DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

January 14, 1983

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

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: Catawba Nuclear Station
Docket Nos. 50-413 and 50-414

Dear Mr. Denton:

In order to facilitate the completion of the review of the Catawba FSAR, Duke Power Company is transmitting herewith responses or revised responses to open items of the following technical review branches.

Attachment 1 - HGEB/GSB
Attachment 2 - Auxiliary Systems
Attachment 3 - Power Systems
Attachment 4 - Reactor Systems
Attachment 5 - Core Performance

These responses will be included in FSAR Revision 7.

Very truly yours,

Hal B Tucker

Hal B. Tucker

ROS/php
Attachments

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Mr. P. K. Van Doorn
NRC Resident Inspector
Catawba Nuclear Station

B001

Mr. Robert Guild, Esq.
Attorney-at-Law
P. O. Box 12097
Charleston, South Carolina 29412

cc: Palmetto Alliance
2135½ Devine Street
Columbia, South Carolina 29205

Mr. Jesse L. Riley
Carolina Environmental Study Group
854 Henley Place
Charlotte, North Carolina 28207

Mr. Henry A. Presler, Chairman
Charlotte-Mecklenburg Environmental Coalition
943 Henley Place
Charlotte, North Carolina 28207

Attachment 1

HGEB/GSB

VII in the region and the overburden amplification that contributed to those maximum observed surface intensities.

The historic earthquake which is assumed to be the largest earthquake to occur in the Piedmont is VII MM. This is larger than the historic maximum surface intensity at the site, which is VI-VII MM from the August 31, 1886 Charleston earthquake.

The NRC position allows the maximum earthquake determined for the seismotectonic province to coincide with the Safe Shutdown Earthquake. On this basis, the acceptable Safe Shutdown Earthquake for Catawba would be VII MM. (The Safe Shutdown Earthquake actually assumed for Catawba is VII-VIII MM, or 1/2 intensity unit higher than the maximum historical epicentral intensity experienced in the site seismotectonic region). For intensity VII MM, the "Trend of the Mean" relationship of the data of Trifunac and Brady (Reference 62) yields 0.12g.

The design response spectra are discussed in Section 2.5.2.8.

2.5.2.7 Operating Basis Earthquake

Appendix A of 10 CFR 100 provides that the Operating Basis Earthquake (OBE) shall be specified by the Applicant and shall be defined by response spectra. The OBE acceleration value recommended for foundations on closely jointed and slightly weathered rock is 0.08g. This is a conservative value, and is slightly more than one-half the SSE.

2.5.2.8 Design Response Spectra

Four synthetic earthquake records with maximum accelerations of 0.15g are developed to generate the response spectra for the Safe Shutdown Earthquake. In simulating the earthquakes, a maximum duration of 20 seconds is used in the model, of which 0 to 2 seconds is used for the rising period, 2 to 7 seconds for the constant acceleration period, and 7 to 20 seconds for the receding period. The shape of the response spectra of the simulated earthquakes for a single degree of freedom approximates the "Spectrum Curve" discussed by Newmark (Reference 64).

The numerical average of the response of the four earthquakes is used to generate the response spectra for 0.5, 1.0, 2.0 and 5.0 percent damping. The design response spectrum is a smoothed curve drawn through the averaged spectra. Figure 2.5.2-5 gives comparisons of the smoothed and the averaged spectra for 0.5, 1.0, 2.0 and 5.0 percent damping. Figures 2.5.2-6 and 2.5.2-7 give the smoothed response spectra for 0.5, 1.0, 2.0 and 5.0 percent for 0.08g and 0.15g ground acceleration, respectively.

Certain Category I tanks and other small structures are not founded on "continuous" rock as described in Section 2.5.4.10. These structures are designed using the design response spectra for 25 ft of soil (fill) above rock as shown on Figure 2.5.2-8. The spectra on Figure 2.5.2-8 are computed using a lumped mass model; the mathematics for the method are described in standard texts such as Chapter 2 of Newmark and Rosenblueth (Reference 105). The soil parameters used in the lumped mass model are shear modulus, G_{used}, equals 576 KSF, and soil damping, D_{used} at 10 percent of critical. These parameters are equivalent to strain-corrected soil properties (G_{used} and D_{used}) obtained when the program SHAKE (Reference 106) and the equivalent linear method are used to perform amplification analyses.

The subsurface conditions at structures listed in Table 2.5.4-4 and for which the amplified smoothed design response spectra on Figure 2.5.2-8 are used for design are summarized on Figure 2.5.2-8A. As can be seen from Figure 2.5.2-8A, the site conditions are such that only the Unit 2 Diesel Fuel Oil Tanks and the Unit 2 Above Ground Storage Tank actually justify consideration of a design response spectrum other than the one for rock on Figure 2.5.2-7. However, all the structures named on Figure 2.5.2-8A were designed using the amplified response spectrum on Figure 2.5.2-8.

For the Unit 2 Diesel Fuel Oil Tanks and Unit 2 Above Ground Storage Tank, horizontal response spectra are calculated for the specific soil columns at the structure for comparison to the smoothed design spectrum actually used and shown on Figure 2.5.2-8. The program SHAKE is utilized for these calculations using the soil parameters shown on Figure 2.5.2-8B. The strain dependency of shear modulus and damping of all the soil and sand in the soil columns is assumed to conform to the average curve for sand found in Seed and Idriss, 1970 (Reference 102). The strain dependency of the shear modulus of the compacted crushed stone backfill is calculated using information contained in Reference 107. The shear wave velocity (shear modulus) at low strain of the compacted crushed stone is computed from information contained in Reference 107. The damping in the crushed stone is assumed to be about 15 percent less than the average sand damping at the equivalent confining pressure and shear strain.

The numerical average of the response due to input of each of the four synthetic earthquakes at an exposure of the rock-like material is used to plot the response spectra for actual site conditions as shown on Figure 2.5.2-8C. The smoothed response spectrum for which the structures are designed is also shown on Figure 2.5.2-8C for comparison with the response spectra computed for actual site conditions.

The computed response spectra for the actual site conditions at the Unit 2 Diesel Fuel Oil Tanks is below the design response spectrum except for periods above 0.4 seconds. The fundamental period of these tanks is less than 0.4 seconds. The computed response spectrum for the Unit 2 Above Ground Storage Tank is below the design response spectrum for periods less than 0.7 seconds. The fundamental period of the Above Ground Storage Tank is less than 0.7 seconds. Thus, the design spectrum exceeds the computed spectra for actual site conditions within the period range of both these facilities and the use of the design response spectrum (25 ft of overburden) is conservative for the design.

As stated in Section 2.5.4.8, the granular and earth backfill, partially weathered rock and rock are not susceptible to liquefaction resulting from dynamic loading of the SSE.

The smoothed spectrum of ground motions (not a response spectrum) which is used for analyzing the buried piping for seismic design adequacy (referenced in Section 3.7.3.12) is compatible with the SSE response spectra for rock on Figure 2.5.2-7 when spectral amplification factors are considered. The spectrum of ground motions is found on Figure 11 of Newmark, et al., 1973 (Reference 108) and is scaled to 0.15 g to represent the ground motions for the SSE on rock at Catawba. For the pipeline in areas underlain by residual soil or compacted fill, the ground motion spectrum for 0.15 g is scaled upward by an assumed conservative value of 0.40/0.15 (equals 2.66 times), at all periods, to represent the motion to which the pipeline is assumed to be subjected (see Section 3.7.3.12). The data for the Unit 2 Diesel Fuel Oil Tanks (maximum ground acceleration 0.25 g at the pipeline depth) on Figure 2.5.2-8B and the acceleration at low period (0.27 g at the ground surface) on the design spectrum for 25 ft of soil (Figure 2.5.2-8) show computed maximum ground accelerations considerably less than the 0.40 g assumed for pipeline design in these areas. The small thicknesses of residual soil/saprolite beneath the pipeline (refer to Figure 2.5.4-19) indicate little amplification of ground acceleration would occur in these locations. Thus, the ground motion spectrum used to analyze the buried pipelines for design adequacy was quite conservatively selected. Where partially weathered rock is the material through which the pipelines passes, the data for the Unit 2 Above Ground Storage Tank on Figure 2.5.2.8B indicate the computed maximum ground acceleration at the pipeline depth is 0.17 g. Therefore, the pipeline would be subjected to less motion in partially weathered rock areas than was assumed for the above computations in fill and residual soil.

Table 2.5.4-4 lists the foundation design condition and the response spectrum used for each Category I structure.

2.5.3 SURFACE FAULTING

There is no geologic evidence of (capable) surface faulting in the Piedmont, the tectonic province in which the site is located. Therefore, a design basis for surface faulting is not applicable to this site.

2.5.3.1 Geologic Conditions of the Site

The geologic conditions in the region surrounding the site and of the site itself are discussed in Sections 2.5.1.1 and 2.5.1.2, respectively.

2.5.4.5.4.3 Fill Concrete

Fill concrete, where used, has a minimum compressive strength of 3000 psi after 28 days.

2.5.4.6 Groundwater Conditions

Groundwater conditions at the plant site are discussed in Section 2.4.13.2.4. The deep foundation and basement excavations for the plant area structures extend below the groundwater table, and as a result there is groundwater seepage into the excavations. This water seepage is controlled during construction by methods discussed in Section 2.5.4.5.2.

With the exceptions of very low pits in the Reactor and Auxiliary Buildings, hydrostatic uplift on the plant area structures is relieved by a permanent groundwater drainage system consisting of foundation underdrains and continuous wall drains which maintain the groundwater levels at or near the base of foundation mats and basement walls. The permanent groundwater control system is discussed in detail in Section 2.4.13.5. The deep pits are designed to withstand any resultant uplift and hydrostatic loads. Stability of the structures against groundwater induced forces is thus achieved by removing the buoyant uplift and hydrostatic forces or by providing suitable reaction against them.

Effects of plant construction on the groundwater conditions and plans to monitor post-construction groundwater levels are discussed in Sections 2.4.13.2.2, 2.4.13.2.4, and 2.4.13.3.5. Records of field and laboratory permeability tests are given in Section 2.4.13.2.5.

2.5.4.7 Response of Soil and Rock to Dynamic Loading

The testing performed to evaluate the dynamic properties and characteristics of the soil and rock at the site is discussed in Section 2.5.4.2. Evaluation of the liquefaction potential at the site is discussed in Section 2.5.4.8. The soil structure interaction analyses is discussed in Section 3.7.2.4. The dynamic response of buried pipe lines and earthworks is described in Sections 3.7.3.12 and 2.5.6.5.

2.5.4.8 Liquefaction Potential

All major nuclear safety related structures are founded on rock or partially weathered rock except for localized portions of the NSW pipe lines and the NSW conduit manholes, the SNSW Pond Outlet Works, the Diesel Fuel Oil Tanks as presented on Table 2.5.4-4. The rock and partially weathered rock will not be subject to liquefaction resulting from dynamic loading from the SSE.

As shown on Figure 2.5.4-17, a portion of the NSW pipeline near borings A-138, A-152, A-153, and A-154 is supported by compacted backfill which is underlain by residual soils, partially weathered rock and rock. Level ground conditions exist in this location on the pipeline, which is about 270 ft from the nearest slope. At boring A-138, a pocket of firm alluvial soil is present between the compacted backfill and partially weathered rock. Nearby borings A-152, A-153, and A-154 did not encounter the alluvial soil during continuous sampling, confirming the alluvium is of limited horizontal extent. The alluvium is a firm micaceous slightly silty fine to coarse sand having standard penetration resistance (N) equal to 13 blows per foot. The compacted backfill is a silty fine to coarse sand and micaceous fine sandy silt, having typical N-values of 15 to 34 blows per foot, with a few N-values of 10 to 14 bpf. The residual soil, which is present only in borings A-152 and A-154, is a micaceous silty fine to coarse sand, having typical N-values of 20 to 43, with one N-value as low as 9 in a thin zone of residual soil at boring A-152. The behavior of the earthfill, granular, residual and alluvial materials during earthquake loading is discussed in the following sections.

2.5.4.8.1 Earth Backfill

The remolded fill soils tested for cyclic shear strength from the general borrow area of the structures and plant excavations, and similar soils tested from the SNSW Pond Dam borrow areas do not exhibit liquefaction behavior in the sense that the pore pressure does not increase to equal the mean confining pressure. Since liquefaction does not occur, a failure criterion is assigned to these soils based on 5 percent strain, as discussed in Section 2.5.6.5. Analyses made for the SNSW Pond Dam embankment under shaking by the SSE confirm that the dynamic stresses generated in the soils are less than those required to cause 5 percent strain (see Section 2.5.6.5). Thus, it is concluded that Group I fills of site soils compacted to 96 percent standard Proctor maximum dry density and founded on firm saprolite soils and/or partially weathered rock will not undergo liquefaction or excessive deformations during the SSE.

Q241.4 The basis for using 96 percent standard Proctor maximum dry density for compacting Group 1 fills of site soils is discussed in Section 2.5.4.2.4.2. Field tests performed and controls exercised to assure proper compaction of fills of the site soils are described in Section 2.5.4.5.4.1.

The low consistency (N=10) soil encountered in one sample of boring A-154 is a slightly clayey micaceous fine to medium sandy silt and is compacted fill, which is underlain by residual soils (micaceous silty fine to coarse sand). Degree of compaction, not standard penetration resistance, is the control criterion for placing the earth backfill. As discussed above, the compacted earth backfill will not undergo liquefaction or excessive deformations during the SSE. This conclusion is confirmed by the results of soil column response analyses presented on Figure 2.5.4-14A, comparing the cyclic shear strength of the compacted fill to the cyclic shear stresses induced by the SSE. The minimum safety factor within the compacted fill is 1.91.

2.5.4.8.2 Granular Backfill

The granular backfill material compacted to a minimum relative density of 80 percent will not be susceptible to liquefaction or excessive deformations during the SSE.

2.5.4.8.3 Residual Soil

The low consistency (N=9) soil encountered in boring A-152 is a micaceous silty fine to coarse sand and is residuum. The N=9 condition occurs in a single SPT sample. (This boring is located 50 ft perpendicular from the axis of the pipeline.) Because of its location, the low consistency residual soil in boring A-152 is not of concern to the NSW pipeline. The residual soil directly below the pipeline in borings A-138, A-153, and A-154 is partially weathered rock having N-values of 100 or more and silty fine to coarse sand-saprolite having N-values of 20 or more.

2.5.4.8.4 Alluvial Soil

In order to evaluate the liquefaction potential of the pocket of alluvial soils encountered in boring A-138 (a single sample within the interval from 33 to 30 ft), a soil column analysis using the program SHAKE is performed to compute the cyclic shear stresses induced by the SSE (Figure 2.5.4-14A). The shear wave velocity of the compacted fill is assumed the same as from the SNSW Pond Dam (Section 2.5.6). The shear wave velocity of the alluvium is estimated from the standard penetration test value, overburden pressure, and information contained in Anderson, et al., (1978) (Reference 109). The shear wave velocity of the partially weathered rock was obtained from in-situ measurements of shear wave velocity in similar material at the Catawba site. The cyclic shear strength of the compacted fill is obtained from tests on the compacted fill for the SNSW Pond Dam, Figure 2.5.6-14. The cyclic shear strength of the alluvial sand is estimated from Figure 24 of Seed (1979) (Reference 110). As can be seen from Figure 2.5.4-14A, the cyclic shear strength of the compacted fill exceeds the induced cyclic shear stresses by a safety factor of 1.91 (minimum). The cyclic shear stresses exceeds the cyclic shear strength in the pocket of alluvial sands; thus, this localized zone of alluvial soil has a potential for pore pressures to become equal to the confining pressure during the SSE (consisting of the synthetic time histories).

Borings with continuous sampling are drilled 20 ft each way along the axis of the pipeline and perpendicular to the pipeline (50 ft downstream in the pre-construction drainage feature) to explore the lateral extent of the alluvial soil encountered in one SPT sample of boring A-138. These borings do not encounter any of this soil; therefore, the alluvial soil at boring A-138 occurs as a pocket of limited lateral extent (maximum of 40 ft along the pipeline) and is confined on all sides by soil (residuum and compacted earth fill) that does not liquefy or undergo excessive deformation during a seismic event.

If the local alluvial soil does experience pore pressures equal to the initial effective confining pressure in this material during the SSE, the relatively small volume and constrained nature of the alluvial zone would not cause a mass soil movement in the flat ground; rather the effect would be localized settlement. By assuming compaction of the alluvial soil from the estimated in-situ relative density of 52 percent to 80 percent relative density, it is conservatively estimated that the 6 ft thick pocket of alluvial soil may have a settlement potential as much as 3 to 4 inches as a result of the SSE. The settlement of the pipeline subgrade would be less due to attenuation by the 24 ft of compacted earthfill above the layer and below the pipelines. No estimate of the attenuation is made due to the relatively insignificant amount of settlement potential. Therefore, from the above discussions and engineering judgement, alluvial soils will not significantly affect the performance of the NSW pipeline as a consequence of the SSE occurring.

2.5.4.9 Earthquake Design Basis

The earthquake design basis is discussed in Section 2.5.2.

2.5.4.10 Static Stability

Major Category I structures are identified on Figure 2.5.1-12 and listed on Table 2.5.4-4. Major Category I structures are supported by mat foundations which bear on rock or fill concrete to rock. These rock bearing mats have maximum gross total static bearing pressures ranging from 10 to 20 ksf and average bearing pressures in the range of 3 to 10 ksf.

Category I structures founded on partially weathered rock (or coreable weathered rock) include the Refueling Water Storage Tanks, the NSW and SNSW Intake Structures and the SNSW Discharge Structures. These structures are also supported by mat foundations. As shown in Table 2.5.4-4, bearing pressures are low.

The NSW pipelines and the NSW Conduit Manholes bear on residual material, except at several isolated locations where the pipes are placed on Group I Earth Fill. The buried Diesel Fuel Oil Tanks and the NSW Pond Outlet Works bear on Group I Earth Fill. These buried structures apply very little net loading to the foundation soils.

Figure 2.5.4-17 shows subsurface profiles through the NSW pipelines at one location where the pipes bear on structural fill. A localized zone of alluvium underlies the structural fill at this location. Due to the limited extent of this zone, as determined by subsurface investigation, it will have no effect on the stability of the NSW pipe. At all other locations where the NSW pipes bear on structural fill, all alluvium and other unsuitable materials were removed prior to placing fill. The sequence of foundation preparation for the NSW pipe backfill was as follows. The trench was excavated using common earthmoving equipment to the depth required for pipe installation. After the pipe was installed and prior to placing backfill, the foundation was inspected by the field engineer, who verified its adequacy. If, in the judgement of the field engineer, an area contained loose or otherwise unsuitable material, that material was removed to a depth which ensured an adequate foundation. The plan and longitudinal profiles of the NSW pipes are shown with subsurface information on Figure 2.5.4-22 (Sheet 1-4).

of the cyclic loading tests, expressed as field strength $(\tau_f)_{10}$, are summarized in Figure 2.5.6-14.

The vertical component of earthquake motion does not appreciably affect the shear stresses calculated on horizontal planes in an earth dam (Reference 111). Hence, only horizontal motion is employed to calculate the shear stresses induced in the embankment. For the SNSW pond embankment, however, a vertical motion equal to two thirds the horizontal motion was included. For multidirectional horizontal shaking, level ground in the "free field" is affected by both horizontal components of earthquake motion. A dam, however, may respond much less in the longitudinal direction (along the length) then in the transverse direction; such evidence for a preferred upstream-downstream direction of motion appears in the seismoscope record of the Lower San Fernando Dam in the 1971 California earthquake. For the analyses of shear stresses induced in the SNSW Pond Dam, only upstream-down-stream horizontal shaking is considered appropriate. This is consistent with the usual practice in analyzing earth dams (Serf, Seed, Makdisit, Chang, 1976).

The seismic response and dynamic shear stresses induced in the embankment are analyzed with the computer program QUAD-4, developed at the University of California at Berkeley (Reference 89). This program allows, as input, both horizontal and vertical earthquake motions, and modulus and damping values that are strain dependent for each finite element of the mesh. The static finite element analysis provides values of initial effective confining stress. These data are then used in conjunction with the relations of Figure 2.5.6-40 to assign the initial modulus values to each finite element. Full Lake Wylie level is used in the analysis since this produces lower normal stresses within the embankment than would be obtained with a lower Lake Wylie level and thus produces lower safety factors under cyclic loading. Normal SNSW Pond level is used. Higher pond or lake levels corresponding to flood conditions are considered inappropriate for anlyses of cyclic loading by the SSE, since this would involve combination of extreme events (flood plus SSE). Analyses of earth structures involving the OBE are considered unnecessary due to less severe cyclic loading (compared to SSE).

Figure 2.5.6-47 shows the relationship determined to represent the "most probable" damping values at various strain levels for the embankment and foundation material while Figure 2.5.6-48 shows the "most probable" values of shear modulus parameter (K_{2max}) for the materials. Figure 2.5.6-18 presents the variation of shear modulus with strain. Computations are done to evaluate what effect some variation in damping and modulus has in the computed cyclic shear stresses. Holding the damping to the "most probable" values on Figure 2.5.6-47, the most probable K_{2max} values are increased by 25 percent and the cyclic shear stresses computed. The result is that cyclic shear stresses increase up to 30 percent in the saprolite and up to 28 percent in the embankment. The elements in the center of the embankment, where

107. Hardin, B. O., "Shear Modulus of Gravels," UKY TR74-73-CE19, Soil Mechanics Series No. 16, University of Kentucky, College of Engineering Dept. of Civil Engineering, September, 1973.

108. Newmark, N. M., Blume, J. A. and Kapur, K. K. (1973), "Seismic Design Spectra for Nuclear Power Plant" Proceedings of Power Division of ASCE, Vol. 99, No. P02, November 1973, pp. 287-303.

109. Anderson, D. G., Espana, C. and McLamore, V. R., (1978) "Estimating In-Situ Shear Moduli at Competent Sites," Proceedings of the ASCE Geotechnical Engineering Division Specialty Conference on Earthquake Engineering and Soil Dynamics, Vol. 1, page 181-197, Pasadena, CA, June 19-21, 1978.

110. Seed, H. B. (1979), "Soil Liquefaction and Cyclic Mobility Evaluation for Level Ground During Earthquakes," Journal of the Geotechnical Engineering Division 105, No. GT2, ASCE, February 1979.

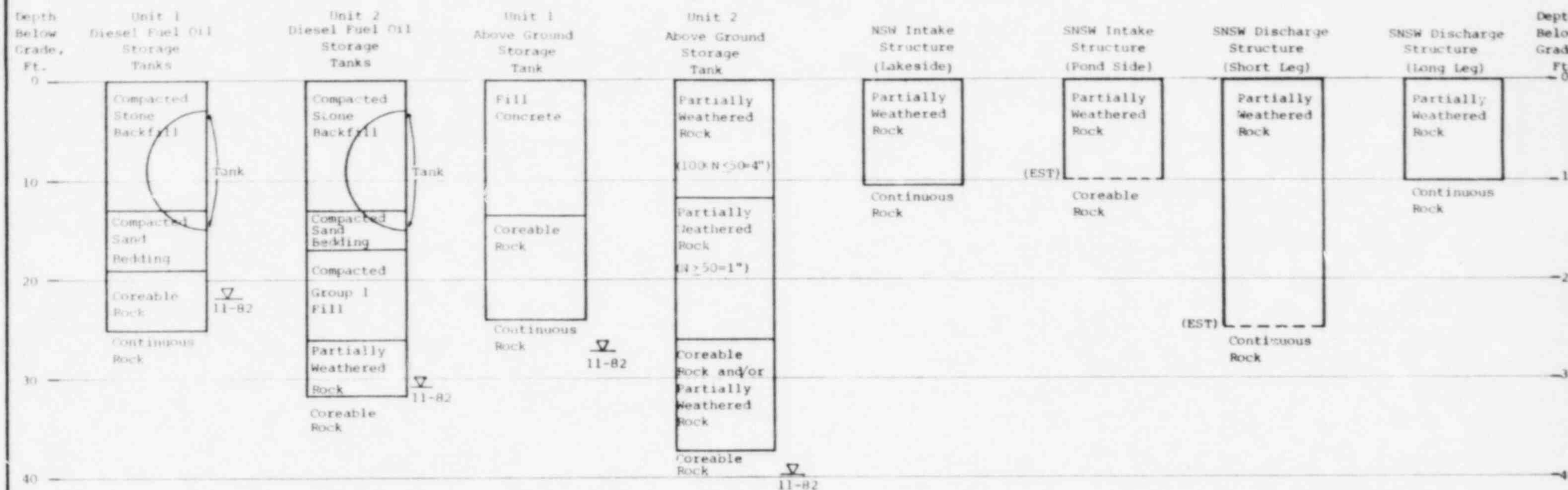
111. Serf, N. Seed, H. B. Makdisi, F. I. and Chang, C. Y., "Earthquake Induced Deformations of Earth Dams" Report No. EERC 76-4, College of Engineering, University of California, Berkeley, California, September, 1976.

112. Newmark, N. M., "Effects of Earthquakes on Dams and Embankments," Geotechnique, Volume 15, No. 2, January 1965.

113. Franklin, Arley G., and Chang, Frank K., "Permanent Displacements of Earth Embankments by Newmark Sliding Block Analysis," WES Miscellaneous Paper S-71-77, November 1977.

114. Seed, H. B., and Martin, G. R., "The Seismic Coefficient in Earth Dam Design," Proceedings of ASCE, SM & FD Journal No. SM3, May 1966.

115. Makdisi, F. I., and Seed, H. B., "A Simplified Procedure for Estimating Earthquake - Induced Deformations in Dams and Embankments," Report No. UCB/EERC 77-19, College of Engineering, University of California, Berkeley, August, 1977.



Continuous Rock $V_s \geq 7200$ fps

Coreable Rock $2500 \text{ fps} \leq V_s < 7200$ fps

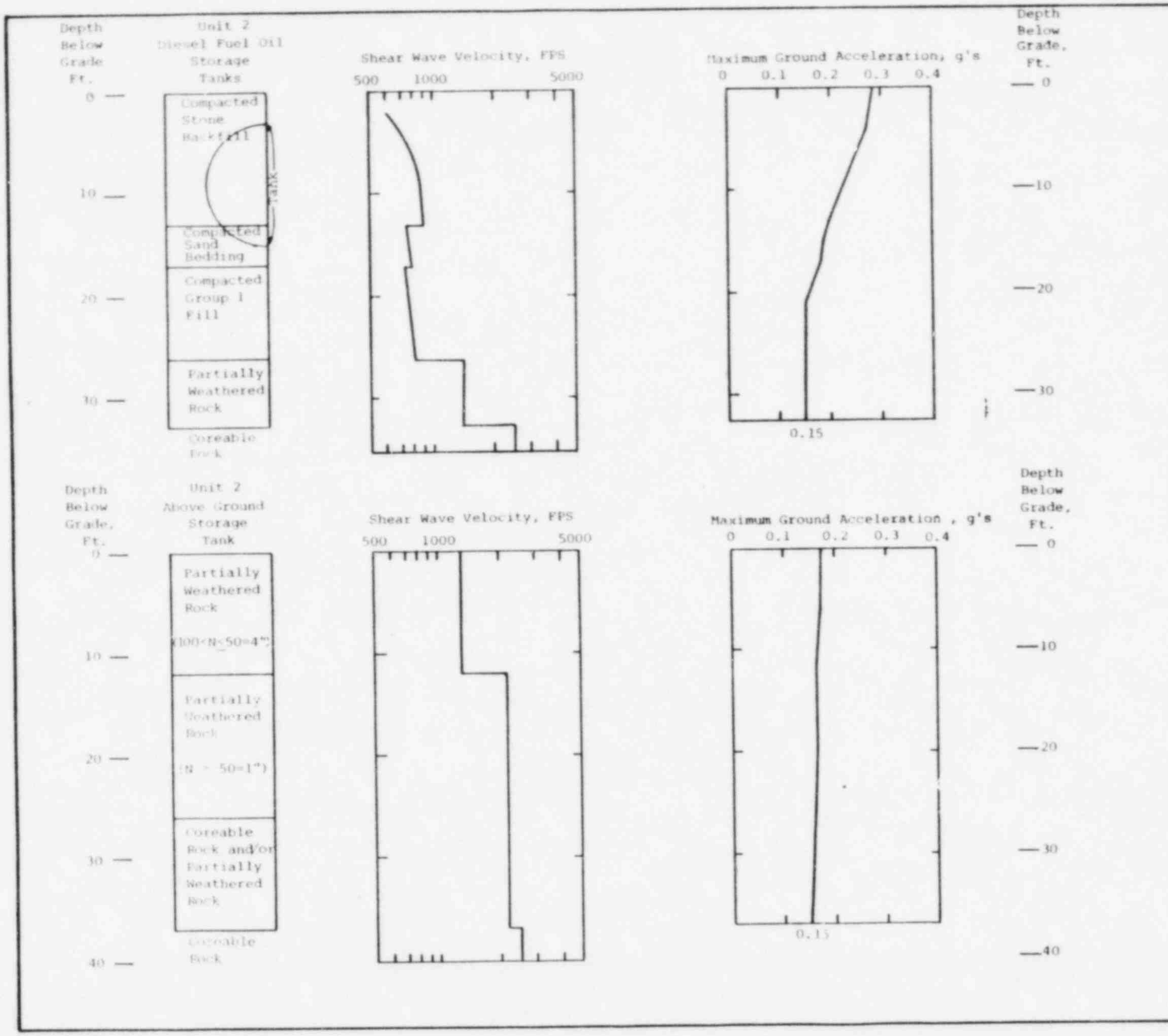
ACTUAL FOUNDATION CONDITIONS AT STRUCTURES DESIGNED USING RESPONSE SPECTRUM COMPUTED FOR 25 FT. OF OVERBURDEN (FI

CATAWBA NUCLEAR STATION

Figure 2.5.2-8A

Revision 7

New Figure



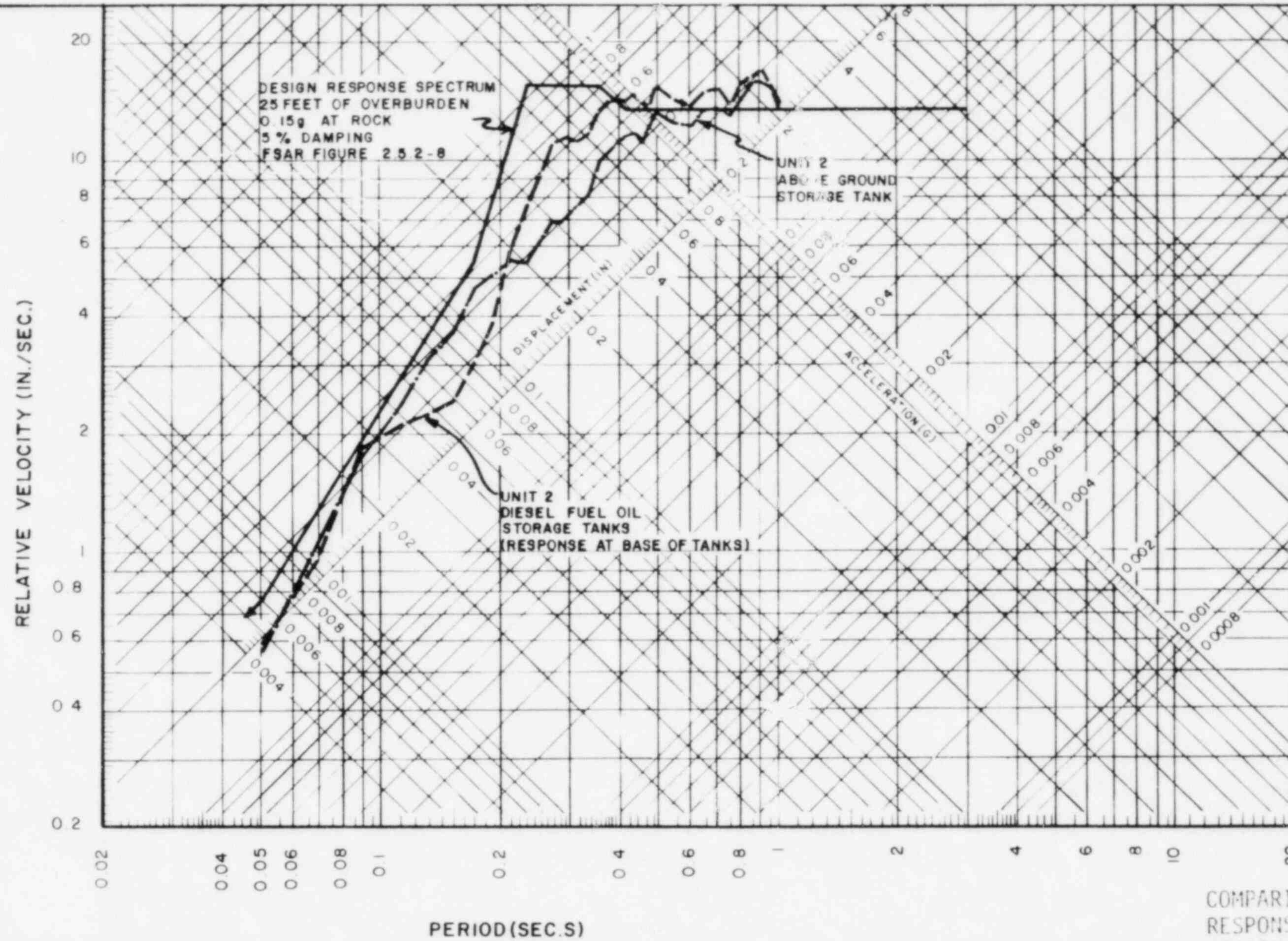
SOIL COLUMNS FOR UNIT 2 FUEL OIL STORAGE TANKS AND UNIT 2 ABOVE GROUND STORAGE TANK

CATAWBA NUCLEAR STATION

Figure 2.5.2-8B

Revision 7

New Figure



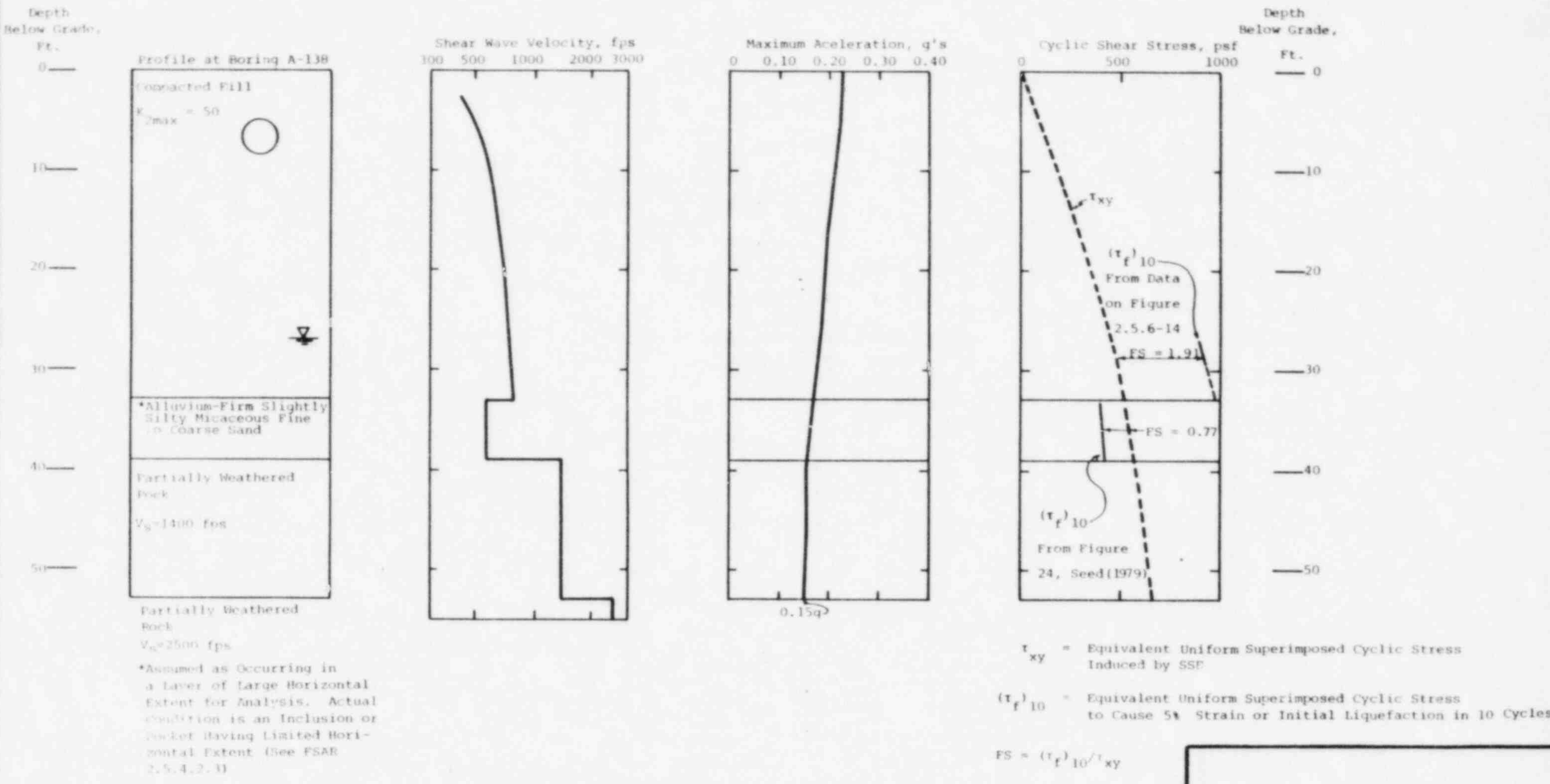
COMPARISON OF COMPUTED RESPONSE SPECTRA AND DESIGN RESPONSE SPECTRUM

CATAWBA NUCLEAR STATION

Figure 2.5.2-8C

Revision 7

New Figure



SOIL COLUMN ANALYSIS - NSW PIPELINE

CATAWBA NUCLEAR STATION

Figure 2.5.4-14A

Revision 7

New Figure

Attachment 2

Auxiliary Systems Branch

K = heat exchange coefficient,

E = equilibrium temperature,

p = water density,

C = Specific heat,

d = depth of the upper slice of water,

and t = length of time cooling takes place.

After cooling, each of the stacked horizontal layers of water is shifted down one layer, retaining their previously defined temperatures. A check is then made for density instabilities which are averaged out if necessary. By use of the computer the entire simulation is repeated hundreds of times. A program listing, input data listing, and sample run are presented in Figure 9.2.5-3. A list of variables for the program is presented in Figure 9.2.5-4. Results of this analysis indicate the maximum achieved intake temperature to the NSW system during an accident condition with extreme meteorology is 96°F (35.5°C).

The cooling water flow rate for the NSW system used in the computer program is 136 cfs (3.9 m^3/S) for the first 4 hours of the LOCA and 74 cfs (2.1 m^3/s) thereafter. The initial temperature of the pond is assumed to be equal to the average equilibrium temperature for the 30 day period.

The total heat input to the SNSWP from the NSW system is shown in Figure 9.2.5-5. Heat input to the pond is calculated by adding the fixed heat load due to safety related pump and motor coolers, spent fuel pool coolers, air conditioning equipment, and diesel generator jacket water coolers to the sensible and residual heat loads due to one unit following a LOCA and the second unit due to an immediate cooldown. The residual heat input to the pond is calculated from the Westinghouse total residual decay heat curve (Figure 9.2.5-5, curve 4) for the cooldown unit, starting after 4 hours (after steam dump is complete) plus the LOCA unit, starting immediately. No credit is taken for the ice condenser in the cooldown unit nor for heat transfer in the RN Pumphouse and yard piping, in terms of heat dissipated in the 30 day period following LOCA, thus adding to the conservatism of the analysis. The rate of heat rejection, both residual and sensible for the LOCA unit is determined by summing the containment spray and residual heat removal heat exchanger heat removal rates as calculated by Westinghouse (Figure 9.2.5-6). At the end of this curve (5 X 10^5 seconds), the value is equal to the decay heat curve because all sensible heat has been removed. Therefore, the decay heat curve is utilized from 5 X 10^5 seconds out to 30 days after LOCA.

The heat input to the SNSWP from the station auxiliary systems is distributed as follows:

a. For the first four hours, all components in both units are considered operating representing 106 X 10^6 BTU/hr.

Attachment 3

Power Systems Branch

a) Construction traffic dust is controlled by wetting the road surfaces periodically.

b) The impact of Unit 2 construction activities will be minimized by the placement of the Interim Security Boundary limiting the movement of traffic on the Unit 1 side of the station (see Figure 1.2.2-18).

c) Unit 1 side roadways will be paved at commercial operation. Landscaping (grass) will be completed at that time also.

d) The proximity of the diesel intake structure to the Auxiliary and Reactor Buildings provides further shielding from the Unit 2 construction activity.

e) Diesel relay contacts, switch contacts and other electromechanical devices associated with starting/operation are housed in Class 1E, drip proof, bottom-entry NEMA 12 control panels. Process control devices located external to the control panels are NEMA 4 enclosures. (NEMA 12 enclosures provide protection against fibers, flyings, lint, dust, dirt, light splashing seepage, dripping, and external condensation of non-corrosive liquids. NEMA 4 enclosures provide water-tight protection. Reference: NEMA publication No. ISI.1-1977).

430.90
(9.5.8)
RSP

Section 9.5.8.2.1 of the FSAR describes the combustion air intake structure for the diesel generator building. Figures 9.5.4-3 through 9.5.4-9 show the layout of the diesel generator building. The figures are not clear and it is difficult to determine the arrangement and location of the outer air intake structure. The description in the FSAR implies that both diesel generators share the same outer air intake structure. a) The description of the system is insufficient and is unacceptable. We require that each diesel generator has its own intake structure which is separate and independent of the other diesel generator's air intake structure. Provide a detailed description of the system and show that you comply with the above position. b) The FSAR states that for the air intake structure, dust, rain, ice, and snow are removed by floor drains in the outer combustion air intake compartment. Floor drains will only remove water accumulation, not dust, snow, ice, or freezing rain. Discuss the provisions made in your design of the diesel engine combustion air intake and exhaust system to prevent possible clogging, during standby and in operation, from abnormal climatic conditions (heavy rain, freezing rain, dust storms, ice and snow) that could prevent operation of the diesel generator on demand. (SRP 9.5.8, Part III, Item 5.)

Response:

See revised Section 9.5.8.2.1.

The diesel generator building arrangement is shown on Figures 9.5.8-2, -3, and -4. These figures have been revised and added to provide a clear graphic description of the building arrangement.

Each diesel generator is provided with a separate intake structure. The intake structure is designed to provide a protective cover over the diesel generator intake air openings. The structure overhang provides both missle protection and weather protection. Intake openings are protected with louvers and birdscreen. Intake air face velocity is approximately 300 feet per minute, eliminating carryover of rain, freezing rain, snow or dust. (Carryover is negligible up to face velocity of 800 fpm per AMCA Standard 500 Certified Ratings Program.)

In addition, sump capacity formed at the bottom of each intake structure provides over 3,200 gallons capacity preventing any weather carryover from interfacing with emergency diesel generator operation.

Dust control is addressed in the response to question 430.89 above.

430.91 (9.5.8) You state in Section 9.5.8.3 of the FSAR that "A fire within one diesel room, along with a single failure of the fire protection system, will be completely contained within that room. The combustion products will be exhausted from the room by the ventilation system at the end of the building opposite from the end which contains the intake structure for the redundant diesel. If the fire protection system operates as designed and extinguishes the fire, the gaseous carbon dioxide (extinguishing medium) will be contained in the same matter." We disagree with this statement. A fire within one diesel room along with the failure of the supply ventilation fire damper would allow the products of combustion and/or the carbon dioxide to go out the ventilation inlet which shares the same plenum as the combustion air intake. If the design is as is stated above in Question 430.90 or if the outer air intake structures are separate, the gaseous products could be drawn into the other diesel generator's air intake. Show by analysis that a potential fire in the diesel generator building together with a single failure of the fire protection system will not degrade the quality of the diesel combustion air so that the remaining diesel will be able to provide full rated power.

Response:

A Fire Hazards Analysis of the Diesel Generator Building is found in Duke's "Response to Appendix A to Branch Technical Position APCSB 9.5-1" (submitted by W. O. Parker, Jr. letter dated October 23, 1981 to H. R. Denton). Primary fire protection is provided by an automatic carbon dioxide system. The system is activated by temperature detectors (i.e., not smoke) which alarm and annunciate in the control room. Ten detectors per diesel room are provided. The circuit is supervised to annunciate control malfunctions.

Thermal detectors have a 225°F setpoint and will actuate on rate of temperature rise. Actuation takes 60 seconds during which visual/audible alarms are given, the CO_2 System master valve opens-charging the supply header, ventilation systems shut down and the hazard selector valve opens discharging CO_2. The volume of CO_2 discharged will not fill the intake structure preventing carryover into the adjacent structure. Excess CO_2 will exit through the lower exhaust structure openings (approximately 10 ft difference).

Manual hose stations are provided as a secondary fire protection system. Hose station water source is the Nuclear Service Water System essential header. Floor drains are provided to remove fire protection water if secondary means are needed in addition to the CO_2 System.

Inadvertent operation of the automatic CO_2 System would follow the control sequence described above. The CO_2 System is non-safety and during a seismic event, the header piping would not remain intact preventing discharge although the diesel equipment will function during an inadvertent release. Combustion air is taken from outside and is not contaminated by an inadvertent discharge. A "purge" switch located immediately outside the diesel room will utilize the ventilation system to remove CO_2. Ventilation is manually restored at the same location following an inadvertent CO_2 System actuation. Each diesel room is provided with electrically separate CO_2 actuation systems to prelcude a common malfunction affecting both diesel rooms.

Products of combustion will be contained by closing the ventilation system dampers early in the CO_2 detection/actuation sequence. Should some products of combustion escape, the intake structures are separated by a 3-hour rated fire wall (approximately 20 ft. height). Infiltration into the adjacent room's intake will not degrade diesel performance since the relay contacts, switch contacts and other electro-mechanical devices associated with starting/operation are housed in Class 1E, drip proof, bottom-entry NEMA 12 control panels. Process control devices located external to the control panels are NEMA 4 enclosures. (NEMA 12 enclosures provide protection against fibers, flyings, lint, dust, dirt, light splashing seepage, dripping, and external condensation of non-corrosive liquids. NEMA 4 enclosures provide water-tight protection. Reference: NEMA publication No. ISI.1-1977).

430.110 Section 10.4.4.1 of the FSAR indicates Catawba can accept up to 100% turbogenerator load reduction without tripping the reactor or main steam relief valve actuation. Since this allows the turbine generator to remain on line powering station loads following a loss of the offsite power system, describe the magnitude and effect of the transient and steady state voltage and frequency output of the main generator on the station loads (especially on Class 1E loads) starting with and following load reduction.

Response:

Duke is evaluating the effect of 100% turbogenerator load reduction on station loads and will advise the NRC staff of the results and any modifications found to be necessary. It is anticipated that any modifications would be completed prior to fuel loading.

9.5.2.2.5 Power Supply Separation

The Intraplant Telephone System (PABX) is powered from three (3) battery backed, 120VAC, 1 Ø power panelboards that are located in the Auxiliary Building (and therefore seismically mounted) and are independent of each other. These panelboards are 1KXPA, 1KXPB, and 2KXPA and feed the switch via cables 1ECI541, 1ECI542, and 1ECI585 respectfully. The minimum separation distance between panelboards is 25 feet. Cables 1ECI541 and 1ECI542 are run in the same cable tray from the Auxiliary Building to the Telephone Equipment Room in the Administration Building, however, Cable 1ECI585 is run in a separate tray system in excess of 20 feet from the 1ECI541 and 1ECI542 cables to a point in the Service Building, El. 594'-0" at Column U-7, where all three cables enter a final tray run to the Telephone Equipment Room.

Q430.54 The Intraplant Public Address (PA) System is powered from two (2) shared Motor Control Centers that are located independent of each other. Motor Control Center SMXC is located in the Auxiliary Building and feeds PA Power Panelboard PAP-1 also located in the Auxiliary Building. Motor Control Center SMXS is located in the Service Building and feeds PA Power Panelboard PAP-2 also located in the Service Building. Therefore, the PA is fed from two (2) sources located in different buildings.

The Emergency Sound-Power Telephone System is powered on a per Unit basis, via a double feed circuit through a power transfer contactor. For Unit 1, the system is fed from diesel-backed Emergency Lighting Panelboard 1ELB1 and Normal Lighting Panelboard 1LA6. Panelboard 1ELB1 is located in the Auxiliary Building, EL. 560'-0". Panelboard 1LA6 is located in the Auxiliary Building, El. 543'-0", thus separation is one floor elevation (17 feet). Unit 2 is similarly installed. The cabling running from 1ELB1 and 1LA6 to the Power Transfer Contactor is 2/C #12ALS.

See Figures 9.5.2-17 and 9.5.2-18 for one-line representations of the telephone systems.

9.5.2.3 <u>Communication During Transient and Accident Conditions</u>

In order to achieve a safe cold shutdown, it may be necessary for plant personnel to communicate with the control room or the emergency shutdown panel from selected working stations. These work stations and the communication systems available at each station are identified in Tables 9.5.2-1 and -2. The types and locations of these communication devices/stations are indicated on Figures 9.5.2-1 through 9.5.2-16.

The emergency sound-powered telephone system is the means of communication intended for use during accident conditions. Effective communication is provided by the emergency sound-powered phones in background noise levels as high as 110 dBA. PABX handsets are also available at all of the subject work stations and can be effectively used in noise levels or approximately 90 to 95 dBA.

Hand held radio transceivers are provided for use by station personnel in routine and emergency situations. A fifty watt fixed location repeater base assures general coverage of the Turbine Building, Auxiliary Building, and Containment Building areas. The redundant repeaters receive emergency power, while individual radios have their own batteries.

9.5.2.4 Inspection and Testing

All communication systems are inspected and checked for operability after installation to assure proper operation and coverage. After a unit is operational, plant noise levels will be measured during normal and simulated accident conditions. Based on these measurements, an evaluation will be made to determine the need for sound isolation booths or noise-cancelling devices.

The communication systems are used routinely and do not require periodic testing.

9.5.3 LIGHTING SYSTEMS

The plant is provided with adequate illumination through the integrated use of normal and emergency lighting systems. These lighting systems provide illumination for normal and emergency plant operation.

9.5.3.1 Normal Lighting System

The Normal Lighting System provides general illumination throughout the plant in accordance with the illumination levels recommended by the Illuminating Engineering Society. Power to the Normal Lighting System is supplied from independent 600VAC motor control centers through individual 600-208Y/120VAC dry-type transformers located in selected areas throughout the plant. All lighting in the Reactor Building is incandescent, while incandescent, flourescent, and high intensity discharge (HID) lighting is provided for the Auxiliary and Turbine Buildings. Normal lighting panelboards and their associated transformers and motor control centers are located such that a single failure in the Normal Lighting System will not result in a total loss of illumination in any area.

9.5.3.2 Emergency Lighting Systems

9.5.3.2.1 Design Bases

The emergency lighting systems are designed to assure that adequate lighting is provided in all vital areas of the plant including essential access routes to these areas. A single failure analysis of the emergency lighting system is provided in Table 9.5.3-1.

9.5.3.2.2 Emergency 250VDC Lighting System

The Emergency 250VDC Lighting System provides general emergency lighting for the control room and selected stairways and corridors throughout the plant. Voltage sensing relays automatically energize the normally deenergized emergency DC lighting system in the event of a loss of normal lighting. Power to the Emergency 250VDC Lighting System is from the 250VDC Auxiliary Power
Q430.57 System as described in Section 8.3.2. Emergency 250VDC Lighting available for a safe shutdown condition is shown in Table 9.5.2-2.

9.5.3.2.3 Emergency 208Y/120VAC Lighting System

The Emergency 208Y/120VAC Lighting System provides general emergency lighting in the following areas:

Auxiliary Building: control room, cable room and equipment room, stairs, exits, corridors, hot machine shop, fuel pool, fuel unloading area, decontamination rooms, pump and tank room areas, fan and ventilation rooms, penetration rooms, purge rooms, and diesel rooms

Reactor Building: stairs and platforms

The emergency AC lighting is divided into two independent trains (A and B) arranged such that a single failure will not result in a total loss of illumination in any area served. Voltage sensing relays automatically energize the normally deenergized emergency AC lighting in the event of a loss of normal lighting. Power to train A and B of the Emergency 208Y/120VAC Light System is from the A and B diesel-generators, respectively, through independent trains of the Essential Auxiliary Power System as described in Section
Q430.57 8.3.1. Emergency 208Y/120VAC lighting available for safe shutdown is shown in Table 9.5.2-2.

9.5.3.2.4 Emergency 8 Hour Battery Lighting

Q430.57 The Emergency 8 Hour Battery Lighting System is provided specifically for station illumination and access/egress for safe shutdown of the plant and for any other emergency situations that may arise. This safe shutdown and other emergency lighting is provided in the following areas:

Diesel Generator Rooms: general room coverage

Auxiliary Building: primary sample sink, auxiliary feedwater pump room, HVAC control panels, switchgear room, electrical penetration room, selected instruments, selected valves, selected stairs and corridors, Auxiliary Shutdown Panel Rooms, and Fuel Pool area

Control room annex: area near NC and NV panels

Q430.56 Control room: area over vertical control panels

Turbine Building: 6.9 KV switchgear room

Service Building: instrument and station air compressors, instrument air dryers

The 8 Hour Battery Lighting System consists of individual 200 watt, self-contained, sealed lead calcium battery units. The units are normally on continuous charge from the unit normal auxiliary power system. Upon loss of normal voltage these are energized. Means are provided to test each lighting unit individually. Emergency 8 Hour Battery Lighting available for a
Q430.57 safe shutdown condition is shown in Table 9.5.2-2.

9.5.4 DIESEL GENERATOR ENGINE FUEL OIL SYSTEM

9.5.4.1 <u>Design Bases</u>

The Diesel Generator Engine Fuel Oil System is designed to provide for the storage of a seven-day supply of fuel oil for each diesel generator engine and to supply the fuel oil to the engine, as necessary, to drive the emergency generator. The system is designed to meet the single failure criterion, and to withstand the effects of natural phenomena without the loss of operability.

Fuel oil amenders are added as necessary to extend oil life by preventing oxidation, stratification, etc. A sample is used to inspect the oil for water content or degradation and if degradation is determined, the oil may be pumped out for disposal. Accumulated water in the fuel oil storge tanks
Q430.67 will be removed by the recirculation system through a sample connection provided on the recirculation pump discharge as required by the Technical Specifications.

If deleterious amounts of algae are found, the tank will be drained and cleaned by contracted professional industrial tank cleaning personnel.

The day tank vent and fuel oil storage tank vents and fill connections which are exposed outdoors, are protected from tornado missiles due to the construction of the vents using heavy gauge pipe. Should a tornado missile strike a
Q430.60 vent or fill connection the pipe will bend without crimping to relieve the impact load. The day tank vent terminates 4 feet above grade elevation and
Q430.68 the fuel oil storage tank fill and vent lines terminate 3 feet and 1'-7" respectively above grade elevation to prevent entrance of water. Each fill connection is provided with a locking dust cap and each vent line is down turned. The storage tanks can be filled and vented through the manway should the fill or vent lines become impaired.

9.5.4.2.2 Component Descriptions

Fuel is recirculated within the storage facility to prevent deterioration at the rate of 25 gpm at 32 psi by a recirculation pump. The pump is driven by a 3 HP, 575 volt, 3 phase, 60 Hz motor whose power source is the 600 VAC Unit Normal Auxiliary Power Supply (Section 8.3.1.1.1.5).

The fuel oil booster pump is designed to deliver fuel oil to the engine during the startup period (approximately 11 seconds) at 8 gpm. The pump is driven by a 2 HP, 120 volt DC motor whose power source is the 125VDC Diesel Essential Auxiliary Power System (Section 8.3.1.1.3.11).

9.5.4.2.3 Instrumentation and Alarms

Each diesel generator engine is provided with sufficient instrumentation to monitor the operation of the fuel oil system. All alarms are seperately annunciated on the local diesel engine control panel which also signals a general diesel trouble alarm in the control room. There are two redundant safety related interlocks provided on the fuel oil recirculation system. One interlock is provided to shutdown the recirculation pump in the event of a LOCA. The second interlock is provided to shutdown the recirculation pump should the fuel oil level in the storage tanks drop below Technical Specifications level. The fuel oil system is provided with the following instrumenta-
Q430.58 tion and alarms:

Fuel oil storage tanks -

- Low level and high level annunciators
- Tech spec low-low level alarm
- Level indication, 0-100%
- The capability for use of a stick gauge to measure the fuel oil level

Attachment 4

Reactor Systems Branch

Response:

The maximum post-accident flood level inside containment has been determined to be elevation 570'0". The only safety related control room instrumentation below this elevation are the reactor coolant loop elbow flow rate instruments. This instrumentation provides both control room indication and a reactor trip (on low flow in any one loop) neither of which is required after an accident (no operator actions taken on indication, and reactor trips due to safety injection signal).

A list of safety related solenoid valves in containment that are below maximum flood elevation is presented in Table Q440.48-1. These solenoids perform one of two functions; namely, controlling air to air diaphragm operated valves and providing air to the lower personnel air lock inflatable seals. All of the air diaphragm operated valves are designed to assume their safety position on loss of air. All of the solenoids controlling the air supply are designed to vent the air diaphragm on loss of power. Therefore, even if control of these solenoid valves is lost the air operated valve will assume its correct position. The solenoids which supply air to the lower personnel air lock seals are designed to fail in the position which supplies air to the seals. None of these valves are required to be repositioned to perform short or long term ECCS functions.

A list of active valves in containment that are below maximum flood elevation is presented in Table Q440.48-2. In this evaluation it was discovered that two valves were required to be raised above flood elevation (the two valves -- 1NW46A and 1NW110B provided sealing water for several containment isolation valves). The valves which will potentially be flooded are, except as noted, electric motor operated. These are assumed to fail in the position they are in when flooded. There is sufficient time for the ones which receive a safety signal to stroke to their safety positions before being flooded. None of these valves are required to be repositioned to perform short or long term ECCS functions.

Duke is evaluating solutions to the problem of containment flooding of valve operators not previously qualified for submergence (1KC429B, 1NC54A, 1NI95A, 1NI266A, 1NI267A, 1NM6A, 1NM72B, 1NM75B, 1NM78B, 1NM81B, 1NM187A, 1NM190A, 1NM197B, 1NM200B, 1NM207A, 1NM210A, 1NM217B, and 1NM220B). Options include operator modification or electrical control circuit changes. Duke will advise the NRC staff of any modifications to be made. It is anticipated that any modifications would be completed prior to fuel loading.

$NPSH_A = (14.696-9.34)(2.386) + 26.5 - 15.28 = 24.0$ ft @ 5300 gpm

$NPSH_R$ @ 5300 gpm = 23.0 ft.

b) Pump flow rates are given above.

c) The manufacturer did not add velocity head to the pressure measured during $NPSH_R$ tests so velocity head does not need to be subtracted from $NPSH_A$ calculations.

d) The containment water level in the above analysis was a maximum of 2 feet which corresponds to less than 100,000 gallons or about half the minimum RWST injection volume. Pump discharge centerline was selected since it is higher than pump suction centerline and is thus conservative.

440.138
(6.3)
(440.26)

The response to Q440.113 did not provide quantified detail about parameters of comparison with McGuire adequate to show that the McGuire sump tests are applicable to Catawba.

Identify pertinent parameters (e.g., sump suction pipe submergence, etc.) and quantitatively (giving values for each plant) compare them, making sure that such parameters for Catawba are also consistent with the values determined/assumed in RWST sizing and NPSH analyses.

Response:

The following Table 440.138-1 compares the Catawba recirculation sump with the parameters used in the McGuire model test performed by Alden Research Laboatory.

The minimum water depth analyzed was conservatively assumed to be the result of minimum assured injection volume from the FWST and a fraction of ice melt. No credit was taken for RCS spill, cold leg accumulator injection or UHI injection volumes. The volume was converted to an elevation using the results of a calculation of containment free volume which conservatively assumed only concrete structures and major equipment (e.g. reactor vessel, pressurizer relief tank, reactor coolant drain tank, etc.,---ignoring piping, valves, pipe hangers, etc.) displaced volume. The tabular results of this calculation is given in Table 6.2.1-14B.

Table Q440.138-1

Comparison Between Catawba Sump and McGuire Sump

Item	McGuire	Catawba
a. Minimum water depth	6.7 ft	6.7 ft
b. Maximum water depth	13.25 ft	18.0 ft
c. Maximum discharge per pipe	7577 gpm	7577 gpm
d. Approach tunnel width	13 ft	13 ft
e. Approximate overall approach area	164 ft^2	210 ft^2
f. Approach velocity upstream of screen (no blockage); based on overall approach area	0.21 fps	0.16 fps
g. Obstructions	pipes HVAC duct columns	pipes HVAC duce columns
h. Gratings	1" x 3/16" STD floor type	1" x 3/16" STD floor type
i. Screens	1/16" wires, 3-3/4 meshes/inch	0.08" dia. wires, 5 meshes/inch
j. Vortex suppressor	2 - 1-1/2" x 1/8"	2 - 1-1/2" x 3/16"
k. Pipe centerline to top cover minimum distance	1'9"	2'0"
l. Pipe projection inside containment vessel wall	4'2"	4'2"
m. Top covers	All solid covers	All solid top covers
n. Top solid cover air venting	Sloping with gaps for air venting	Horizontal, with holes for venting air
o. Sump structure height from floor	About 2'9" more or less uniform	Varies with sub-assembly from 2' to approximately 5'
p. Approach velocity at the screen considering net area (after deducting the area of support frames)	Not known	0.40 fps

Attachment 5

Core Performance Branch

of the Engineered Safety Feature devices of the control board is designed to minimize the time required for the operator to evaluate system performance under accident conditions.

7.8.7 OCCUPANCY

Safe occupancy of the control room during abnormal conditions is provided for in the design of the Auxiliary Building. Adequate shielding is used to maintain tolerable radiation levels in the control rooms for maximum hypothetical accident conditions. Each control room ventilation system is provided with radiation detectors and appropriate alarms. Provisions are made for the control room air to be recirculated through absolute and charcoal filters. Emergency lighting is provided.

7.8.8 LOOSE PARTS MONITORING SYSTEM

The following design considerations form the basis for the Loose Parts Monitoring System (LPMS) installed at Catawba.

1.) The LPMS is designed to detect and record signals resulting from loose-part impacts occurring within the Reactor Coolant System.

2.) Channel separation is addressed in response to Q492.1.

3.) The Primary Coolant System in its entirety is designed to withstand seismic events, therefore, loose parts are not anticipated resultants from seismic events.

4.) Seismic qualification of the LPMS is addressed in response to Q429.1.

5.) Complexity and demand on operators time is held at a minimum while providing reliable indications.

Twelve transducers are located in the areas where loose parts are most likely to become entrapped. These are:

- two on the reactor vessel lower head, diametrically opposed.
- two on the reactor vessel upper head, diametrically opposed.
- two on the lower head of each steam generator

Experience has shown that the exact location of these transducers is not critical since the acoustic wave that results from an impact propagates throughout the entire head.

The transducers are piezoelectric accelerometers. These accelerometers are individually tested and calibrated.

quake requirements of the Regulatory Guide 1.133, and therefore no seismic test reports for this system are available. The in-containment portion of the Catawba LPMS consists of accelerometers, preamplifiers and interconnection cables. We have reviewed these components for seismic capability and have determined that:

(i) The design of accelerometers inherently provides some seismic capability. The accelerometer design at Catawba is similar to designs used in systems that have been seismically tested and qualified.

(ii) The preamplifers used are solid state, light weight devices similar to other type amplifers which have been seismically tested and qualified in safety related systems.

(iii) The cables used for LPMS are high quality, low noise cables protected by an overall armor. These cables inside containment are installed in seismically qualified cable support systems.

5. Personnel who are required to perform checks, calibrations and tests of the LPMS will be qualified by training and experience appropriate to their responsibilities. Personnel who perform the qualitative channel checks will receive general familiarization training on recognition of abnormal audio signals and basic operation of the LPMS. Personnel who perform monthly channel checks or who perform maintenance on the LPMS hardware will be qualified instrument and controls technicians and will perform this work under approved procedures.

   Personnel who analyze the LPMS signals and perform evaluations of the spectra and other plant parameters during normal surveillance or alarm investigation will be qualified by education and experience in frequency analysis and interpretation, and will be knowledgable through experience with respect to Reactor Coolant System componets structures and operations. In addition, these personnel will receive specialized training on the detection and analysis of loose parts events.

6. Duke Power will install four additional channels of LPM, one per steam generator. These new channels, i.e., sensors, preamplifiers and cables, will be physically separated from the existing steam generator LPM channels.

Reactor Vessel Level Measurement

The reactor vessel level instrumentation system (RVLIS) is of Westinghouse design. The RVLIS is of standard Westinghouse design for upper head injection (UHI) reactor systems and utilizes a microprocessor for data processing. The RVLIS uses differential pressure (DP) transmitters to measure the pressure drops from the bottom of the reactor vessel to the hot legs for UHI plants and from the hot legs to the top of the reactor vessel. Under natural-circulation or no-circulation conditions, these pressure drops will provide indication of the collapsed liquid level or relative void content in the reactor vessel above and below the hot legs. Under forced-flow conditions, the pressure drops will provide indication of the vessel void content above the hot legs and the relative void content of the circulating primary coolant system fluid. Automatic compensation for changes in the temperature of the impulse lines leading from the reactor vessel and hot legs to the DP transmitters is incorporated in the system. Strap-on RTD's are mounted on the vertical runs of the impulse lines for measuring impulse-line temperatures. Automatic compensation for changes in the reactor coolant system fluid densities is also incorporated in the system. Following a hypothetical accident which causes a loss of primary coolant, the RVLIS will be used by the plant operators to assist in detecting a gas bubble or void in the reactor vessel and assist in detecting the approach to a condition of inadequate core cooling. If forced-flow conditions are maintained after the accident, the RVLIS will also be used to assist in detecting the formation of void in the circulating primary coolant system fluid. The equipment which comprises the RVLIS includes the DP transmitters, impulse lines, impulse-line RTD's, in-containment sensor bellows units, out-of-containment hydraulic isolators, and all the necessary electronic signal conditioning, processing and display equipment. A technical description of the system appears in Westinghouse's manual entitled, "RVLIS - Summary Report, December, 1980."

Incore Thermocouple System

The upgraded incore thermocouple system uses qualified mineral insulated (MI) thermocouple wire to provide a continuous run of MI cable from thermocouple to containment penetration. In accordance with NUREG-0737, the system will utilize 16 thermocouples per train and will be able to handle normal attrition. The safety thermocouple signals will be displayed in accordance with results obtained by the ongoing control board review effort. The indicated range will be 200 degrees to 2300 degrees F. in accordance with R. G. 1.97.