TVA

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John H. Garrity
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APR 01 1992

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2 - RESPONSE TO NRC INFORMATION REQUEST (TAC R00514, M73097, M73098)

Reference: NRC Audit Summary - Report on the September 1991 Civil Calculation Audit (TAC R00514, M73097, M73098) Dated January 31, 1992

By the referenced audit summary, NRC requested additional information relative to several open items resulting from audits of Watts Bar civil calculations.

The TVA responses to these open NRC items are provided in Enclosure 1. New commitments are contained in this submittal and are summarized in Enclosure 2.

If any additional questions exist relative to the enclosed, please contact P. L. Pace at 615-365-1824.

Sincerely,

J H Garrity

John H. Garrity

Enclosures
cc: See page 2

A001
1/1

cc (Enclosures):

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ENCLOSURE 1

WATTS BAR NUCLEAR PLANT
NRC SEPTEMBER 1991 CIVIL CALCULATION AUDIT
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CONCRETE

Item AU-01-NRC Request:

TVA needs to explain the methodology of limiting live loads on the total population of slabs.

TVA Response:

The live load drawing for the total population of slabs has been revised (DCN S16590) to show the permissible operating and outage floor live loads by area. The permissible floor live loads for the remaining population of slabs were established through a process of comparing individual slab attributes (span, thickness, reinforcement), existing loads, and loading requirements to those of the worst case slabs. This comparison is documented in calculation WCG-1-1187. Reference audit response AU-01.

Item AU-05-NRC Request:

TVA needs to perform a generic review for slab areas around columns to determine if the punching shear calculation used an average of the finite element reaction forces rather than the total summation of reaction forces.

TVA Response:

A generic review was performed, and only one other case was determined to have used a reaction force average rather than a total summation of reaction forces in the calculation of the punching shear. The calculation, WCG-1-923, has been revised to use the summation of reaction forces for the calculation of punching shear. Reference audit response AU-05.

ITEM AU-10-NRC Request:

TVA should show the validity of reaction forces and adequacy of the finite element model at the boundary of the slab for calculation WCG-1-923. This evaluation should also be extended to finite element models used for the evaluation of other slab areas.

TVA Response:

The arrangement of the equipment and the positioning of the columns supporting the one-foot thick slab at elevation 737 between column lines "r" and "t," as shown on Sketch 1 of Attachment 1, is one of the worst case slab loadings due to the component cooling water heat exchangers. The slab model spans between column lines "r" and "t." The conditions along column line "r" have a continuous beam and were therefore vertically restrained in the model. The conditions along column line "t" have a series of slabs of different thicknesses, intersecting walls and drop panels for columns (see Sketch 2). All slabs thicker than one foot were restrained in the vertical direction while one-foot thick slabs were freed. This model of the boundary conditions resulted in the reaction patterns at column line "t," which include irregular downward and some upward reactions in the vicinities of the freed slab edges. These effects of the idealized model along column line "t" are localized largely in the vicinity of the boundary itself, and rapidly attenuate with distance away from the column line. Sketch 3 provides a deflected shape along the column line "t" at an offset of 4 feet. In contrast the structural behavior of the slab away from column line "t" and in the areas of expected high stress is realistic and accurate. Therefore, the model used in calculation WCG-1-923 is adequate for the evaluation of the slab around column line "s."

TVA has reviewed the slab calculations completed within the Civil/Seismic program and only the reactor fill slab calculation used finite element analysis. This calculation has been reviewed and we have determined that the model is adequate to represent the actual conditions and loadings.

EMBEDDED PLATES

Item AU-11a-NRC Request:

TVA to revise calculation WCG-1-873 to include the consideration of attachment locations in worst case embedded plate determinations.

TVA Response:

As discussed in the audit responses to Items AU-11a and 11b, the worst case selection, Calculation WCG-1-873, will be revised to document the consideration of attachment locations in worst case embedded plate selection. This calculation is scheduled to be completed by June 12, 1992.

Item AU-11b-NRC Request:

TVA to revise calculation WCG-1-873 to include the consideration of shear in selection of worst case embedded plates.

TVA Response:

As discussed in the audit response to Items AU-11a and 11b, the worst case selection, WCG-1-873, will be revised to document consideration of shear in the selection of the embedded plates. This calculation is scheduled to be completed by June 12, 1992.

Item Number AU-12-NRC Request:

TVA calculations WCG-1-848 and WCG-1-841 used an elliptical formula for calculating the interaction of tension and shear in the stud anchors. However, calculations WCG-1-845 and WCG-1-837 used a straight line formula for the same interaction. TVA should justify the use of the elliptical formula used in calculations WCG-1-848 and WCG-1-841.

TVA Response:

The 1.7 (or 5/3) exponent in the elliptical interaction equation for existing attachments is described in "Headed Steel Anchor Under Combined Loadings," American Institute of Steel Construction (AISC) Volume 10, Appendix B. The use of the elliptical interaction equation is documented in TVA Design Standard DS-C1.7.1 which has been previously reviewed by the staff (see referenced NRC audit summary dated January 31, 1992).

Item Number AU-13-NRC Request:

In calculation WCG-1-841, TVA should justify why the vertical force (Fy) obtained from the STRUDL computer analysis is lower for SSE than for OBE.

TVA Response:

The vertical force (Fy) used in calculation WCG-1-841 was obtained from calculation WCG-1-769. The STRUDL output, as shown in WCG-1-769, shows the loading case of DL + LL (Fy = 1796#) as the controlling load case for Fy. The tables presented in calculation WCG-1-841 did not clearly show that the SSE load (Fy = 529#) exceeds the OBE load (Fy = 477#). The DL + LL is the controlling case due to the reduction in the live load considered for the OBE/SSE load combinations. (Reference Section 2.6.2.2 of report for the September 9-13, 1991, Civil Calculation Audit dated January 31, 1992).

GEOTECHNICAL

Item - Intake Channel Slope Stability Analysis-NRC Request:

a) It was requested that TVA reanalyze the slopes immediately adjacent to the Intake Channel using the actual slope configurations and selecting soil strength properties based either on conservative assumptions or specific laboratory data.

b) In addition, it was suggested that TVA consider the impact of coincident vertical and horizontal ground motions in the reanalysis.

TVA Response:

a Calculation WCG-1-547 has been revised to provide a reanalysis of the slopes adjacent to the Intake Channel. As stated in the FSAR 2.5.5.2.3, TVA has acknowledged that strength loss may occur in alluvial sands during an earthquake. TVA considered the magnitude of the strength reduction, 50% for cohesion and 30% for the angle of internal friction, as reasonable and conservative. This was reviewed by the NRC staff as part of the soil liquefaction studies performed in 1982.

During the April 15-19, 1991 audit of the Intake Channel Slope Stability Analysis, the staff had questions as to the appropriateness of the reductions used by TVA, and TVA agreed to perform a parametric study of reductions for cohesion and angle of internal friction. The parametric study, which investigated 14 combinations of strength reductions, is contained in Appendix B of the revised calculation WCG-1-547 (Attachment 2). The lowest factor of safety revealed in the parametric study was 1.06 which exceeds the minimum allowable safety factor of 1.0. Additionally, the revised calculation tabulates various conservatism in the analysis and interpretation of the laboratory test data.

b) Please refer to our previous response provided and reviewed by the staff. (Attachment 3)

Item - Safety Related Buried Piping-NRC Request:

The stress acceptance criteria presented in WCG-1-867 indicates that all piping is qualified under ASME Code Equation 10A. It was the staff's understanding that this ASME criteria may not be appropriate for buried piping. Therefore, it was recommended that the appropriateness of criteria used should be fully qualified.

TVA Response:

The Essential Raw Cooling Water (ERCW) and High-Pressure Fire Protection (HPFP) piping is classified as ASME piping and therefore must comply with the ASME code. The provisions of Proposed Code Case N-XXX, "Alternate Rules for Analysis of Class 2 and 3 Buried Piping," were examined and confirmed the applicability of ASME Code equation 10A.

Item - Safety-Related Buried Piping-NRC Request:

Several questions remain for the stress calculations of the section of pipe located at the pipe cradle near the Intake Pumping Station, which can be summarized as follows:

a) The effects of surface overburden (soil, protective slab, surface loads, etc.) have not been incorporated into this calculation, even though the pipe is not directly supported by either the ground or the cradle.
b) The length of unsupported pipe is assumed in this calculation, even though the length can be calculated using standard strength of materials approaches.
c) The effects of lift-off of the pipe from the cradle has not been considered.
d) The effects of the concentrated force developed by the cradle at its end point on the pipe stresses (stress concentration effects, local buckling, etc.) has not been considered.

TVA Response:

Several pages of the calculation WCG-1-867 (Attachment 4) provided response to the stated issue. Page 5 of WCG-1-867 describes the methodology used to calculate the unsupported length of pipe between the cradle and settled ground. The length used has been determined as a function of overburden (Page 6), pipe stiffness and weight (Page 7), and site specific soil settlement (Page 7).

In order to provide for a transition and avoid concentrations at the end of the pipe cradle, a layer of sand was provided between the pipe and the cradle. This is depicted on drawing series 17W302.

Item - Sheetpile Walls at the Intake Pumping Station (IPS)-NRC Request:

"Seismic Analysis of Earthfill Contained by Sheetpile Walls at the IPS" calculated that the maximum potential dynamic shear stresses developed within the soils held between the sheet pile walls were well below the shear strengths of the compacted fill material computed from the dead weight of the soil for the column. This calculation was based on an assumption of the linear distribution of acceleration within the soil column where the dynamic shear stresses are computed. However, the complete analytic solution indicated that shear stresses and acceleration levels developed within the soil column are frequency dependent, with the peak stresses not varying linearly. Although there is no significant difference in the results, TVA agreed to modify the calculation for completeness and accuracy of the wall design.

TVA Response:

This calculation CEB820604002 will be revised for completeness to document the frequency dependency of acceleration levels and shear stresses by June 12, 1992.

Item - Rock Bearing Pressures-NRC Request:

TVA needs to verify that the maximum rock bearing pressures under the rock supported structures are less than the allowable pressure.

TVA Response:

TVA has evaluated rock bearing pressures for the Reactor Building as a worst case due to its high aspect ratio (height to width) and foundation size. The rock bearing pressure was determined to be 20.2 ksf which is less than the allowable stated in the Design Criteria WB-DC-20-1, "Concrete Structures General," Section 2.2.1, Rock Bearing Capacity - 180 psi (26 ksf).

VERTICAL TANKS

Item - Nozzle Evaluation NRC-Request:

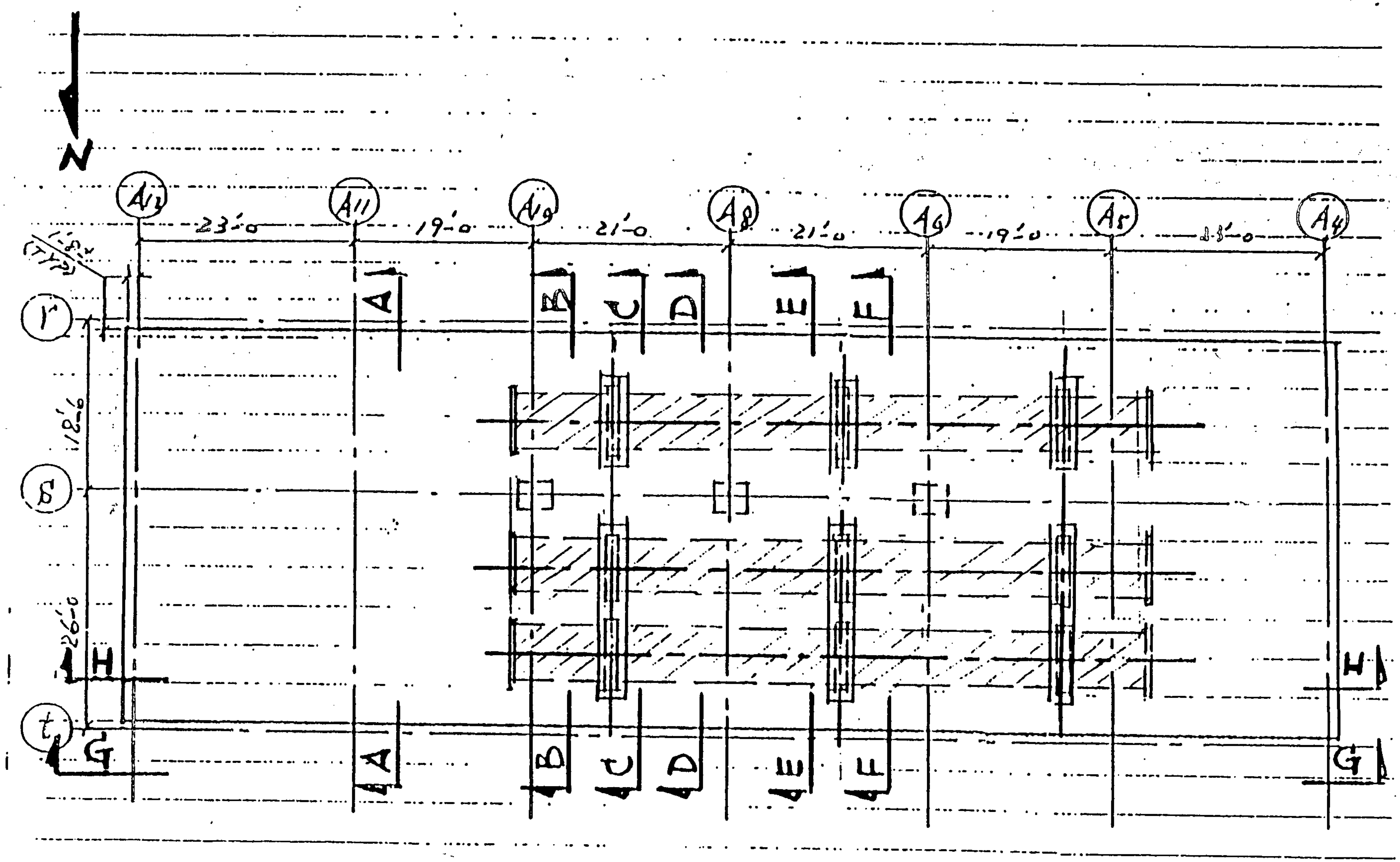
The structural integrity evaluation of nozzles at the piping to tank connections were not reviewed by the NRC since calculations were not available at the time of the audit.

TVA Response:

The structural integrity evaluation of nozzles at the piping to tank connections is a load interface between engineering groups responsible for the seismic qualification of piping and components. Calculations WCG-1-355 and WCG-1-356 provide design input for the evaluation of the refueling water storage tank (RWST) and commodities attached to it. These calculations have been used as design input for piping analysis and cross referencing has been verified. New nozzle loads from the analyzed piping were compared to allowables. The nozzles have been evaluated and found to be acceptable.

ATTACHMENT 1

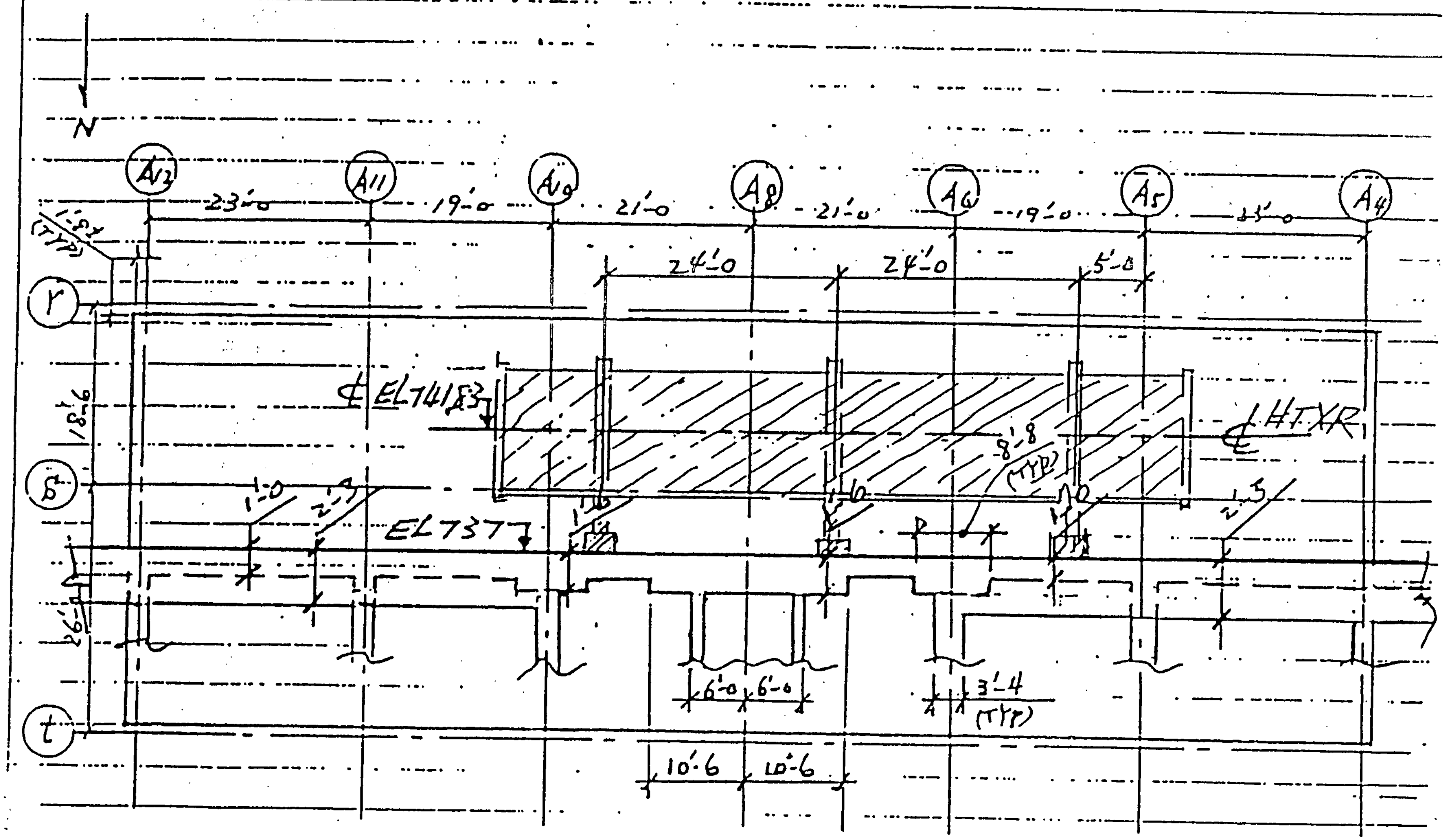
ONE FOOT THICK SLABS AT ELEVATION 737



PLAN OF SLAB AT EL 737

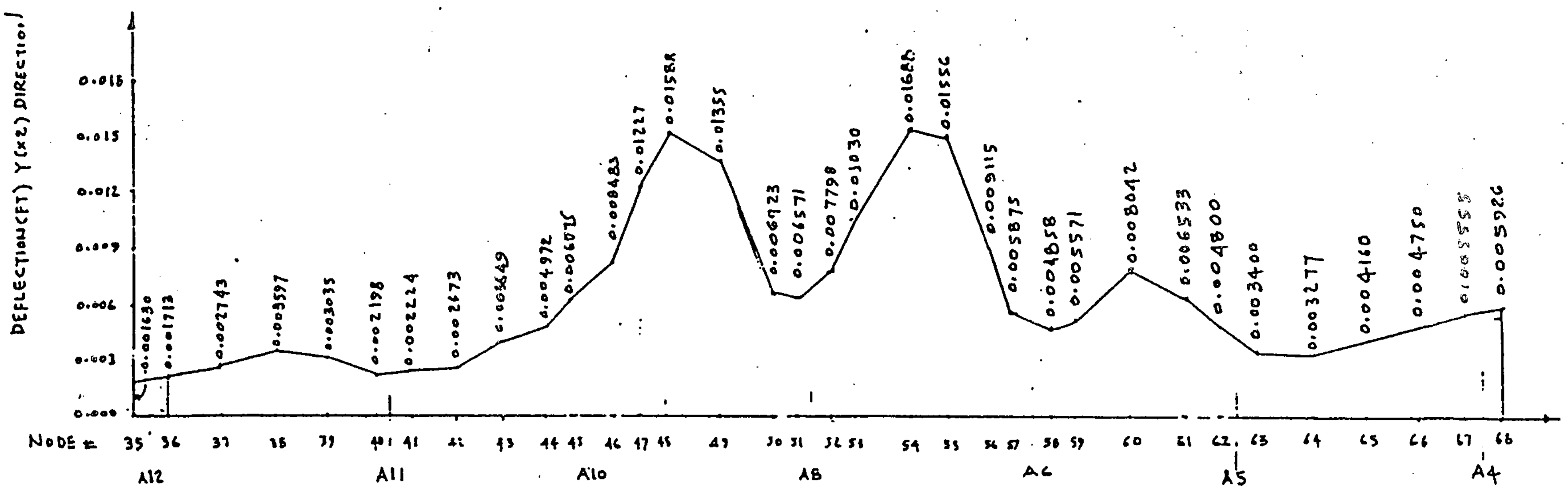
SKETCH 1

ATTACHMENT 1
PAGE 1 OF 3



SECTION THRU (t) SUPERIMPOSED ON PLAN

SKETCH 2



SECTION H-H.

SKETCH 3

ATTACHMENT 1
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