retained by the Owner until the plant is licensed. If the piezometer does not accept water at a constant rate, or if acceptance is noticeably slow, as determined by the Owner or his representative, the airlift cleaning procedure shall be repeated until the piezometer is considered operative.

C2.18.16 ABANDONMENT OF PIEZOMETERS

1. Piezometers which must be abandoned because they interfere with construction activity, are located beneath structures or have been irreparably damaged shall be abandoned, subsequent to approval by Engineering, in accordance with the following:

a. The depth of the piezometer shall be measured by sounding and compared with available records.

b. Loose material in the piezometer shall be removed by washing the piezometer with fresh water pumped through a small-diameter pipe or hose inserted into the 2-inch riser or by use of compressed air. Piezometers located below the marl shall be cleaned at least to the bottom of the marl; piezometers located above the marl shall be cleaned at least to the bottom of the screened interval.

c. All pipe and casing shall be removed from the hole with the exception of drill casing or surface casing already cemented in place.

d. Pipe which cannot be removed from the hole shall be perforated with the exception of surface casing or any pipe already having perforations.

e. Cement grout having a ratio of approximately one part water to one part cement shall be pumped through a tremie pipe inserted to the bottom of the piezometer.

f. Pumping of grout shall continue until surface returns are obtained. The grout pipe may be raised as grouting proceeds but must always be at least ten feet below the top of the grout column. Pumping shall continue while the pipe is withdrawn so as to maintain the level of grout at the top of the hole.

g. If pipe is left in the hole and grout does not return to the surface in the annular space between the pipe and the hole, the annular space shall be grouted.

h. After grouting in the above manner, additional grout shall be placed in the hole from the surface if the level of grout declines before setting.

2. Abandonment of piezometers shall be documented and the information provided to Engineering. Documentation shall include the volume of grout used, the depth, number, coordinates and ground surface elevation of the grouted hole, the date the grouting was completed and other pertinent data. The Contractor shall provide the Owner all such documentation.

3. For abandonment of short term piezometers, reference Paragraph C2.18.17.C.

C2.18.17 SHORT TERM PIEZOMETERS

A. GENERAL

1. Temporary piezometers will be provided in critical areas determined by Engineering to aid in the determination of the water levels in the backfill. In addition to providing data to be used in conjunction with the long term piezometer system these temporary piezometers will quickly provide the water elevation in critical areas such as those where repairs are to take place or where knowledge of the water level is required in order to proceed with backfill.

2. The piezometers will be 4 to 5 feet deep, installed with a hand auger or similar device, and removed and the hole grouted when backfill is to proceed.

B. CONSTRUCTION OF SHORT TERM PIEZOMETERS

1. Drilling the Hole

a. Holes shall be drilled by suitable portable devices approved by the Owners representative. Truck-mounted, trailer-mounted, or skid mounted rigs shall not be used.

b. Diameter of the hole shall not exceed 6 inches. Depth of hole shall be determined in the field by Owner's representative. Generally, it will be necessary to penetrate approximately two feet into the saturated zone.

2. Screen Requirements

Screens for the short term piezometers shall be PVC of a commercial grade approved by the Owner or his representative. Diameter of the screen shall not exceed 2 inches nominal OD. Screen thickness slots shall not exceed .025 inches. Slots may be cut in plain PVC with a .020-.025-inch thick hacksaw blade or similar cutting device. Slots shall be cut parallel to each other and perpendicular to the screen centerline. Slots shall be spaced 0.3 to 0.5 inches apart and their length shall not exceed 1/4 of the circumference of the pipe. No more than 3 slots shall be cut in tandem. The minimum screen length shall be 1 foot and the maximum length 3 feet. Commercially available slotted PVC screens may be substituted with the approval of the Owner's representative.

3. Risers

The riser pipe extending from the top of the screen to ground level, the couplings, and the caps shall be PVC of a commercial grade approved by the Owner's representative. The length of the riser shall be sufficient to allow a minimum 3 foot protrusion above ground surface. The exact length will be determined by the Owner's representative at the time of installation.

4. Backfilling

a. Field cut screens shall be wrapped with commercial filter fabric approved by the Owner's representative, inserted into the hole and the hole backfilled with material equivalent to that removed from the hole.

b. Commercially available screens, where used shall be inserted into the hole and the hole backfilled with a properly graded filter material approved by the Owner's representative.

5. Surface Seal

After piezometer installation is complete, the surface area immediately surrounding the PVC pipe shall be covered with bentonite drilling mud or similar impervious material to provide a seal around the standpipe.

6. Caps

A PVC cap shall be cemented to the bottom of the piezometer below the screen. A removable PVC cap shall also be placed on top of the piezometer to prevent foreign debris from entering the standpipe.

7. Reference attached Sketch SK-2-C-114, Short Term Piezometer.

C. ABANDONMENT OF SHORT TERM PIEZOMETERS

1. After necessary water level data has been acquired and the short term piezometers are no longer needed, they shall be abandoned. The PVC screen and riser shall be worked loose and pulled from the hole. The backfill shall then be cleaned from the hole in the same manner as it was originally removed. The hole shall next be grouted by placing a tremie pipe to within a foot of the bottom of the hole and pumping or pouring the grout through the top of the tremie continuously until a return flow is achieved at the surface. In areas where removal of the PVC riser is not practical, short term piezometers may be abandoned in accordance with Paragraph C2.18.19,I,1, b through e if approved by the Owner or his representative.

2. Grout mix shall be approximately one part cement to one part water. Cement-sand-water mixes and/or non-shrink admixtures are permissible if approved by the Owner or his representative.

3. After grouting in the above manner, additional grout shall be placed in the hole from the surface if the level of grout declines before setting.

4. Abandonment of short term piezometers shall be documented and the information provided to Engineering. Documentation shall include the volume of grout used, the depth, number, coordinates and ground surface elevation of the grouted hole, the date the grouting was completed and other pertinent data. The Contractor shall assist the Owner in obtaining all such information as required.

D. CLEANING

Cleaning and airlifting of short term piezometers shall not be performed unless directed by the Owner's representative. Inoperative short term piezometers shall be abandoned and replaced with new installations unless otherwise directed by the Owner's representative.

E. TESTING

Short term piezometers shall be tested in accordance with Paragraph C2.18.16.B.

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REVISIONS TO GROUND WATER SUPPLEMENT

(APRIL 24, 1985)

TABLE 2-2 (continued)

OBSERVATION WELLS IN CONFINED AQUIFER

Well No.	HISTORY Installed (YR)	HISTORY Current Status	Coordinates N	Coordinates E	Ground Surface Elev.(1) (ft)	Top of PVC Elev.(2) (ft)	Depth Bot. of Marl(3) (ft)	Screen Depth(3) (ft)
175	1971	Grouted, 1985	8386	7363	233.1	--	164	155 - 165
181	1971	Inactive(buried)	8744	6833	258.3	--	194.5	190 - 200
246	1972	Grouted, 1984	10532	6553	210.4	213.5	179.7	220 - 230

(1)

Notes

(1) Elevations shown were determined at time of drilling.

(2) Elevations shown are current or latest determination made prior to well abandonment.

(3) Unless otherwise indicated, depths shown were measured from ground surface at time of drilling.

(4) Well located in channel of Savannah River, marl not present.

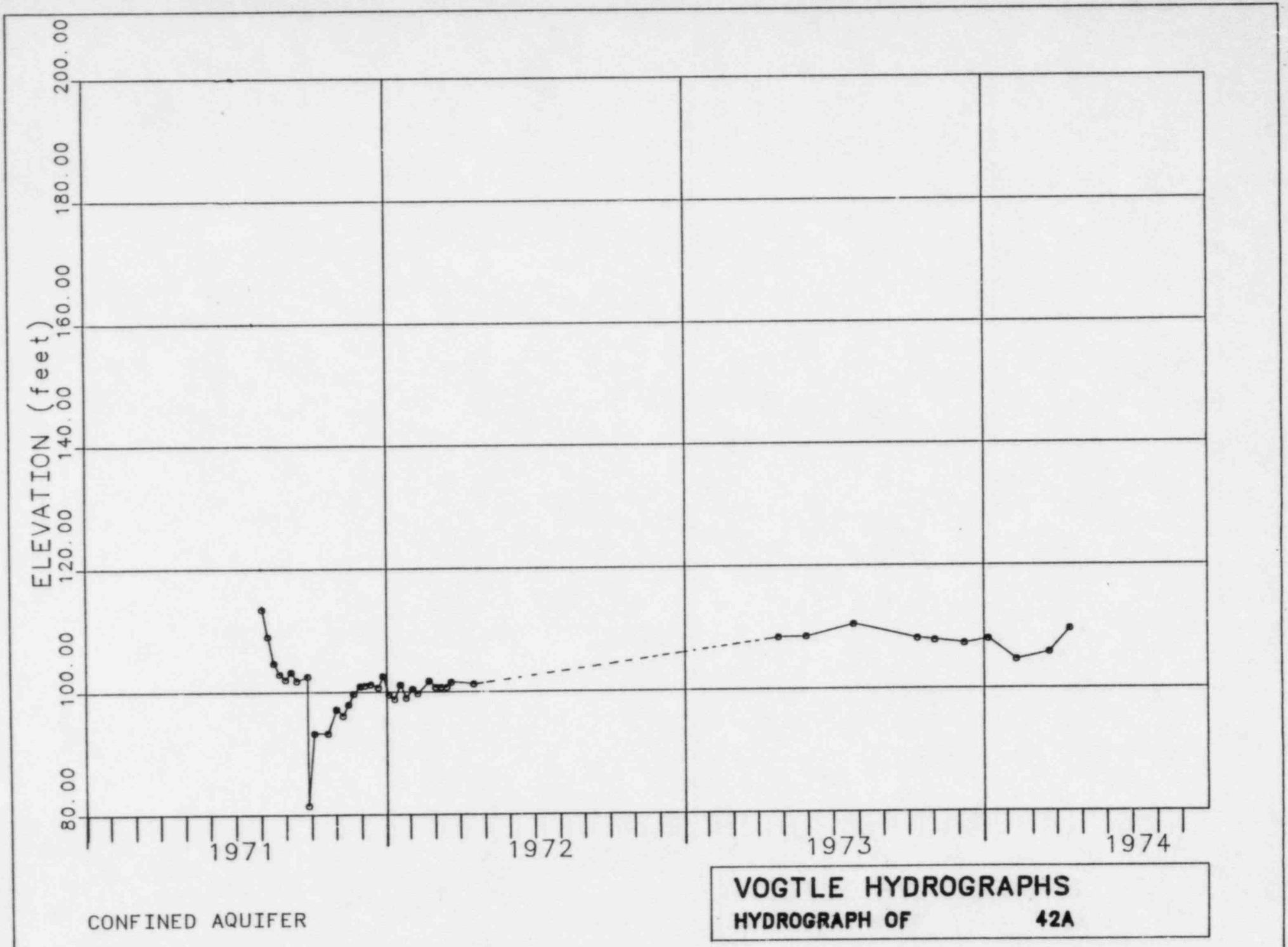
(1) Revised 4/24/85

Water Levels for Well 42A

Date	Elevation	NOTES
15-JUN-1971	141.50	
18-JUN-1971	203.80	
23-JUN-1971	141.00	
01-JUL-1971	200.80	(1)
14-JUL-1971	188.80	
21-JUL-1971	179.10	
04-AUG-1971	113.50	
11-AUG-1971	109.00	
18-AUG-1971	104.70	
25-AUG-1971	102.90	
01-SEP-1971	102.00	
08-SEP-1971	103.20	
15-SEP-1971	101.80	
28-SEP-1971	102.50	
29-SEP-1971	81.50	
06-OCT-1971	93.30	
23-OCT-1971	93.30	
02-NOV-1971	97.20	
10-NOV-1971	96.20	
17-NOV-1971	98.00	
23-NOV-1971	99.70	
01-DEC-1971	100.90	
07-DEC-1971	101.00	
14-DEC-1971	101.20	
23-DEC-1971	100.70	
29-DEC-1971	102.50	
05-JAN-1972	99.50	
12-JAN-1972	98.80	
19-JAN-1972	101.10	
26-JAN-1972	99.00	
03-FEB-1972	100.40	
09-FEB-1972	99.70	
23-FEB-1972	101.70	
02-MAR-1972	100.70	
09-MAR-1972	100.70	
16-MAR-1972	100.70	
21-MAR-1972	101.50	
18-APR-1972	101.20	
26-APR-1973	108.40	
30-MAY-1973	108.50	
27-JUL-1973	110.50	
13-OCT-1973	108.10	
03-NOV-1973	107.80	
09-DEC-1973	107.30	
07-JAN-1974	108.00	
10-FEB-1974	104.60	
23-MAR-1974	105.80	
17-APR-1974	109.60	

NOTE:

(1) These data not valid. The measurements represent water in the well used in construction and development, not aquifer water levels. (Revised 4/24/85)



CONFINED AQUIFER

VOGTLE HYDROGRAPHS

HYDROGRAPH OF 42A

Revised 4/24/85

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4.0 STATUS OF DRILL HOLES

In response to the request for a discussion of the status of the 474 holes referenced in FSAR Section 2.5.4.3.1 and any holes in addition to these (letter from E. G. Adensam to D. O. Foster, dated February 19, 1985), the following discussion and accompanying tables are submitted.

4.1 Holes Penetrating the Blue Bluff Marl

All of the holes that were drilled through the water-table aquifer, the Blue Bluff marl, and into the underlying confined aquifer are listed on Table 4-1. The status of each hole is also shown. It is normal practice of the engineering firms conducting the drilling of exploratory holes to fill them with grout following their completion, unless they are utilized as an observation or production well. Table 4-1 includes 17 active wells. Nine are active ground water observation wells open to the confined aquifer. There are four production wells open to the unnamed Lisbon sand (Tertiary), three of which supply construction water and one supplies water for the Simulator Building. In addition, four wells are completed as production wells open to the deeper Tuscaloosa Formation (Cretaceous); two are plant operation make-up wells, and two are wells originally planned as make-up wells, but are presently planned not to be utilized. Observation well 181 is currently inactive. This well is scheduled to be abandoned (grouted) in the near future. (1)

All observation wells monitoring the unnamed Lisbon sand (Tertiary aquifer) were sealed in the Blue Bluff marl with cement grout during well construction to prevent communication between aquifers. (1)

(1) Revised 4/24/85

All of the remaining holes on Table 4-1 were for exploratory purposes only. There is documentation that all of the holes were grouted except 236, 237, and 239. Although there are no data to indicate the exact disposition of these holes, it is believed these were also grouted. (1)

The grouting method used for sealing all holes, exploratory, seismic, and observation wells is the same. The method employed is commonly known as the "tremie method", which is performed by insertion of a small diameter pipe (drill rods, 1/2 to 1-inch steel or PVC, etc.) to near the bottom of the hole and pumping cement slurry through the pipe, filling the hole from the bottom up. Grouting continues until grout appears at the top of the hole. This method is employed to assure that the hole is completely grouted and no voids are present.

4.2 Other Holes in the Confined Aquifer

Several exploratory holes were drilled through alluvium of the Savannah River flood plain into the confined aquifer, but did not penetrate the marl. As discussed in the FSAR, the Blue Bluff marl is not present beneath the flood plain of the river. All of the holes on Table 4-2 were drilled in the flood plain into the confined aquifer. The area is stratigraphically below the bottom of the marl.

Of these holes, two were completed as observation wells, one of which was grouted in 1985 because its location interferred with construction of the river facilities. The other is a flowing well that has been capped and equipped with a pressure gage for monitoring.

(1) Revised 4/24/85

There is documentation that hole 123 was grouted to elevation 29 feet but there is no documentation as to the final completion or abandonment of the remaining holes. The grouting method for sealing observation well 121 and hole 123 was the tremie method as discussed in Section 4.1.

4.3 Holes Drilled only into the Unconfined Aquifer or River Alluvium

Holes penetrating only the unconfined aquifer or the river alluvium are shown on Table 4-3. Thirty of these holes were completed as observation wells to monitor the unconfined aquifer, thirteen of which are still in use. Of the remaining seventeen, 10 have been grouted, leaving seven that are inactive but with no documentation concerning the method of abandonment.

One of the wells, PW-1, is the water supply well for Plant Wilson.

Included in Table 4-3 are a number of wells constructed as temporary observation wells in the backfill at the Powerblock excavation. These wells (LT and ST series) were installed to monitor the water level in the backfill as backfilling operations were conducted to assure that the

TABLE 4-1

HOLES THAT PENETRATE BLUE BLUFF MARL AQUICLUDE

(Drilled into confined aquifer)

Hole Number	Status
1	Grouted
2	Grouted
3	Grouted
5	Grouted
6	Grouted
7	Grouted
8	Grouted
9	Grouted
10	Grouted
11	Grouted
12	Grouted
13	Grouted
14	Grouted
15	Grouted
16	Grouted
17	Grouted
18	Grouted
19	Grouted
20	Grouted
21	Grouted
22	Grouted
23	Grouted
24	Obs. well, grouted*
25	Grouted
26	Obs. well, grouted
27	Obs. well, active
29	Obs. well, active
31	Obs. well, grouted
32	Obs. well, grouted
33	Obs. well, grouted
37	Grouted
38	Grouted
39	Grouted
40	Grouted
42	Grouted
42A	Obs. well, grouted
42B	Obs. well, grouted (1)
42C	Obs. well, grouted (1)
45	Grouted
101A	Obs. well, grouted
102	Grouted
102A	Grouted
104A	Grouted
105	Grouted
106	Grouted
107	Grouted
107A	Grouted
109	Grouted
111	Grouted
111A	Grouted
113	Grouted
114	Grouted
114A	Grouted
116	Grouted
119	Grouted
122	Grouted
132	Grouted
133	Grouted
134	Grouted
135	Obs. well, grouted
136	Grouted
137	Grouted
138A	Grouted in marl**
139	Grouted
144	Obs. well, grouted
144A	Grouted
145	Grouted
147	Obs. well, grouted
152	Grouted
156	Grouted
157	Grouted (2)
170	Grouted
175	Obs. well, grouted
180	Grouted
181	Obs. well, inactive
182	Grouted
202	Grouted
203	Grouted in marl
204	Grouted in marl
216	Grouted
217	Grouted
218	Grouted
219	Grouted
220	Grouted in marl
221	Grouted
222	Grouted
223	Grouted
224	Grouted
225	Grouted
226	Grouted
227	Grouted
228	Grouted

(1) Not drilled into confined aquifer, screened in marl aquiclude.

(0632g)

(2) Revised 4/24/85

TABLE 4-1 (Continued)

HOLES THAT PENETRATE BLUE BLUFF MARL AQUICLUDE

(Drilled into confined aquifer)

Hole Number	Status	Hole Number	Status
229	Grouted	502	Grouted
230	Grouted	503	Grouted
235	Grouted	503A	Grouted
236	No closure record	504	Grouted
237	No closure record	505	Grouted
238	Grouted in marl	506	Grouted
239	No closure record	507	Grouted
243	Obs. well, grouted	508	Grouted
244	Obs. well, grouted in marl***	509	Grouted
245	Obs. well, grouted	510	Grouted
246	Obs. well, grouted	511	Grouted
247	Obs. well, grouted in marl	512	Grouted
248	Obs. well, grouted in marl	513	Grouted
249	Obs. well, grouted in marl	514	Grouted
301	Grouted	515	Grouted
302	Grouted	516	Grouted
303	Grouted	517	Grouted
304	Grouted	518	Grouted
305	Grouted	519	Grouted
306	Grouted	520	Grouted
307	Grouted	521	Grouted
308	Grouted	522	Grouted
309	Grouted	523	Grouted
310	Grouted	524	Grouted
311	Grouted	601	Grouted
312	Grouted	603	Grouted
313	Grouted	605	Grouted
314	Grouted	607	Grouted
316	Grouted	609	Grouted
319	Grouted	609A	Grouted
322	Grouted	610	Grouted
324	Grouted	611	Grouted
326	Grouted	613	Grouted
329	Grouted	615	Grouted
331	Grouted	617	Grouted
333	Grouted	619	Grouted
334	Grouted (1)	621	Grouted
335	Grouted	623	Grouted
336	Grouted	624	Grouted
337	Grouted	625	Grouted
338	Grouted	627	Grouted
339	Grouted	629	Grouted
408	Grouted	631	Grouted
409	Grouted	633	Grouted
501	Grouted	702	Grouted
501A	Grouted	704	Grouted

(0632g)

(1) Revised 4/25/85

TABLE 4-1 (Continued)

HOLES THAT PENETRATE BLUE BLUFF MARL AQUICLUDE

(Drilled into confined aquifer)

Hole Number	Status	Hole Number	Status
705	Grouted	P-5	Grouted
705A	Grouted	RF-1	Grouted
706A	Grouted	RF-1	Grouted
707	Grouted	RF-2	Grouted
709	Grouted	RF-3	Grouted
711	Grouted	RF-4	Grouted
712A	Grouted	RF-5	Grouted
713	Grouted	RF-6	Grouted
850	Grouted	RF-7	Grouted
850A	Obs. well, active	RF-8	Grouted
851	Grouted	RF-9	Grouted
851A	Obs. well, active	CW-1	Construction well, active
852	Obs. well, active	CW-2	Construction well, active
853	Obs. well, active	CW-3	Construction well, active
854	Obs. well, active	MU-1	Make-up well, active
855	Obs. well, active	MU-1A	Make-up well, grouted (1)
856	Obs. well, active	MU-2	Make-up well, active
P-1	Grouted	MU-2A	Make-up well, active
P-2	Grouted	SB-1	Simulator bldg. well, active
P-3	Grouted	TW-1	Test well, active
P-4	Grouted		

* Obs. well, grouted - hole was completed as observation well. Observation well was grouted at later date.

** Grouted in marl - hole was drilled through marl. Marl was grouted before hole abandoned.

*** Obs. well, grouted in marl - hole was drilled through marl. Marl was grouted and hole completed as observation well open to unconfined aquifer.

(0632g)

(1) Revised 4/24/85