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July 3, 1980

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Virgil C. Summer Nuclear Station
Docket No. 50-395
Additional NRC Questons -
Service Water Intake Structure

Dear Mr. Denton:

South Carolina Electric & Gas Company, acting for itself and as agent for South Carolina Public Service Authority, hereby submits five (5) copies of "Responses to Requests for Additional Information - Settlement of Service Water Intake Structure." This information is being submitted in response to additional NRC questions on the service water intake structure as enclosed with NRC letter dated June 23, 1980, concerning "Summary of Meeting Held on June 13, 1980 with South Carolina Electric & Gas Company."

Very truly yours,

E. H. Crews, Jr.

RBW:EHC:jw

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RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
SETTLEMENT OF SERVICE WATER INTAKE STRUCTURE
V. C. SUMMER UNIT 1
SOUTH CAROLINA ELECTRIC & GAS CO.

Question 1:

Evaluate the existing structure to determine safety margin against NRC SRP 3.8.4.

Response:

The Service Water Intake Structure (SWIS) is designed as a two dimensional structure in the transverse direction. The loads are primarily sustained by sections normal to the longitudinal axis. All load combinations and loads specified in Standard Review Plan (SRP) 3.8.4 for reinforced concrete strength design were satisfied.

The controlling load combination included dead, hydrostatic, and soil pressure loads for the unique condition of the SWIS being dewatered, via stop logs, and the Service Water Pond being completely filled. Provisions for stop logs have been made at the intake end of the SWIS and at the entrance to the pump chamber.

A comparison of factored internal forces and moments to the acceptance limits of SRP 3.8.4 results in the most critical section having a strength which is 20% in excess of that required. The load combinations which include OBE and SSE result in the most critical section having a strength of 150% and 230% respectively in excess of those required.

As far as the longitudinal direction of the SWIS is concerned, the original design of the SWIS included longitudinal reinforcing steel for distribution of cracks associated with thermal and shrinkage effects. The original design did not include consideration of the magnitude of differential settlement that

Response to Question 1 (Continued):

occurred. Since the unanticipated settlement has occurred, and the cracks have been grouted, the longitudinal reinforcing steel now serves exactly the same purpose as originally intended.

As described in the Response to Question 3, the longitudinal direction could crack due to a seismic event. It is conservatively calculated using Newmark's theory that the actual maximum crack width that could occur due to an SSE is 0.16 inches. The safety margin in the longitudinal direction can only be based upon the degree of cracking and its effect on safe function of the SWIS. In response to Question 3, we have determined that the SWIS will function satisfactorily with a crack width of 1/2 inch. The 1/2 inch is a lower bound number, but nevertheless could be used to determine a safety margin by comparing it with the actual calculated crack width of 0.16 inches. On this basis, the safety margin of the structure in the longitudinal direction can be said to be at least 3.0.

Question 2:

> If there were longitudinal separation and transverse relative displacement, evaluate the functionability of the existing structure, with a conservative assumption on the extent of through structure cracking.

Response:

Transverse relative displacements of at least 2½ ft. (wall thickness) would be needed to cause a net opening which might impair functionability of the SWIS. This event would require a shear mechanism capable of transverse rupture of the SWIS and the West Embankment. Such extensive movement would require a seismic event far in excess of the magnitude postulated for the site.

Response to Question 2 (Continued):

In the longitudinal direction, the calculated maximum crack width using the Newmark method during an SSE event is 0.16 inches. Based on an average effective cohesion of 875 psf for the West Embankment fill, it is concluded that a soil with a shear strength of that magnitude will easily bridge over the postulated maximum crack width of 0.5 inch with negligible infiltration of soil into the structure, even during a seismic event. Therefore, the function of the existing structure will not be impaired.

Question 3:

> Describe the engineering evaluation criteria of the existing structure in the longitudinal direction. Such criteria should be given in terms of quantitative values of stress, strain, force or deflections. Justify why such criteria is adequate for seismic load. Provide any examples where such criteria has been used (ASME, ACI, or AISC, etc.) possibly in nuclear plant design.

Response:

The unpredicted differential settlement of the SWIS created transverse cracking and possibly yielding of reinforcement in the longitudinal direction. Settlement is now considered stabilized, and the cracks have been grouted. The SWIS, as it currently exists, is capable of performing its intended function. This conclusion is supported by the fact that the primary loads (Dead, Hydrostatic, Soil Pressure and Seismic) described in the Response to Question 1, are all resisted in the transverse direction.

ACI 318 and ACI 349 do not include quantitative stress, strain, force or deflection criteria of a secondary nature that would be applicable to the longitudinal direction of the SWIS. This means that acceptance criteria for the longitudinal direction must be based directly upon the conditions which can lead to no loss of function. A loss of function in the longitudinal

Response to Question 3 (Continued):

direction is the development of gross separations and cracks to the extent that surrounding soil could enter the SWIS and either impair flow or create voids in the surrounding embankment. Based on evaluation of the shear strength of the soil, a through thickness crack width of 1/2 inch will not impair function of the SWIS.

The seismic load in the longitudinal direction is of a secondary nature and is self-limiting. The SWIS would move with the embankment based on the assumption of Newmark's equation for buried structures. Since the embankment is qualified seismically, the tunnel will remain functional during and after the seismic event.

Question 4:

> Describe the action that would be taken if the acceptance criteria were to be exceeded (settlement monitoring).

Response:

South Carolina Electric & Gas submitted the criteria to be applied to the bi-annual survey data to the USNRC on June 6, 1980. If that criteria is exceeded, the USNRC will be notified and an engineering evaluation will be performed. The principal concern of the engineering evaluation will be to ascertain that the extent of cracking at that time has not resulted in circumstances which would lead to an impairment of function.

Dependent upon the conclusions of the evaluation, the following actions may be taken:

a) Increased frequency of surveys for continuing review.

b) Other tests or inspections that may be deemed necessary.

Question 5:

> If there were through thickness cracks, determine the differential hydrostatic pressure between inside and outside the structure with pumps in operation.

Response:

In the event of an accident condition with two pumps in operation at high speed, the flow velocity in the SWIS is 0.42 ft./sec. The corresponding pressure differential between inside and outside the SWIS, due to the pumping operation, is essentially zero.