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SUBJECT: Forwards response to RAI re GL 87-02,including responses to nine items from NRC staff & seismic evaluation work sheets.

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March 10, 1997

AEP:NRC:1040E

Docket Nos.: 50-315
50-316

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

Gentlemen:

Donald C. Cook Nuclear Plant, Units 1 and 2
RESPONSE TO NRC LETTER REQUEST FOR ADDITIONAL
INFORMATION RELATED TO COOK NUCLEAR PLANT'S RESPONSE
TO GENERIC LETTER 87-02 (TAC NO. M69437)

By letter dated October 21, 1996, the NRC requested additional information regarding our January 30, 1996, response to generic letter 87-02. The following attachments contain the requested information.

Attachment No. 1 - contains the responses to the nine items from the NRC staff.

Attachment No. 2 - contains the sample seismic evaluation work sheets (SEWS) and anchorage calculations as requested in item 2.

Attachment No. 3 - contains the sample SEWS and anchorage calculations for tanks and heat exchangers as requested in item 5.

Attachment No. 4 - contains the seismic adequacy calculations for tanks 1-TK-33 and 2-TK-32 as requested in item 6.

Attachment No. 5 - contains the SEWS and anchorage calculations for horizontal tanks and heat exchangers as requested in item 7.

Attachment No. 6 - contains the calculations for limited analytical reviews (LARs) of the cable and conduit raceways as requested in item 8.

Sincerely,

E E Fitzpatrick

E. E. Fitzpatrick
Vice President

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 10th DAY OF March 1997

Jan Watson
Notary Public

My Commission Expires: ________

JAN WATSON
NOTARY PUBLIC, BERRIEN COUNTY, MI
MY COMMISSION EXPIRES FEB. 10, 1999

vlb

Attachments

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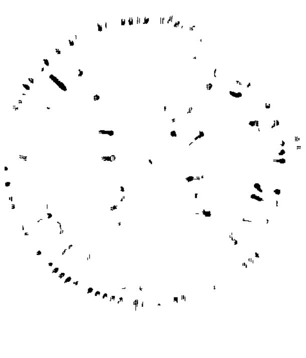


cc: A. A. Blind
A. B. Beach
MDEQ - DW & RPD
NRC Resident Inspector
J. R. Padgett

ATTACHMENT 1 TO AEP:NRC:1040E

RESPONSES TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) RELATED TO COOK NUCLEAR PLANT'S RESPONSE TO GENERIC LETTER 87-02 (TAC NO M69437)

9703170230

RESPONSE TO THE USNRC REQUEST FOR ADDITIONAL INFORMATION
UNRESOLVED SAFETY ISSUE USI A-46 REVIEW FOR
DONALD C. COOK NUCLEAR PLANT, UNITS 1 & 2

1) **With respect to Section 2.2, page 2-2, discuss the engineering basis for using the In-Structure Response Spectra (ISRS) developed for the Diesel Generator Building to determine loads in the Auxiliary Building at Elevation 609 feet, and provide the Diesel Generator Building and Auxiliary Building ISRS.**

The basis for using the ISRS developed for the diesel generator building to determine loads in the auxiliary building at elevation 609 feet is provided in the third full paragraph of page 2-2 of the final Seismic Evaluation and Walkdown Summary Report submittal. This paragraph states: "The ISRS are not available at some of the floor elevations where safe shutdown equipment is located. When this is the case, either the ISRS for a higher elevation or the ISRS developed by a linear interpolation between existing ISRS may be used in the evaluation. In the case of the auxiliary building elevation 609 feet, since the interpolated ISRS are very close to the corresponding ISRS for the diesel generator building, the ISRS for the diesel generator building were used."

To further illustrate this basis, figure 1 shows a plot of four ISRS (SSE, 5% equipment damping) for the elevations in question. These spectra include the auxiliary building 587' and 633' elevations which are the elevations where developed spectra exist directly above and below the 609' elevation, and the spectra at 609' in the diesel generator building. In addition to these spectra, a 609' auxiliary building spectra is provided that was generated by interpolating the spectral acceleration values at 587' and 609'. The auxiliary building and diesel generator building share a common foundation mat. As shown in figure 1, there is essentially no difference between the diesel generator spectra at 609' and the interpolated auxiliary building spectra at 609', and, therefore, there is no engineering significance with regard to the load determination if either of these are used.

With regard to the diesel generator building and auxiliary building ISRS, the ISRS for all elevations of all buildings at Cook Nuclear Plant included in the USI A-46 evaluation for 2% and 5% equipment damping have been provided in appendix B of the final Seismic Evaluation and Walkdown Summary Report submittal.

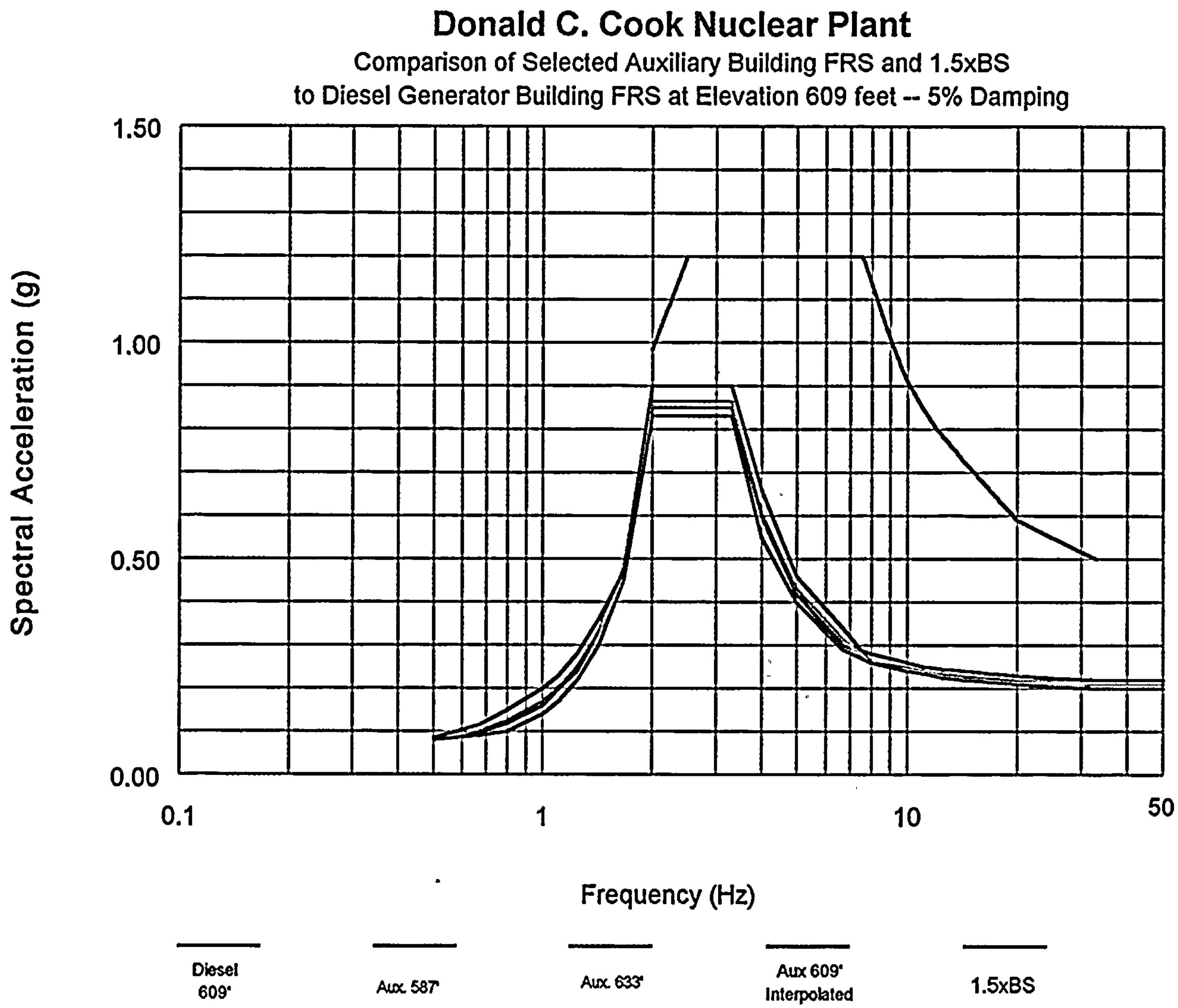


Figure 1 ISRS for D.G. Building El 609' Compared to ISRS for Auxiliary Building El. 587', 609' & 633' - 5% Damping

2) **Discuss key examples of designated "rigorously analyzed anchorages," (page 4-6) using hand calculations and ANCHOR4 software package and provide copies of their engineering calculations. Also discuss a few cases of anchorage verification based on the results of tug tests conducted and provide a description of the tests and applicable engineering justification for such an approach.**

Table 1 provides a list of key examples of equipment items with varying levels of anchorage evaluations. These examples include "rigorously analyzed anchorages," comparisons to analyzed equipment items and judgments based on the anchorage inspection and in some cases judgments supplemented by tug tests. Copies of the completed seismic evaluation work sheets (SEWS), the analysis (if applicable) and the corresponding anchorage inspection sheets are included in attachment 2 of this response to the RAI for those items marked with a * in table 1. When comparison or judgment was used to satisfy the GIP anchorage criteria an appropriate description of the evaluation is documented in the notes of the SEWS. The anchorage inspections and installation testing performed for the Cook Nuclear Plant USI A-46 evaluations, discussed in greater detail in the response to RAI question 4, greatly exceed the requirements of the GIP. This provides greater confidence in the judgments made by the seismic review team (SRT) that capacity greatly exceeded demand when a formal anchorage calculation was not made.

A review of notes within the data base for each equipment item in the Cook Nuclear Plant USI A-46 effort was conducted in order to respond to this request for additional information (RAI). Anchorage evaluations performed can be categorized as follows: a) a detailed ANCHOR4 evaluation was performed; b) a detailed hand calculation was performed; c) the anchorage was screened based on an anchorage evaluation on an identical item of equipment and anchorage or a worst case evaluation of a similar equipment item; or d) the SRT judged, based on the weight and anchorage of the equipment, that the anchorage obviously met the GIP screening criteria.

In some cases when method (d) was used, a tug test was performed. This was performed by an SRT member that would tug on the assembly in the weakest direction to a level of about two times the estimated weight of the item. The tug test from a practical standpoint was unnecessary due to the relative light weight and robust anchorage of the equipment. Each anchorage evaluation whether detailed or by judgment was based on a detailed anchorage inspection and the SRT inspection. Items tug tested were in general light weight components.

Samples of detailed analysis performed by ANCHOR4 and by hand calculations are included with the sample SEWS in attachment 2. When judgment was used the basis for the judgment is included in the notes section of the SEWS. The detailed anchor inspection documentation is also included with each SEWS provided.

The engineering justification for the approach used for performing the anchorage evaluations is described in section 4.4, page 4-26 second paragraph of the Rev. 2 GIP. This paragraph states: "There are various combinations of inspections, analyses, and engineering judgment which can be used to verify the adequacy of equipment anchorage. The Seismic Capability Engineers should select the appropriate combination of elements for each anchorage

installation based on the information available. For example, a simple hand calculation may be sufficient for a pump which has only a few, very rugged, anchor bolts in a symmetrical pattern. On the other hand, at times it may be advisable to use one of the computer codes to determine the loads applied to a multi-cabinet motor control center if its anchorage is not symmetrically located." The anchorage evaluations used the appropriate combinations of elements necessary to determine that any screened equipment met the GIP criteria.

Table 1 provides a brief description of the anchorage evaluation performed. There is a good cross section of examples that include all equipment classes on the Cook Nuclear Plant safe shutdown equipment list (SSEL) (1 to 20) and categories of anchorage evaluations performed. Examples of class 0 and 21 anchorage evaluations are provided in response to RAI questions 5 and 7.

Table 1
Examples of Anchorage Evaluations

Class	Equipment ID	Anchorage Evaluation Performed
1	1-AB-N	Three section MCC. Detailed ANCHOR4 evaluation performed.
1	1-ABD-A*	Six section MCC. Detailed ANCHOR4 evaluation performed.
1	2-ABV-A	Six section MCC. Detailed ANCHOR4 evaluation performed.
1	2-AM-D	Eight section MCC. Detailed ANCHOR4 evaluation performed.
1	2-EZC-D	Eleven section MCC (including attached EZC-BS). Detailed ANCHOR4 evaluation performed.
2	1-11A	Large Multisection 600V Switchgear. Detailed ANCHOR4 evaluation performed.
2	1-52-RTB	Reactor Trip Breaker Units composed of 4 breaker vertical sections. Detailed ANCHOR4 evaluation performed.
2	2-21B	Large Multisection 600V Switchgear. Detailed ANCHOR4 evaluation performed.
3	2-T21B	Large Multisection 4KV Switchgear. Detailed ANCHOR4 evaluation performed.
3	1-T11A	Large Multisection 4KV Switchgear. Detailed ANCHOR4 evaluation performed.
4	1-CRID-III-CVT	Small Transformer 4'-6" x 2'-6" x 2'-4". Weight estimated at 1180 lbs. Detailed ANCHOR4 evaluation performed.
4	1-TR11B	Large supply transformer. Detailed ANCHOR4 evaluation performed.
4	2-CRID-I-CVT*	Small Transformer 4'-6" x 2'-6" x 2'-4". Weight estimated at 1180 lbs. Detailed ANCHOR4 evaluation performed.

Table 1 (Continued)
Examples of Anchorage Evaluations

Class	Equipment ID	Anchorage Evaluation Performed
4	2-TR-ELSC	Small Transformer 20" D x 30" W x 36" H. Detailed ANCHOR4 evaluation performed.
5	1-PP-10W*	900 GPM pump. Detailed ANCHOR4 evaluation performed including nozzle loadings on the suction and discharge piping.
5	1-PP-4	440 GPM pump. Detailed ANCHOR4 evaluation performed including nozzle loadings on the suction and discharge piping.
5	1-PP-50W	Large Pacific Pump with a weight of 20,000 lbs. Detailed ANCHOR4 evaluation performed.
5	1-QT-111-AB	Small 90 GPM Pump - weight about 800 lbs. Detailed ANCHOR4 evaluation performed.
5	12-PP-31S	100 GPM pump - 2076 lbs. Detailed ANCHOR4 evaluation performed.. Item was designated an outlier until nozzle loads are defined.
5	2-PP-26N	Pacific Pump - total weight 5500 lbs. Detailed ANCHOR4 evaluation performed including nozzle loadings on the suction and discharge piping.
5	2-PP-3E	Large Ingersoll Rand Pump - 7935 lbs. Detailed ANCHOR4 evaluation performed.
5	2-PP-46-4*	Small Goulds Pump - 511 lbs. Nozzle loads judged to be small by SRT. Anchorage screened by judgment after review of the anchorage inspection documentation (four 5/8" anchors) and the walkdown.
5	2-PP-82S	Small Goulds Pump - 214 lbs. Nozzle loads judged to be small by SRT. Anchorage screened by judgment after review of the anchorage inspection documentation (four 5/8" anchors) and the walkdown.
5	2-QT-106-CD1	Small Worthington Pump - 135 lbs. Detailed ANCHOR4 evaluation performed including nozzle loadings on the suction and discharge piping.
6	1-PP-7W	Large vertical pump with a 45' long vertical casing. Screening of anchorage based on a review of existing qualification that included an anchorage evaluation.
6	2-PP-9W	Vertical pump. Detailed ANCHOR4 evaluation performed including nozzle loadings on the suction and discharge piping.
9	1-HV-AFP-BRE-2	Small light weight fan - 154 lbs. Anchorage accepted by judgment after a review of the anchorage drawings.

Table 1 (Continued)
Examples of Anchorage Evaluations

Class	Equipment ID	Anchorage Evaluation Performed
9	1-HV-AFP-M1*	Medium size fan - 500 lbs, mounted with 16 1/2" steel to steel bolts. Anchorage accepted by judgment after a review of the anchorage drawings.
9	1-HV-AFP-X1	Small light weight fan - 287 lbs, mounted with 12 3/8" steel to steel bolts. Anchorage accepted by judgment after a review of the anchorage drawings.
9	1-HV-CEQ-1	Large fan unit. Detailed ANCHOR4 evaluation performed.
9	12-HV-ESW-7*	Large fan unit. Detailed ANCHOR4 evaluation performed.
9	12-HV-ESW-1	Large fan unit similar to 12-HV-ESW-7. Anchorage screened based on comparison to ANCHOR4 evaluation for 12-HV-ESW-7.
9	2-HV-AFP-BRE-1	Small light weight fan - 154 lbs. Anchorage accepted by judgment after a review of the anchorage drawings.
9	2-HV-DGS-1	Large fan - 1531 lbs. Detailed ANCHOR4 evaluation performed.
9	2-HV-DGX-1	Large fan - 1100 lbs. Detailed ANCHOR4 evaluation performed.
10	1-HV-ACRA-1	Cooler unit with a weight estimate of 3000 lbs. Detailed ANCHOR4 evaluation performed.
10	1-HV-AES-1 (FLT)	Large filter unit - 24,000 lbs. Detailed ANCHOR4 evaluation performed.
14	1-AFW*	Small wall mounted panel (36" H x 20" W x 6" D). Panel estimated to weigh 50 lbs. Anchorage screened by judgment after a review of the anchorage description and a 100 lb. tug test.
14	1-BCTC-AB	Panel 38" W x 60" H x 9" D. Weight estimated at 300 lbs. Detailed ANCHOR4 evaluation performed.
14	1-CRCD	Rack 38" W x 84" H x 9" D - Weight estimated at 400 lbs. Detailed ANCHOR4 evaluation performed.
14	1-ELSC	Small wall mounted panel (36" H x 20" W x 6" D). Panel estimated to weight 50 lbs. Anchorage screened by judgment after a review of the anchorage description and a 100 lb. tug test.
14	1-ELSCX	Small distribution panel 57" H x 22" W x 6" D. Weight estimated at 370 lbs. Detailed ANCHOR4 evaluation performed.

Table 1 (Continued)
Examples of Anchorage Evaluations

Class	Equipment ID	Anchorage Evaluation Performed
14	1-MDAB	Wall mounted switchboard 38" W x 84" H x 9" D. Anchorage accepted by comparison to the ANCHOR4 evaluation performed for 1-MCAB.
14	1-TDAB	Wall mounted switchboard 38" W x 84" H x 9" D. Anchorage accepted by comparison to the ANCHOR4 evaluation performed for 1-MCAB.
14	1-VDCD-1 & 2	Pair of 22" W x 38" H x 7" D distribution panels. Anchorage accepted by comparison to the ANCHOR4 evaluation performed for 1-VDAB-1 (Identical Construction).
14	2-AFWX	Wall mounted panel - 57" H x 22" W x 6" D. Weight estimated at 100 to 150 lbs. Anchorage screened by judgment after a review of the anchorage description and a tug test.
14	2-BATT-N-SH	Wall mounted Battery Shunt. Weight estimated at 100 lbs. Anchorage screened by judgment after a review of the anchorage description, the ANCHOR4 evaluation performed for 1-BATT-N-SH and a tug test.
14	2-DCN	Switchboard bolted to a steel rack. Anchorage screened based on comparison to the ANCHOR4 analysis for similar panel 1-DCN.
14	2-VDAB-1 & 2	Pair of 22" W x 38" H x 7" D distribution panels. Anchorage screened based on comparison to the detailed ANCHOR4 evaluation performed for similar panel 1-VDAB-1.
15	2-BATT-AB*	Substantial 2 - step battery rack. Anchorage evaluation based on a review of existing anchorage and recent modifications made to the racks.
16	1-BC-AB1	Battery Charger 3025 lbs. Detailed ANCHOR4 evaluation performed.
16	1-CRID-I-INV	Inverter 2'-5" x 3' x 6'-3" - 2100 lbs. Detailed ANCHOR4 evaluation performed.
16	2-BC-A	Battery Charger 32" L x 24" W x 46" H. Detailed ANCHOR4 evaluation performed.
16	2-DGAB-INV	Inverter 28" x 28" x 57". Detailed ANCHOR4 evaluation performed.
17	1-OME-150-AB*	Large Diesel Generator. Anchorage capacity for 2-OME-150-CD indicated an additional margin of 36. Anchorage screened based on comparison to that evaluation.

Table 1 (Continued)
Examples of Anchorage Evaluations

Class	Equipment ID	Anchorage Evaluation Performed
18	1-CLI-113	Small transmitter - 27 lbs. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
18	1-CPS-317	Small 9" x 9" panel. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
18	1-CPS-410	Rack supported device. One detailed ANCHOR4 analysis was performed to encompass 1-CPS-410, & 420 and 2-CPS-410 & 420.
18	1-MPP-232	Small pressure transmitter - 35 lbs. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
18	1-NPP-151	Small pressure transmitter - 24 lbs. including bracket. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
18	2-BLI-110	Instrument on small, stiff bracket. Assembly weighs less than 100 lbs. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
18	2-CLI-113	Transmitter bolted to support composed of a small diameter pipe. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
18	2-CPS-410	Small device on a rack. Detailed ANCHOR4 evaluation performed.
18	2-FFI-210	Transmitter bolted to support composed of a small diameter pipe. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
18	2-IFI-311	Transmitter bolted to support composed of a small diameter pipe. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
18	2-IFI-51	Transmitter bolted to support composed of a small diameter pipe. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.

Table 1 (Continued)
Examples of Anchorage Evaluations

Class	Equipment ID	Anchorage Evaluation Performed
18	2-XRV-153	Small rack consisting of a small panel bolted to P1000 unistruts. Anchorage screened by judgment after review of the anchorage inspection documentation and the walkdown.
19	1-VTS-356	Light weight component - 5 lbs. Anchorage screened by judgment after review of the anchorage inspection documentation, the walkdown and a tug test.
20	2-A11*	Relay panel included in a section of panel from A6 to A15. Weight estimate of entire panel 3000 lbs. Detailed ANCHOR4 evaluation performed.
20	1-ACRA-2	Stand alone panel 24" L x 24" D x 84" H. Weight estimated @ 700 lbs. Detailed ANCHOR4 evaluation performed.
20	1-CAS	Large Control Panel 24'-6" L x 6'-3" D x 7' H. Hand calculation performed on the weak link in the anchorage system and found to be more than adequate.
20	1-DGAB	Large Control Panel in Diesel Generator Room. Detailed ANCHOR4 evaluation performed.
20	1-GR-1	Relay Rack 6'-6" L x 8' H. Weight estimated @ 300 lbs./lineal foot of rack. Hand calculation performed on the weak link in the anchorage system and found to be more than adequate.
20	1-HSD1	Walkthrough cabinet 12' W x 6' D x 8' H. Detailed ANCHOR4 evaluation performed.
20	1-NRI-23-ISO	Heavy duty rack. Anchorage judged adequate based on review of the anchorage inspection documentation, the walkdown and the obvious ruggedness and installation of this new design.
20	2-CG2	Control cabinet 5'-6" L x 2'-6" W x 7'-7" H. Anchorage screened based on comparison to the ANCHOR4 evaluation performed for similar panel 1-RPC-1.
20	2-PRZ	Item is included in a Control Panel with two other items. Total panel is 12'-3" L x 8' H. Weight estimated at 300 lbs/lineal ft. Anchorage screened based on comparison to the ANCHOR4 evaluation performed for 1-SG.
20	2-RPS-A	Relay cabinet 90" W x 30" D x 90" H, welded to embedded steel. Detailed ANCHOR4 evaluation performed.
20	2-SWRR	Cabinet 16' L x 8' H x 18" D. Weight estimated at 300 lbs/lineal ft. Detailed ANCHOR4 evaluation performed.

3) **Table 4.5 shows that the 1.5 x Bounding Spectrum and the GERS with an amplification factor of 7 do not envelope the floor response spectra. Provide copies of the seismic demand versus capacity spectral comparison.**

The location of the devices that are documented as outliers in table 4.5 are at elevation 687' in the containment building. Figure 2 shows a comparison of the ISRS at elevation 687' in the containment building to 1.5 times the bounding spectrum. The GERS must be compared to 1.5 times the demand spectra for median centered spectra because Cook Nuclear Plant response spectra was designated as median centered spectra by the NRC. An amplification factor through the piping and support of the piping system must also be considered when comparing GERS to the demand spectra. The GIP defines the upper bound amplification factor as 7. Therefore, the total ISRS was multiplied by 1.5 x 7 (10.5) to define the demand that is compared to the GERS. Figure 3 shows a comparison of the GERS for air operated valves (AOVs) to 10.5 x the ISRS at containment building elevation 687'. Figure 4 shows a comparison of the GERS for solenoid operated valves (SOVs) to 10.5 x the ISRS at containment building elevation 687'. Figure 5 shows a comparison of the GERS for motor operators to 10.5 x the ISRS at containment building elevation 687'. As shown in figures 2, 3, 4, and 5, the demand exceeds the capacity.

The outlier resolution for these items is to review the existing piping analyses and compare the demand acceleration from the analysis to the capacity acceleration. It is believed that the actual amplification factor is less than 7 and the capacity will be shown to be greater than the demand once the outlier resolution has been completed.

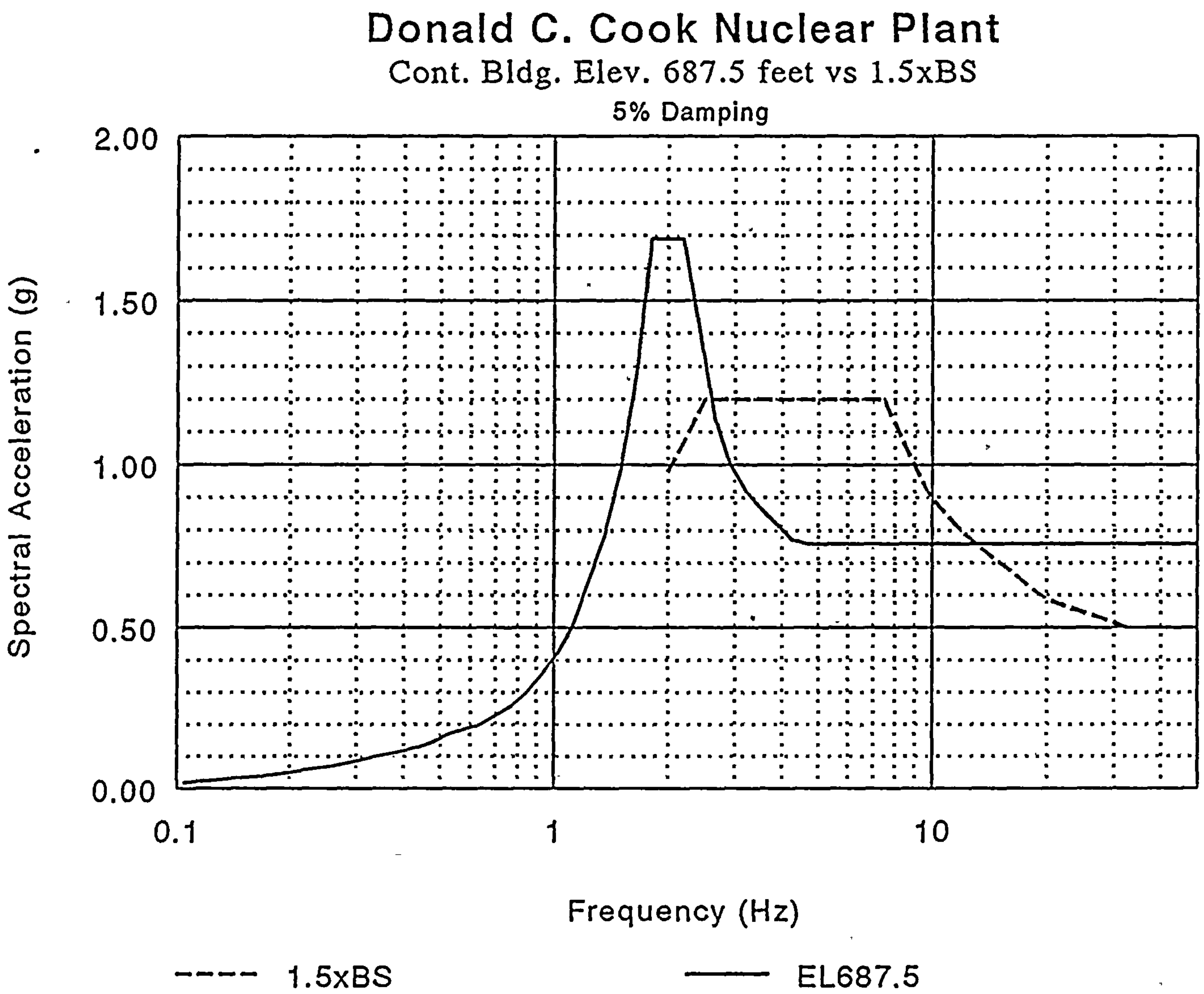


Figure 2 ISRS for Containment El. 637.5' Vs. 1.5 x Bounding Spectrum - 5% Damping

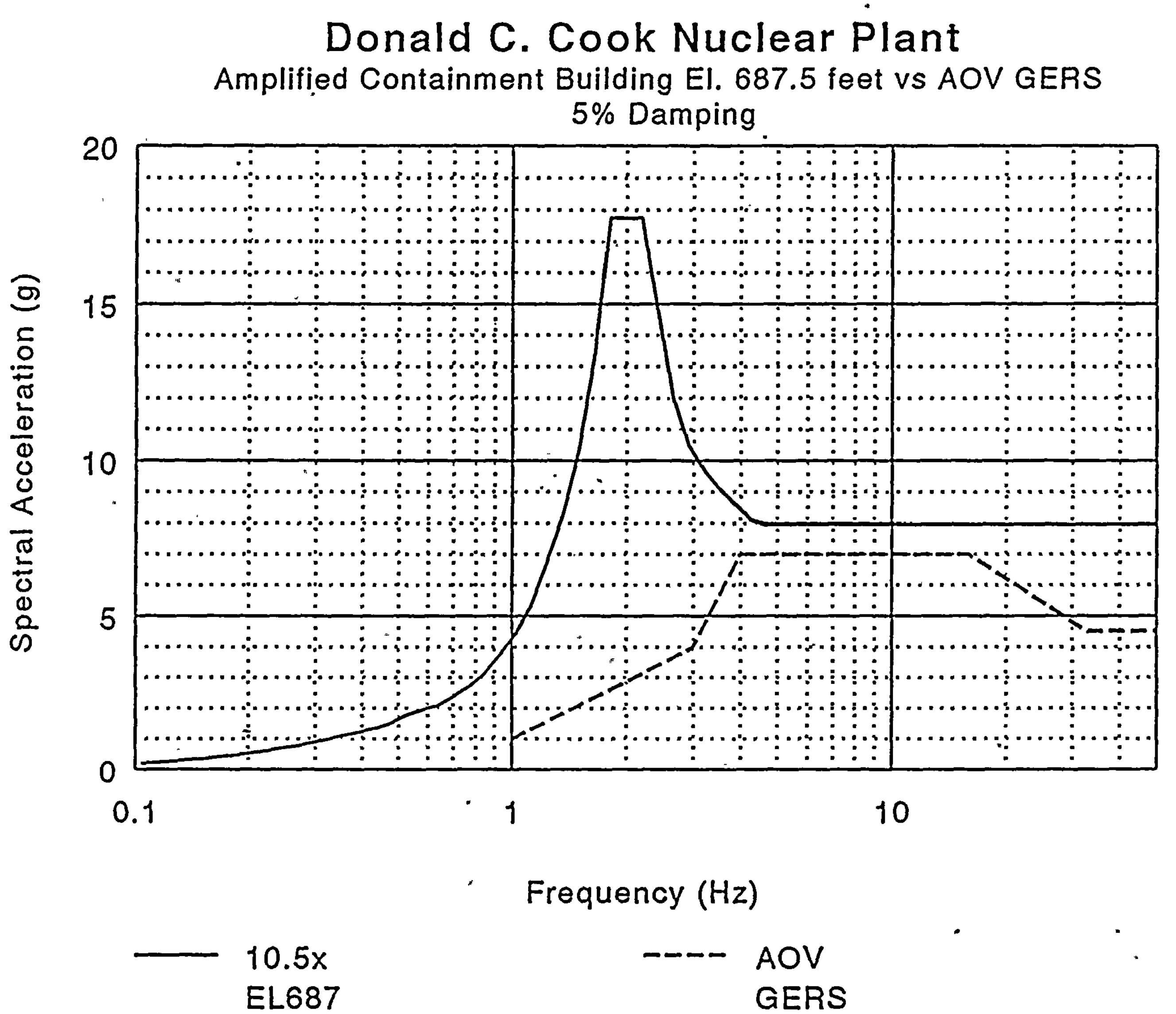


Figure 3 Amplified ISRS for Containment El. 687.5' Vs. AOV GERS - 5% Damping

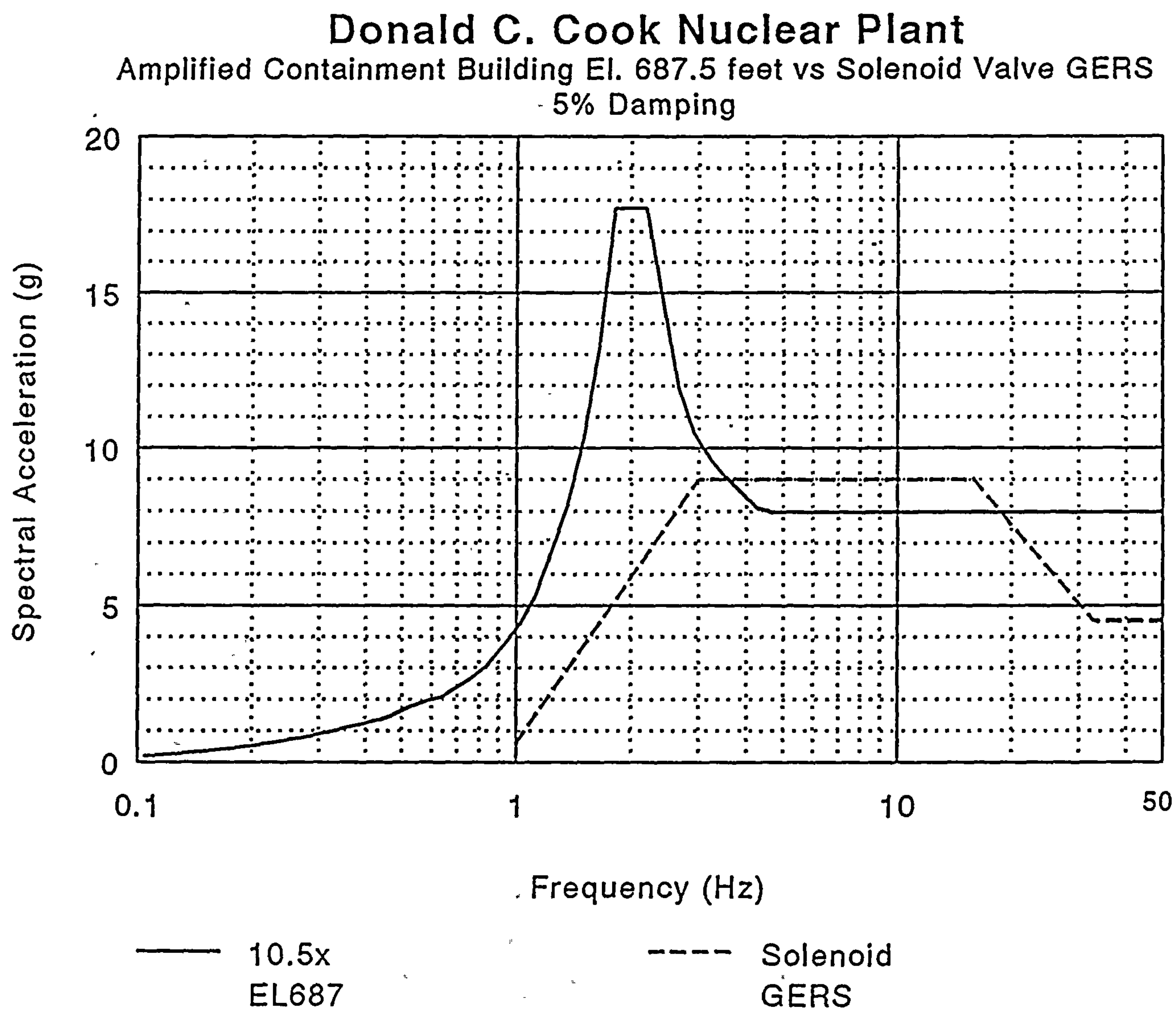


Figure 4 Amplified ISRS for Containment El. 687.5' Vs. Solenoid Valve GERS - 5% Damping

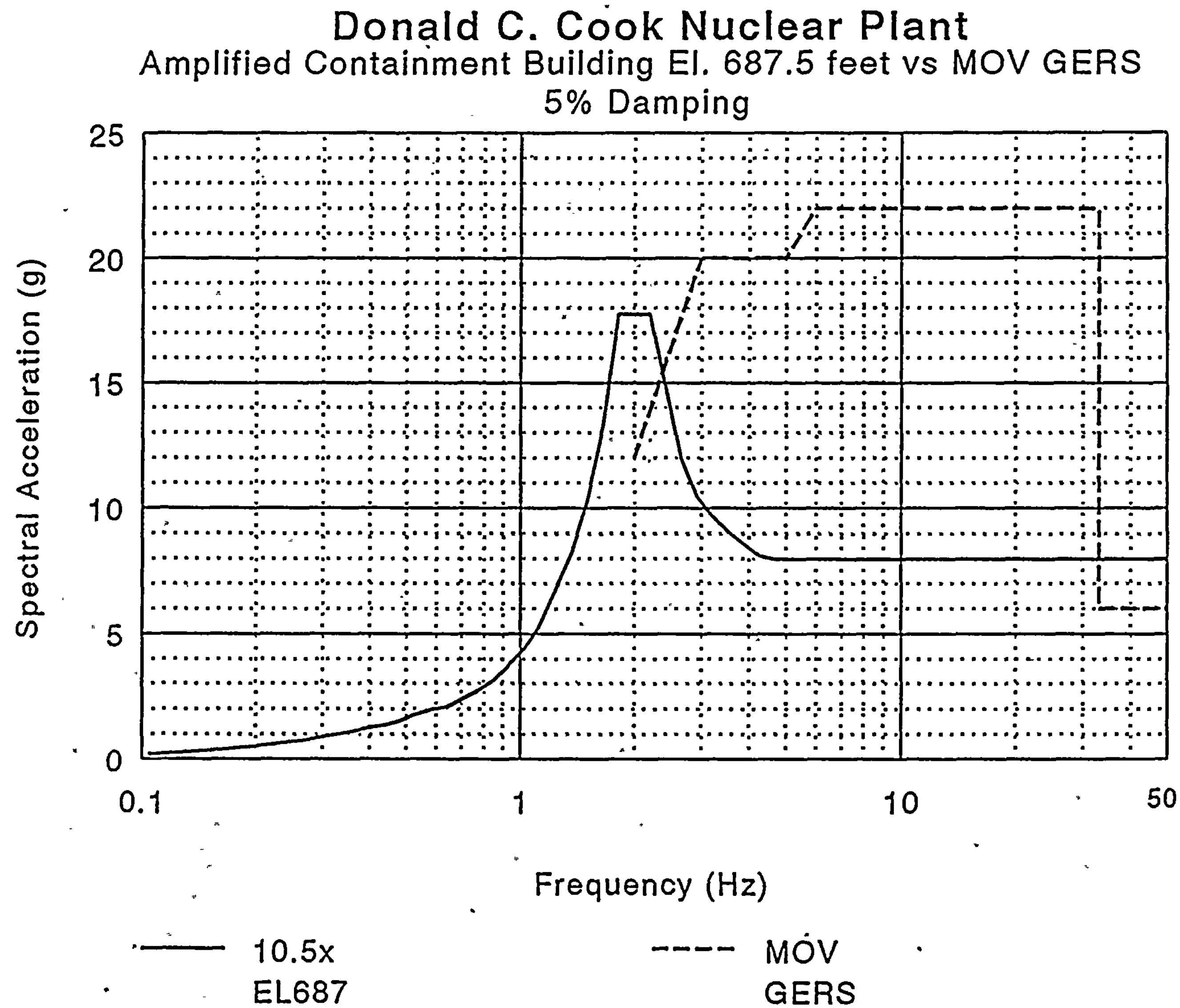


Figure 5 Amplified ISRS for Containment El. 687.5' Vs. Motor Operator GERS - 5% Damping

4) Regarding the tightness check of expansion anchors performed on a representative number of mechanical and electrical components, state whether the representative number meets the sample size for expansion anchor tightness check as listed on table C.2-4 of the GIP.

The number of expansion bolts tightness tested for the Cook Nuclear Plant USI A-46 effort exceeded the sample size for expansion anchor tightness check as listed on table C.2-4 of the GIP. Bolt tightness checks were conducted on every accessible expansion bolt in the scope of USI A-46 equipment on the SSEL. In addition all accessible steel to steel and cast-in-place bolts/nuts were visually inspected and loose nuts were tightened as needed. This was done to ensure that the bolts were snug and therefore active in the event of vertical reaction loadings on the anchorage during an earthquake. Other tests using ultrasonic techniques to determine embedment length and weld quality were also performed as an enhancement to the program. Anchorage inspection documentation is included with the SEWS in attachment 2 of this RAI.

When the type of expansion anchor used could not be positively determined, a 0.6 reduction factor for unknown expansion bolts was used in the anchorage evaluations performed in accordance with the GIP.

Inaccessible anchor bolts were not tightness tested. The GIP excludes inaccessible anchors from the sample and states in the second paragraph of section 4.4.1 that "all accessible anchorages should be visually inspected. All practicable means should be tried to inspect inaccessible anchorages or those obstructed from view if they are needed for strength to secure the item of equipment or if they secure equipment housing essential relays (to avoid impact or excessive cabinet motion). For example, it is not considered practicable to resort to equipment disassembly, removal, etc., to inspect inaccessible anchorages. The basis for the engineering judgment for not performing these inspections should be documented." The majority of anchorages for SSEL equipment were accessible. These anchorages were tightness tested, had their embedment length verified and were visually inspected by the anchorage inspection team and were again visually inspected by the SRT.

There were some fans that had inaccessible anchorages that would have required removal of fire protection material to inspect and disposal of material that could possibly be contaminated. This would not have been consistent with the ALARA goals at the site (dust and exposure). These fans had calculated or judgmental anchorage margins of 10 or greater and therefore were not inspected. Anchorages for these were primarily cast in place or steel to steel bolts and the tightness check was not required to be performed. The regenerative heat exchanger anchorages were also not visually inspected due to the time required to remove insulation and to perform the anchorage inspection in a high radiation area. There were also a number of wall mounted panels (class 14 and 20) that were not tightness checked. Tightness checking of these bolts would have required complete equipment disassembly and removal of the equipment. This activity would be contrary to section 4.4.1 of the GIP. These panels also had very high margins even when considering a 0.6 reduction factor for unknown expansion anchors. In the cases mentioned above, the engineering judgment for not performing the inspections were documented on the SEWS for the equipment item. There were also some cases when isolated bolts were not tested on a given assembly because they could not be reached without disassembly. These cases are documented in the anchorage inspection documentation.

5) **Table 5.1 shows only four (4) vertical tanks for GIP review. Provide the engineering criteria for selecting only four vertical tanks and the justification of the structural integrity of the other smaller vertical tanks for Safe Shutdown Earthquake (SSE). Indicate the number of vertical tanks supported on skirts and structural legs at Cook Nuclear Plant, Units 1 & 2.**

Table 5.1 of the final Seismic Evaluation and Walkdown Summary Report submittal includes only the flat bottom vertical tanks that may be evaluated using the GIP methodology in section 7 of the GIP. These tanks are described in the first paragraph of section 7.3.1 of the GIP which states: "The type of vertical tanks covered by the screening guidelines are large, cylindrical tanks whose axis of symmetry is vertical and are supported, on their flat bottoms, directly on a concrete pad or a floor."

The evaluation of the remaining tanks are documented in table 4-7 of the final Seismic Evaluation and Walkdown Summary Report submittal. Items 1 and 2 of table 4-7 "Commentary on Equipment Items Meeting the Intent of the GIP Caveats" discuss this evaluation. Item 1 includes class 0 equipment items and states "There are 50 and 51 equipment items identified as class 0 in unit 1 and unit 2 respectively. These items were primarily passive and were similar to items considered as components of the class 21 equipment. For these equipment items the SRT assessed the potential for seismic damage and made the necessary evaluations. All these items were at locations in the plant where 1.5 times the bounding spectrum is greater than the floor response spectra where they are located. Anchorage was evaluated using the GIP criteria." Item 2 includes class 21 tanks and heat exchangers not covered by the GIP criteria (section 7 of the GIP). This item states: "There are 63 and 58 equipment items identified as class 21 in unit 1 and unit 2 respectively. Of these tanks and heat exchangers, there were only 20 where the GIP criteria was applicable. The remaining 98 were evaluated by meeting the intent of the GIP criteria. Anchorage was evaluated using the GIP criteria."

The class 0 and 21 equipment items on the SSEL that may be categorized as tanks and heat exchangers for unit 1 and 2 are listed in tables 2 & 3, respectively. The table includes a description of the tank or heat exchangers configuration and anchorage evaluation. Included in that list are all tanks supported on skirts and structural legs that are on the Cook Nuclear Plant SSEL. Tanks on legs include 1,2-QT-113-AB1, AB2, CD1, CD2 (eight diesel oil filters); 1,2-QT-144-AB, CD (four diesel oil filters); 1,2-TK-10 (two reactor coolant letdown volume control tanks); 1,2-TK-11 (two boron injection tanks); 1-TK-12-N, 12-TK-12-M and 2-TK-12S (three boric acid storage tanks). Tanks on skirts include 1,2-TK-37 (two component cooling water surge tanks); and 1,2-QT-141, AB1, AB2, CD1, CD2 (eight diesel starting air receivers).

Sample SEWS (including the calculations and anchorage inspection documentation) are provided in attachment 3 for the tanks that have an * after the equipment ID in tables 2 and 3.

Table 2
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
0	1-QT-112-AB & CD (2 filters)	AB & CD EMERG DIESEL FULL FLOW LUBE OIL FILTERS	AUXILIARY	579	Small tank-like component containing oil, with a height of about 5', and a diameter of 3'. Weight full = 2707 lbs. Anchored by three 3/8" diameter J-bolts and three 5/8" wedge anchors at 60 degree intervals (i.e., evenly spaced). The anchorage was screened based on a review of an existing vendor calculation that indicated a high anchorage margin.
0	1-QT-113-AB1*, 113-AB2, 113-CD1, 113-CD2 (4 strainers)	AB & CD EMERG DIESEL FULL FLOW LUBE OIL STRAINERS	AUXILIARY	579	Strainer supported on 4 angle legs. Each leg is anchored by one 1/2" J-bolt anchor. The total weight is 1730 lbs. The ANCHOR4 analysis performed for 1-QT-113-AB1 and 1-QT-113-AB2 together, since they are connected by a relatively rigid piping segment, indicated that the anchorage was adequate. .
0	1-QT-116-AB & CD (2 heater tanks)	AB & CD EMERG DIESEL LUBE OIL HEATER (TANK)	AUXILIARY	579	Heaters anchored by three 3/8" J-bolts at 120 degrees apart, on a 5" high concrete pad. The weight of the tank is approximately 152.5 lbs. Anchorage screened by an ANCHOR4 evaluation.
0	1-QT-118-AB & CD (2 filters)	AB EMERG DIESEL BYPASS LUBE OIL FILTER	AUXILIARY	579	Filter anchored by three 3/8" J-bolts with a minimum embedment of 10.25", at 120 degrees. The approximate weight of the tank is estimated to be the same as 1-QT-112-CD (Wt =2707 lbs.), because the tanks are of the same manufacturer, and size, and both hold oil. Anchorage screened by an ANCHOR4 evaluation.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
0	1-QT-143-AB1, AB2, CD1 & CD2 (4 dryers)	AB EMERG DIESEL CONTROL AIR DRYER 1	AUXILIARY	58 7	Air dryer mounted on 2-1/2" x 2-1/2" x 1/4" angle steel frame with other air dryer tanks. Angle frame on 1-3/4" Grout Pad. Frame anchored by eight 1/2" non-shell type expansion anchors, four per base plate. Tanks hold air and are the size of fire extinguishers. Anchorage judged adequate based on the walkdown and review of the anchorage inspection documentation.
0	1-QT-144-AB & CD (2 filters)	AB EMERG DIESEL FUEL OIL TRANSFER FILTERS	AUXILIARY	58 7	Small filter 10" in diameter, 44" high, mounted on three angle legs anchored by three 5/8" Phillips Red Head Wedge/coupling anchors Anchorage screened based on an ANCHOR4 evaluation for 1-QT-144-AB.
0	1-TK-253-1, 2, 3 & 4 (4 tanks)	PRESSURIZER TR "B" PRESSURE RELIEF VALVE NRV-152 RESERVE CONTROL AIR TANKS	CONTAINMENT	61 2	This horizontal tank contains air and is supported by other than standard saddles: Tank is well welded to building steel, and judged adequate by the SRT.
0	12-TK-207	REACTOR PLANT NITROGEN BULK STORAGE TANKS #3,4,5,6,7,8	GROUNDS	60 9	Similar to a horizontal heat exchanger; each tank is approximately 2' in diameter and 20' long (about 15' between supports). Tank weight is about 4800 lbs. Anchorage consists of four cast-in-place (in buried concrete pedestals) 3/4" diameter J-Bolts. Anchorage screened based on an ANCHOR4 evaluation.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-HE-11	REACTOR COOLANT PUMP SEAL WATER HEAT EXCHANGER	AUXILIARY	609	Vertical Heat Exchanger is identical to 2-HE-11. The anchorage was screened by comparison to the calculation for 2-HE-11.
21	1-HE-13*	EXCESS LET DOWN HEAT EXCHANGER	CONTAINMENT	612	Relatively small exchanger (1600 lbs) on two saddles in extremely high rad area. Anchorage includes four 3/4" diameter J-bolts, embedded at least 2 feet into piers. Could not inspect the anchorage due to ALARA considerations. Due to large anchorage (four 3/4" bolts) and small exchanger, the anchorage was judged adequate by the SRT.
21	1-HE-14	LETDOWN HEAT EXCHANGER	AUXILIARY	633	Exchanger anchored with two 7/8" diameter J-bolts on 11-3/8" spacing. Vertical distance from the base of exchanger to the C.G. of exchanger is 13". Vertical distance from the base of the exchanger to the top nozzle is 29". Anchorage adequacy was accepted based on a short hand calculation..
21	1-HE-15E & W (2 exchangers)	EAST AND WEST CCW HEAT EXCHANGERS	AUXILIARY	609	Component Cooling Water Heat Exchanger on two reinforced saddles. Anchorage is two 7/8" diameter J bolts. There are four 1" wedge expansion anchors in one pedestal in the horizontal direction. C.G. of exchanger from the top of the saddle pedestal about 3'. A hand calculation was performed for the heat exchanger and the results show that the anchor bolts and saddles are adequate.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-HE-17E & W (2 exchangers)	EAST & WEST RHR HEAT EXCHANGERS	AUXILIARY	609	Anchorage more than adequate based on previous analysis of exchanger without top braces. Braces had since been installed.
21	1-HE-18E* & W (2 exchangers)	EAST & WEST CONTAINMENT SPRAY HEAT EXCHANGERS	AUXILIARY	609	Very well engineered support structure. There is a ring support at top of the exchanger bracketed to the wall in each of the four quadrants. This takes the overturning loads on the exchanger. Bottom support (at about the 1/4 point of the exchanger, with the remainder of the exchanger hanging below) is a heavy duty ring with gussets at the bolt locations. These are bolted to a steel support structure that is obviously well engineered. Qualification data indicates an analysis to the design basis. Based on the review of this analysis and anchorage inspection documentation the Heat Exchanger is adequate.
21	1-HE-32E & 32W (2 exchangers)	EAST RHR PUMP PP-35E MECHANICAL SEAL HEAT EXCHANGERS	AUXILIARY	573	8" diameter by 2" wide exchanger, attached to East Residual Heat Removal Pump with two 1/2" bolts. Could have been considered with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-HE-33E & W (2 exchangers)	EAST AND WEST CONTAINMENT SPRAY PUMP PP-9E MECHANICAL SEAL HEAT EXCHANGER	AUXILIARY	573	6" diameter by 8-3/4" high exchanger, attached to East Containment Spray Pump with two 1/2" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.
21	1-HE-34-NE*, 34-NW, 34-SE, & 34-SW (4 exchangers)	NORTH SAFETY INJECTION PUMP PP-26N INBOARD MECHANICAL SEAL HEAT EXCHANGERS	AUXILIARY	587	6" diameter by 8-3/4" high exchanger, attached to North Safety Injection Pump with two 1/2" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.
21	1-HE-35N, 35S (2 coolers)	NORTH SAFETY INJECTION PUMP PP-26N LUBE OIL COOLERS	AUXILIARY	587	Small exchangers 1'-5" long and 4" in diameter attached to North Safety Injection Pump with four 1/4" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-HE-36-EN, 36-ES, 36-WN, 36-WS (4 exchangers)	EAST & WEST CENTRIFUGAL CHARGING PUMP PP-50E INBOARD MECHANICAL SEAL HEAT EXCHANGERS	AUXILIARY	587	6" in diameter 8-3/4" high heat exchanger, attached to East Centrifugal Charging Pump with two 1/2" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.
21	1-HE-37E, 37W (2 coolers)	EAST & WEST CENTRIFUGAL CHARGING PUMP PP-50E, & 50W GEAR OIL COOLERS	AUXILIARY	587	Small exchanger 1'-6" long and 5" in diameter attached to reinforced plate support with four 1/2" bolts. Plate support bolted to East Centrifugal Charging Pump with three 1/2" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.
21	1-HE-38E & 38W (2 coolers)	EAST & WEST CENTRIFUGAL CHARGING PUMP BEARING LUBE OIL COOLERS	AUXILIARY	587	Small exchangers 1'-6" long and 5" in diameter bolted to two 1' long channel columns that are welded to the skid of the East Centrifugal Charging Pump. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-HE-47-ABN & 47-ABS, 47-CDN & 47-CDS (4 aftercoolers)	AB & CD EMERG DIESEL NORTH COMBUSTION AIR AFTERCOOLERS	AUXILIARY	587	Aftercooler on Diesel Generator skid transfers its lateral load to the inlet manifolds. Gravity loads are carried by a post on a spring hanger base, so the post is incapable of carrying lateral or longitudinal load. The Diesel Generator Turbochargers in Unit 1 were replaced in a recent outage. As part of the modification, an analysis was performed for the associated piping and the aftercoolers. All supports met D.C. Cook acceptance criteria.
21	1-QP-21	NORTH BORIC ACID BLENDER (MIXING TEE)	AUXILIARY	587	Boric Acid Blender supported by piping. It is in-line with the pipe between two pipe supports off the floor. Blender very small (6" in diameter and 11" long). Screened based on drawings (insulation precluded inspection of the blender connection to the piping system) and inspection for interactions.
21	1-QT-107- AB & CD (2 tanks)	CD EMERG DIESEL FUEL OIL DAY TANKS	AUXILIARY	587	Horizontal tanks which sits on two saddles. Each saddle has two, 1/4" thick plates, forming a "U", with no gussets. There are two 5/8" anchors per saddle. A Horizontal Tank Analysis was performed to show that the tank anchorage is adequate.
21	1-QT-110-AB & CD (2 Coolers)	AB & CD EMERG DIESEL LUBE OIL COOLERS	AUXILIARY	587	Lube Oil Coolers mounted to wall with fourteen 3/4" wedge type expansion anchors. External Anchor Analysis was performed on the Unit 2 Jacket Water Heater 2-QT-131-CD which has the same configuration as 1-QT-110-AB. Based on this analysis, both supports are adequate.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-QT-131-AB & CD (2 Coolers)	AB & CD EMERG DIESEL JACKET WATER COOLERS	AUXILIARY	587	Jacket Water Cooler mounted to wall by fourteen 3/4" wedge type expansion anchors. External Anchor Analysis was performed on the Unit 2 Jacket Water Heater 2-QT-131-CD. Based on this analysis both supports are adequate.
21	1-QT-133-AB & CD (2 Tanks)	AB & CD EMERG DIESEL JACKET WATER SURGE TANKS	AUXILIARY	587	100 Gal. Tanks, 2'-6" D x 3' H. Notes and the ANCHOR4 analysis for 1-QT-133-CD also apply to 1-QT-133-AB since they are essentially identical. The surge tanks are supported (bolted) to a shelf. The shelf is bolted to the wall by four J-bolts. In addition, two 3/4" wedge anchors attach the top channel to the wall. The wedge anchors were conservatively left out of the ANCHOR4 analysis. The anchorage was screened based on an ANCHOR4 analysis for the anchorage to the shelf.
21	1-QT-134-AB & 134-CD (2 Tanks)	AB & CD EMERG DIESEL AUX JACKET WATER HEATERS (TANKS)	AUXILIARY	587	The AB tank is the same as the CD tank except that 3/8" bolts were measured in the field instead of the 1/4" bolts on the drawings for AB. The ANCHOR4 analysis for 1-QT-134-CD (using 1/4" diameter Phillips Redhead Wedge Anchors) demonstrated adequacy. The base plates were also shown to be adequate.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-QT-141-AB1, 141-AB2, 141-CD1, 141-CD2 (4 air receivers)	AB & CD EMERG DIESEL STARTING AIR RECEIVERS 1 & 2	AUXILIARY	587	Air tanks anchored by four 5/8" J-bolts (Ref. 1, 4). Total weight for each tank is 6000 lb. Tank anchorage was verified by an ANCHOR4 analysis. Nozzle loads were included.
21	1-TK-10	REACTOR COOLANT LETDOWN VOLUME CONTROL TANK	AUXILIARY	609	Tank on 4 wide flange legs, 90 inches in diameter and 120 inches in height. Tank 1-TK-10 is similar to the 2-TK-10. Tank anchorage and wide flange legs were evaluated in a hand calculation for 2-TK-10 and found to be adequate.
21	1-TK-11*	BORON INJECTION TANK	AUXILIARY	612	Tank is 5' diameter by 10' in height supported by 4 Wide Flange Leg supports (10" WF w/ 5/8" flange) 4'-4" in height.. Each leg is bolted to the pedestal w/ two embedded 1 3/4" bolts. The Seismic Evaluation of the Boric Acid Tank (2-TK-12S) is seismically adequate. The Boron Injection Tank (1-TK-11) is much smaller but has about the same support. Therefore, Tank 1-TK-11 is judged adequate based on comparison.
21	1-TK-200	MAIN STEAM LEADS CONDENSATION DRAIN TANK (POT)	AUXILIARY	621	Small tank supported from floor. Anchorage judged acceptable based on the walkdown and the anchorage inspection documentation.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-TK-32	CONDENSATE STORAGE TANK	GROUNDS	609	Large flat bottom tank 52'-0" inside diameter 34'-5 1/2" height (31'-7" liquid tank). 500,000 gallons and weighs 128,700 lbs. Anchored with thirty 3/8" th x 5" w x 4' - 4" long strap that is embedded in the concrete at a 2' depth with a 2" radius hook at the end. The strap detail is identical to the strap for the Unit 1 and 2 Refueling Water Storage Tanks (RWST) 1-TK-33 and 2-TK-33. The calculation for the RWST resulted in the conclusion that the weld to the tank and embedment in the concrete was sufficient to develop the full yield strength of the strap. The RWST has a very similar configuration as this CST. The calculation for the RWST using the GIP methodology indicated an overall safety factor of 2.57 for overturning and 1.72 for shear. The CST was screened based on a comparison of the significant attributes to the RWST.
21	1-TK-33	REFUELING WATER STORAGE TANK	GROUNDS	609	Large flat bottom tank 48'-0" inside diameter 32'-3" height (31' liquid tank). 420,000 gallons, weight 94,000 lbs. The tank is founded on a concrete pad and anchored with twenty-five 3/8" th x 5" W x 4' - 4" L strap, embedded in concrete a 2' depth with a 2" radius hook at the end. A detailed calculation was performed to the SQUG GIP criteria. The calculation resulted in the conclusion that the weld to the tank and embedment in the concrete was sufficient to develop the full yield strength of the strap. The calculation for the RWST using GIP methodology indicated an overall safety factor of 2.57 for overturning and 1.72 for shear.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	1-TK-37*	COMPONENT COOLING WATER SURGE TANK	AUXILIARY	650	Skirted tank 11'-10 1/4" diameter and 17' in height. Skirt is 4'-6" high from the top of the pad to skirt connection to tank. Skirt has 1/2" thickness. There are 8 bolts evenly spaced around tank, with a solid steel washer 3-3/4" high x 4" length x 2" width. Bolts supported from 3" x 3" x 1/2" angle. The anchorage was screened based on a hand calculation performed for the bolt stresses.
21	1-TK-76N, 76S	CONTROL ROOM A/C NORTH AND SOUTH CHILL WATER EXPANSION TANKS	AUXILIARY	650	Small tank 2' in length x 9 " in diameter on a 1" diameter piping system. Tank in-line with pipe, supported by a U-bolt on a cantilevered angle (2 1/2" x 2 1/2" x 3/8") about 1' - 6" long. Angle welded to a plate that is bolted to the wall with 2 1/2" expansion anchors. Anchorage and support for these small tanks were accepted by SRT judgment after the walkdown and a review of the anchorage inspection documentation.
21	1-TK12-N	NORTH BORIC ACID STORAGE TANK	AUXILIARY	587	Boric Acid Tank on 4 Wide Flange Beam Legs. This Tank is identical to tank 2-TK-12S which was evaluated by means of a calculation. The calculation indicated that the legs and anchorage are adequate.
21	12-HE-16N	NORTH SPENT FUEL PIT HEAT EXCHANGER	AUXILIARY	609	3' - 2" diameter horizontal heat exchanger about 22' long on two saddles supported by piers. Total weight full given as 26,200 lbs. Exchanger bolted into pier with four 7/8" diameter bolts per saddle. Piers are doweled into floor. The results of tank analysis show that the tank anchorage and saddles are adequate.

Table 2 (Continued)
Description of Configuration and Anchorage Evaluation for Tanks and Heat Exchangers (Unit 1)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	12-OME-44N-2 & 44S-2	NORTH & SOUTH RADIOACTIVE WASTE GAS COMPRESSOR OME-44N-2 SEAL WATER HEAT EXCHANGERS	AUXILIARY	609	Small Heat Exchanger 3'-2" long by 10" in diameter attached to South Radioactive Waste Gas Compressor OME-44S-1 with 4 - 1/2" bolts. Compressor anchored to ground with 4 3/4" bolts. The SRT reviewed the anchorage drawings for the compressor and judged the anchorage to be adequate (4 J-bolts). The compressor is not on the SSEL and only anchorage adequacy is required. The anchorage of the compressor was judged acceptable after a review of the anchorage during the walkdown.
21	12-TK-47-AB* & 47-CD	AB & CD EMERG DIESEL FUEL OIL STORAGE TANKS	GROUNDS	609	Underground tanks. SRT evaluated this tank based on the available documentation in the equipment package. A tank calculation was performed by hand. The tank was modeled as a beam on elastic foundation. The overall tank stresses were very low (on the order of 3.6 ksi).
21	12-TK12-M	MIDDLE BORIC ACID STORAGE TANK	AUXILIARY	587	Boric Acid Tank on 4 Wide Flange Beam Legs. All dimensions for the tank, legs, connections and anchorage given in the anchorage package for the tank. This Tank is identical to tank 2-TK-12S which was evaluated by means of a hand calculation. The calculation indicated that the legs and anchorage are adequate. This tank was screened based on comparison to the Unit 2 calculation.

Table 3
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
0	12-HE-25A	15GPM RADIOACTIVE WASTE EVAPORATOR HE-25 CONDENSER	AUXILIARY	600	Component is supported off shell of much larger (about 4.0') diameter tank 12-TK-148 which is not on the SSEL. This component is designated an outlier due to concerns related to the anchorage for 12-TK-148 and nozzle loads.
0	12-HE-25B & C (2 Coolers)	15 GPM RADIOACTIVE WASTE EVAPORATOR HE-25 DISTILLATE COOLERS	AUXILIARY	587	The Heat Exchanger is about 14" in diameter and 10 feet long, supported by stiffened saddles with two 3/4" diameter anchor bolts in each saddle, supported off of a steel platform. Weight of HX < 2000 lbs. Capacity exceeds demand for saddles, support frame and platform by inspection.
0	2-QT-112-AB & CD (2 filters)	AB & CD EMERGENCY DIESEL FULL FLOW LUBE OIL FILTER	AUXILIARY	579	Small tank, with a ht of about 5' and a diameter of 3', anchored by six 1/2" expansion anchors at 60 degree intervals. Tank contains oil, total maximum approximate weight = 2707 lbs. ANCHOR analysis shows high margins and includes inlet and outlet nozzle loads.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
0	2-QT-113-AB1, AB2, CD1 & CD2 (4 Strainers)	AB EMERGENCY DIESEL FULL FLOW LUBE OIL STRAINER #1	AUXILIARY	579	Supported on four angle legs. Each leg is anchored by one 1/2" J-bolt anchor. Weight = 1730#, c.g. at approx. mid-height = 33". The ANCHOR analysis performed for CD1 & CD2 including nozzle loads showed a high margin. The inlet and outlet nozzle loads were assumed equally distributed between the two strainers. Anchorage for AB1 and AB2 was acceptable by comparison.
0	2-QT-116-AB & CD	AB & CD EMERGENCY DIESEL LUBE OIL HEATER TANK	AUXILIARY	579	Small heater 9.5" Dia. x 3'-9.5" Ht. Anchorage screened based on the ANCHOR4 analysis for 116-CD.
0	2-QT-118-AB & CD	AB EMERGENCY DIESEL BYPASS LUBE OIL FILTER	AUXILIARY	579	Filter anchored by nine anchors in three groups of three, so each group is 120 degrees for the next (i.e., evenly space). The approx. weight of the tank is estimated to be the same as that of 2-QT-112-CD (Wt =2707#), because the tanks are of the same manufacturer, size, and both hold oil. Anchorage screened based on an ANCHOR4 evaluation.
0	2-QT-143-AB1, AB2 and CD1, CD2 (4 dryers)	AB EMERGENCY DIESEL CONTROL AIR DRYER #1	AUXILIARY	587	Small tank mounted together on steel frame with the other air dryer tank (AB1 with AB2 and CD1 with CD2). Frame anchored by eight 3/8" non-shell type expansion anchors, four per base plate. Tanks hold air and are the size of fire extinguishers, (approx. 8.9 lbs. filled weight each). The nozzle loads are not a concern. Anchorage screened based on judgment after walkdown and review of anchorage inspection documentation.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
0	2-QT-144-AB & CD (2 filters)	AB & CD EMERGENCY DIESEL FUEL OIL TRANSFER FILTER	AUXILIARY	587	Small filter on three angle legs anchored by three 5/8" Phillips Red Head Wedge anchors. No interactions. Anchorage screened by judgment after walkdown and review of anchorage inspection documentation.
0	2-TK-253-1 & 2	PRESSURIZER TRAIN 'A' PRESSURE RELIEF VLV NRV-153 RESERVE CONTROL AIR BOTTLE RACK	CONTAINMENT	612	This component is a small (about 4.5' long x 16" diameter) air tank horizontally mounted (welded) on a short length of I beam which in turn is welded to building steel. Tank weight was assumed to be 250 lbs. An ANCHOR4 analysis showed a very high margin.
0	2-TK-253-3 & 4	PRESSURIZER TRAIN 'B' PRESSURE RELIEF VLV NRV-152 EMERGENCY AIR BOTTLE RACK	CONTAINMENT	650	This component is a cylindrical compressed air "bottle" about 12" in diameter and 60" tall, secured to the crane wall with steel straps that are attached to a very stout steel bracket arrangement, secured to the wall with a number of expansion anchors. AEPSC Structural & Analytical Design Nuclear Section reviewed the as-found condition of the support for this tank, and found it to be adequate for design loads.
21	12-HE-16S	SOUTH SPENT FUEL PIT HEAT EXCHANGER	AUXILIARY	609	Horizontal heat exchanger 3' - 2" diameter, and about 22' long on two saddles supported by piers. Total weight full given as 26,200 lbs. Exchanger bolted into pier with four 7/8" diameter bolts per saddle. Piers are doweled into floor. The tank anchorage and saddles were adequate based on the analysis for 12-HE-16N as noted in Table 2.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-HE-11*	REACTOR COOLANT PUMP SEAL WATER HEAT EXCHANGER	AUXILIARY	609	Vertical Heat Exchanger on a Gusseted steel pedestal. Each Pedestal is anchored to the floor with eight 3/4" J-Bolts embedded 20" into floor. Exchanger is 16" in diameter and 14' in height. Exchanger is bolted to the steel pedestal with two 1" diameter steel bolts on 6" centers in weak direction and 2'-8" in strong direction. This connection is more limiting than the anchorage to the floor. A hand calculation was performed to demonstrate the adequacy of these four bolts.
21	2-HE-13	EXCESS LETDOWN HEAT EXCHANGER	CONTAINMENT	612	Heat exchanger (1600 lbs) on two saddles in extremely high rad area. Anchorage includes four 3/4" diameter J-bolts, embedded at least 2 feet into piers. Due to large anchorage (four 3/4" bolts) and small exchanger, the anchorage is acceptable by SRT judgment.
21	2-HE-14	LETDOWN HEAT EXCHANGER	AUXILIARY	633	Exchanger anchored with two 7/8" diameter J-bolts on 11-3/8" spacing. Vertical distance from the base of exchanger to the C.G. of exchanger is 13". Vertical distance from the base of the exchanger to the top nozzle is 29". Anchorage adequacy was accepted based on a short hand calculation.
21	2-HE-15E & 15W (2 exchangers)	EAST & WEST COMPONENT COOLING WATER HEAT EXCHANGER	AUXILIARY	609	Component Cooling Water Heat Exchanger on two reinforced saddles. Anchorage is two 7/8" diameter J bolts. There are four 1" wedge expansion anchors in one pedestal in the horizontal direction. C.G. of exchanger from the top of the saddle pedestal about 3'. Anchorage screened based on a hand calculation for 1-HE-15E.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-HE-17E & 17W	EAST & WEST RESIDUAL HEAT REMOVAL HEAT EXCHANGER	AUXILIARY	609	Very well engineered support structure. There is a ring support at top of the exchanger bracketed to the wall in each of the four quadrants. This takes the overturning loads on the exchanger. Bottom support is a heavy duty steel gusset structure supported by two peers. There are two bolts in each peer. The support structure for the exchanger is obviously well engineered. Qualification data indicates an analysis to the design basis. Based on the inspection and anchorage data collected, the Heat Exchangers are adequate.
21	2-HE-18E & 18 W	EAST & WEST CONTAINMENT SPRAY HEAT EXCHANGER	AUXILIARY	609	Very well engineered support structure. There is a ring support at top of the exchanger bracketed to the wall in each of the four quadrants. This takes the overturning loads on the exchanger. Bottom support (at about the quarter point of the exchanger, with the remainder of the exchanger hanging below) is a heavy duty ring with gussets at the bolt locations. These are bolted to a steel support structure that is obviously well engineered. Qualification data indicates an analysis to the design basis. Based on the inspection and anchorage data collected the Heat Exchanger is adequate.
21	2-HE-32E & 32W	EAST & WEST RESIDUAL HEAT REMOVAL PUMP PP-35E MECHANICAL SEAL HEAT EXCHANGERS	AUXILIARY	573	8" in diameter by 2" long exchanger, attached to East Residual Heat Removal Pump with two 5/8" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by SRT judgment.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-HE-33E & 33W (2 exchangers)	EAST & WEST CONTAINMENT SPRAY PUMP PP-9E MECHANICAL SEAL HEAT EXCHANGERS	AUXILIARY	573	6" diameter by 8-3/4" high exchanger, is not attached to the East Containment Spray Pump as shown on the anchorage sketch, however piping can support the small exchanger. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.
21	2-HE-34-NE, 34-NW, 34-SE, & 34-SW (4 exchangers)	NORTH & SOUTH SAFETY INJECTION PUMP PP-26N OUTBOARD MECHANICAL SEAL HEAT EXCHANGERS	AUXILIARY	587	6" diameter by 8-3/4" high exchanger, attached to North Safety Injection Pump with two 1/2" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.
21	2-HE-35N & 35S (2 Coolers)	NORTH & SOUTH SAFETY INJECTION PUMP PP-26N LUBE OIL COOLERS	AUXILIARY	587	Small exchanger 1'-5" long by 4" in diameter by 8-3/4", attached to North Safety Injection Pump with four 1/4" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-HE-36-EN, 36-ES, 36-WN, 36-WS (4 exchangers)	EAST & WEST CENTRIFUGAL CHARGING PUMP PP-50E INBOARD MECHANICAL SEAL HEAT EXCHANGERS	AUXILIARY	587	6" in diameter 8-3/4" high heat exchanger, attached to East Centrifugal Charging Pump with two 1/2" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.
21	2-HE-37E, 37W	EAST & WEST CENTRIFUGAL CHARGING PUMP PP-50E GEAR OIL COOLER	AUXILIARY	587	Exchanger 1'-6" long and 5" in diameter attached to reinforced plate support with four 1/2" bolts. Plate support bolted to East Centrifugal Charging Pump with three 1/2" bolts. Could have screened using the rule of the box, however the exchanger has a separate SSEL listing. Anchorage to the pumps was judged adequate by the SRT.
21	2-HE-38E* & 38W	EAST & WEST CENTRIFUGAL CHARGING PUMP PP-50E LUBE OIL COOLER	AUXILIARY	587	Small exchanger 1'-6" long and 5" in diameter bolted to 2 1' long channel columns that are welded to the skid of the East Centrifugal Charging Pump. Could have screened with the pump using the rule of the box, however the exchanger was listed separately on the SSEL. Anchorage to the pumps was judged adequate by the SRT.
21	2-HE-47-ABN & 47-ABS, 47-CDN & 47-CDS (4 aftercoolers)	AB & CD EMERGENCY DIESEL NORTH COMBUSTION AIR AFTER-COOLERS	AUXILIARY	587	Aftercooler transfers its lateral load to the inlet manifolds. Gravity loads are carried by a post on a spring hanger base, so the post is incapable of carrying lateral or longitudinal load. The Diesel Generator Turbochargers in Unit 2 were replaced in a recent outage. As part of the modification an analysis was performed for the associated piping and the aftercoolers. All supports met the D.C. Cook acceptance criteria.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-QP-21	SOUTH BORIC ACID BLENDER	AUXILIARY	587	Boric Acid Blender supported by piping. It is in-line with the pipe between two pipe supports off the floor. Blender very small (6" in diameter and 11" long). Screened based on drawings (insulation precluded inspection of the blender connection to the piping system) and inspection for interactions.
21	2-QT-107- AB & CD (2 tanks)	AB & CD EMERGENCY DIESEL FUEL OIL DAY TANKS	AUXILIARY	587	Horizontal tanks which sits on two saddles. Each saddle has two 1/4" thick plates, forming a "U", with no gussets. There are two 5/8" anchors per saddle. A Horizontal Tank Analysis was performed to show that the tank anchorage is adequate.
21	2-QT-110-AB & CD (2 Coolers)	AB & CD EMERGENCY DIESEL LUBE OIL COOLER	AUXILIARY	587	Lube Oil Coolers, mounted to wall by fourteen 3/4" Wedge type anchors. External ANCHOR4 analysis for 2-QT-110-CD was performed. Based on the results of this evaluation both coolers were screened.
21	2-QT-115-AB & CD (2 Tanks)	AB & CD EMERGENCY DIESEL LUBE OIL SUMP TANKS	AUXILIARY	579	The tank sits on two saddles, two plates per saddle, 1/4" thick. There are two 3/4" anchors per saddle. There are four anchors in total for the tank. Anchorage screened based on review of the anchorage inspection documentation and the vendor qualification of the tanks.
21	2-QT-131-AB & CD (2 Coolers)	AB & CD EMERGENCY DIESEL JACKET WATER COOLER	AUXILIARY	587	Jacket Water Cooler mounted to wall by fourteen 3/4" wedge type expansion anchors. An ANCHOR4 was performed on 2-QT-131-CD. Based on that analysis both coolers were screened.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-QT-133-AB & CD (2 tanks)	AB & CD EMERGENCY DIESEL JACKET WATER SURGE TANK	AUXILIARY	587	100 GAL. TANK, 2'-6" D x 3' H. The surge tanks are supported (bolted) to a shelf. The shelf is bolted to the wall by four 7/8" anchors. An ANCHOR4 was performed on 2-QT-133-CD. Based on that analysis both coolers were screened.
21	2-QT-134-AB & CD* (2 tanks)	AB & CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)	AUXILIARY	587	Heater tanks separately mounted by three 1/2" coupling rods and Phillips Redhead wedge type anchors. An ANCHOR4 was performed on 2-QT-134-CD. Based on that analysis both coolers were screened.
21	2-QT-141-AB1, AB2, CD1, & CD2 (4 Air Receivers)	AB EMERGENCY DIESEL STARTING AIR RECEIVER #1	AUXILIARY	587	Air tanks anchored by four 5/8" J-bolts. Total weight for the tank is 6000 lbs. The tank anchorage was verified by an ANCHOR4 analysis. Nozzle loads were included.
21	2-TK-10	REACTOR COOLANT LETDOWN VOLUME CONTROL TANK	AUXILIARY	609	Tank on four wide flange legs, 90 inches in diameter and 120 inches in height. The tank leg support and anchorage was screened based on a hand calculation.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-TK-11	BORON INJECTION TANK	AUXILIARY	612	Tank is about 5' in diameter by 10' in height supported by 4 Wide Flange Leg supports (10" WF w/ 5/8" flange) 4'-4" in height.. Each leg is bolted to the pedestal w/ two embedded 1 3/4" bolts. Weld of leg to tank about 14" in length and 1/4" thickness on each side of the wide flange and 10" at the top of the wide flange. The seismic evaluation of the Boric Acid Tank (2-TK-12S) indicates that it is seismically adequate. The Boron Injection Tank is much smaller but has about the same support. Therefore, Tank 2-TK-11 is judged adequate based on comparison
21	2-TK-12S	SOUTH BORIC ACID STORAGE TANK	AUXILIARY	587	Boric Acid Tank on four Wide Flange Beam Legs. Tank anchorage and wide flange legs were evaluated using a hand calculation. The calculation indicated that the legs and anchorage are adequate.
21	2-TK-150	MAIN STEAM LEADS CONDENSATE DRAIN TANK	AUXILIARY	600	Small horizontal tank bolted to wall in-line with the piping system. Anchorage was judged acceptable based on the walkdown and a review of the anchorage inspection documentation.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-TK-32	CONDENSATE STORAGE TANK	GROUNDS	609	Large flat bottom tank 52'-0" inside diameter 34'-5 1/2" height, 500,000 gallons and weighs 128,700 lbs. Anchored with thirty 3/8" th x 5" w x 4' - 4" long strap that is embedded in the concrete 2' depth with a 2" radius hook at the end. The strap detail is identical to the strap for the Unit 1 and 2 RWST 1-TK-33 and 2-TK-33. The calculation for the RWST resulted in the conclusion that the weld to the tank and embedment in the concrete was sufficient to develop the full yield strength of the strap. The RWST has a very similar configuration as this CST. The calculation for the RWST using GIP methodology indicated an overall safety factor of 2.57 for overturning and 1.72 for shear. The CST was screened based on a comparison of the significant attributes to the RWST.
21	2-TK-33	REFUELING WATER STORAGE TANK	GROUNDS	609	Large flat bottom tank 48'-0" inside diameter 32'-3" height (31'-0" liquid tank 420,000 gallons and weighs 94,000 lbs. Anchored with twenty-five 3/8" th x 5" w x 4' - 4" long strap that is embedded in the concrete 2' depth with a 2" radius hook at the end. A detailed calculation was performed to the SQUG GIP criteria. The calculation resulted in the conclusion that the weld to the tank and embedment in the concrete was sufficient to develop the full yield strength of the strap. The calculation for the RWST using the GIP methodology indicated an overall safety factor of 2.57 for overturning and 1.72 for shear.

Table 3 (Continued)
Description of Anchorage Evaluation for Tanks and Heat Exchangers (Unit 2)

Class	ID	Description	Building	El.	Description of Configuration and Anchorage Evaluation
21	2-TK-37	COMPONENT COOLING WATER SURGE TANK	AUXILIARY	650	Skirted tank 11'-10 1/4" diameter and 17' in height. Skirt is 4'-6" high from the top of the pad to skirt connection to tank. Skirt has 1/2" thickness. There are eight bolts evenly spaced around tank, with a solid steel washer 3-3/4" high x 4" length x 2" width. Bolts supported from 3" x 3" x 1/2" angle. 2-TK-37 is similar to 1-TK-37. The support for 2-TK-37 was screened based on the hand calculation for 1-TK-37.
21	2-TK-76N*, 76S	CONTROL ROOM AIR CONDITIONING NORTH AND SOUTH CHILL WATER EXPANSION TANKS	AUXILIARY	650	Small tank 2' in length x 9 " in diameter on a 1" diameter piping system. Tank in-line with pipe, supported by a U-bolt on a cantilevered angle (2 1/2" x 2 1/2" x 3/8") about 1' - 6" long. Angle welded to a plate that is bolted to the reinforced block wall with three 5/8" diameter through bolts (other side of wall inspected and bolts came through). Anchorage and support for these small tanks were accepted by SRT judgment after the walkdown and a review of the anchorage inspection documentation.

6) **Section 5.1.2 states that all four tanks reviewed met the intent of the GIP. Indicate that the GIP-2 guidelines and methodology are fully met or identify any deviations from the guidelines and the methodology. Provide calculations for determining the seismic adequacy of the tanks (ID 1-TK-33 and 2-TK-32) using the methodology described in section 7 of the GIP-2. The evaluation of the anchors which restrain the tank movement should also be provided.**

The flat bottom tanks were screened based on calculations performed on August 25, 1989, prior to the publication of the rev. 2 GIP. The evaluation performed followed the procedure available at the time in the rev. 1 GIP. There are only minor differences between the two revisions that do not affect the results due to the resulting high margins.

There are two differences in the configuration of the RWST (1-TK-33) that are not in conformance with the GIP procedure: a) the $t_{cf}/R = .0007351$ which is less than the limits of the GIP screening table of .001; and b) the tank was not anchored with bolts but rather with twenty-five 3/8" x 5" x 4' - 4" long straps that are embedded in the concrete at a two foot depth with a two inch radius hook at the end.

The t_{cf}/R issue was accounted for by making an appropriate adjustment in the calculated natural frequency for the tank. The anchorage was considered by replacing the strap in the calculation with bolts of equivalent area and strength. Both of these modifications meet the intent of the GIP guidelines. The calculation resulted in the conclusion that the weld to the tank and embedment in the concrete was sufficient to develop the full yield strength of the strap. The calculation for the RWST using the Rev. 1 GIP methodology indicated an overall safety factor of 2.57 for overturning and 1.72 for shear. In order to obtain further assurance that the RWST is seismically adequate a calculation that conformed to ASCE Standard 4-86 was performed and yielded similar results.

The strap detail for the CST (2-TK-32) is identical to the strap for the RWST (1-TK-33). The calculation for the RWST resulted in the conclusion that the weld to the tank and embedment in the concrete was sufficient to develop the full yield strength of the strap. The CST also has a very similar configuration as this RWST. The CST was therefore screened based on a comparison of the significant attributes to the RWST.

The SEWS for 1-TK-33 and 2-TK-32 including the calculations are included as attachment 4.

7) **Section 5.1.5 states that horizontal tanks and heat exchangers reviewed met the intent of the GIP. Indicate that the GIP-2 guidelines and methodology are fully met or identify any deviations from them. Provide calculations using the methodology described in section 7 of the GIP-2 for the following tanks and exchangers: 1-HE-14, 2-HE-15E, 12-HE-16N, 1-QT-107-AB and 2-QT-115-CD. The evaluation of the anchors which restrain the tank movement should also be provided.**

As previously discussed in response to questions 2 and 5, anchorage and support evaluations took several different forms consistent with the GIP. These forms included for tanks and heat exchangers: a) detailed evaluations using the step by step procedure in section 7.4 of the GIP; b) detailed hand calculations; c) screening based on an anchorage evaluation for an identical item of equipment and anchorage or a worst case evaluation of a similar item; or d) the SRT judged, based on the weight and anchorage of the equipment, that the anchorage obviously met the GIP screening criteria. The GIP-2 guidelines for adequate strength of the tanks or exchangers, saddles and anchorage are met for all horizontal tanks and heat exchangers that were identified in the final report as screened. The step by step procedure in section 7.4 was not used for supports that were obviously rugged based on the inspection. Exchangers that did not meet the applicable ranges of parameters and assumptions contained in table 7-6 of the GIP could not be evaluated with the section 7.4 procedure. These tanks were evaluated as described in tables 2 and 3 of this response to item 5 of the RAI.

SEWS that include the calculations and the anchorage inspection documentation for 1-HE-14, 2-HE-15E, 12-HE-16N, 1-QT-107-AB and 2-QT-115-CD are contained in attachment 5 of this submittal. The evaluations for 1-HE-15E and 1-QT-107-CD are also provided since the screening for 2-HE-15E and 1-QT-107-AB are based on these evaluations, respectively. These SEWS and calculations provide a good cross section of the evaluations performed. The calculation for 1-HE-14 was a short hand calculation that indicated the anchorage had a safety margin of eight. A hand calculation was performed for 1-HE-15E that was also used to screen 2-HE-15E. These had a calculated safety margin of four. Heat exchanger 12-HE-16N and tanks 1-QT-107-CD and 2-QT-115-CD included a calculation using the step by step methodology in section 7.4 of the GIP.

8) **Tables 6-1 and 6-2 provide a summary of the limited analytical reviews (LARS) for the selected cable and conduit raceways. Provide copies of the calculations of the analyses for resolution of the outliers listed as LAR Numbers 005, 011, 022 and 023. Also provide typical sample calculations for the raceways that are not selected as outliers (i.e., LAR Numbers 001, 010, 027 and 030).**

The requested information is contained in attachment 6 to this RAI.

9) **Discuss the issue described in the Information Notice 95-49 regarding Thermo-Lag panels, in particular, the issue regarding seismic resistance capability of the cable tray and its support when appropriate weight and modulus of the Thermo-Lag are included in the analysis.**

The fire-wrapped raceways were walked-down as part of the USI A-46 raceway evaluations, along with all of the other raceways in the plant. The weight of the Thermo-Lag material was considered in choosing LARS for the USI A-46 effort. None of the hangers supporting fire-wrapped raceways were selected for LAR because: (1) the SRT did not find them to be an enveloping case, i.e., other hangers of similar construction were more heavily loaded; and (2) the SRT was aware that the hangers supporting the fire-wrapped raceways had been evaluated and, unlike most other rod hangers in the plant, had been laterally braced.

In addition, in response to NRC bulletin 92-01 and generic letter 92-08, we performed a walk down of all Thermo-Lag installations in the plant to determine whether seismically induced failure of the Thermo-Lag could result in the Thermo-Lag falling and damaging nearby equipment. This walk down covered all Thermo-Lag installations, including conduits and cable trays, wall pilasters, and electrical equipment. The walkdown team concluded that the Thermo-Lag was well secured, so that large sections could not fall, but smaller pieces (golf ball size and smaller) could fall if local sections of the Thermo-Lag fractured. As a result of the walkdown Thermo-Lag material was removed from some of the conduits to address the safety interface condition.

In the mid 1980s, a minimum number (<10 %) of the cable tray and conduit raceways were fire-wrapped with Thermo-Lag material as part of our 10 CFR 50 Appendix R efforts. Some of the Thermo-Lag material in the plant is being removed and will be replaced with DARMATT material. In some instances, the Thermo-Lag was removed and was not replaced by any other type of material.

ATTACHMENT 2 TO AEP:NRC:1040E

SAMPLE SEWS, ANCHORAGE CALCULATIONS, AND
ANCHORAGE INSPECTION DOCUMENTATION
FOR CLASS 1 THROUGH 20 EQUIPMENT
RAI ITEM 2

This attachment includes sample SEWS, anchorage calculations and anchorage inspection documentation for a cross section of class 1 through 20 equipment items. The samples selected are designated with an * in Table 1 of this RAI. The following examples are included:

Class	ID
1	1-ABD-A
4	2-CRID-I-CVT
5	1-PP-10W
5	2-PP-46-4
9	1-HV-AFP-M1
9	12-HV-ESW-7
14	1-AFW
15	2-BATT-AB
17	1-OME-150-AB/2-OME-150-CD
20	2-A11

SAFE SHUTDOWN EQUIPMENT LIST (SSELWP)

FUNCTION: 600 VAC SYSTEM

Equipment Class: 1 Train: 1

Equipment ID: 1-ABD-A Drawing Number: 1-12001 1-12010

System: ELECTRICAL DISTRIBUTION 600VAC

Equip Description: 600VAC MCC ABD-A

Building: AUXILIARY Room: AB EMERG DIESEL GENERATOR ROOM Elevation: 587

Normal state: Desired state: Power Required: Sort: W,_ Notes:

Supporting System Drawing Number:

Required Interconnections and Supporting Components:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

ADDITIONAL INFORMATION

Alias Number: Power Train: B

Component Served: 600V MCC ABD-A

Manufacturer: CUTLER-HAMMER Model:

Panel:

Elem Drawing: Wiring Drawing: 1-94205 1-94206

Power Source: 1-11AS

Walkdown: F Relay Only: N

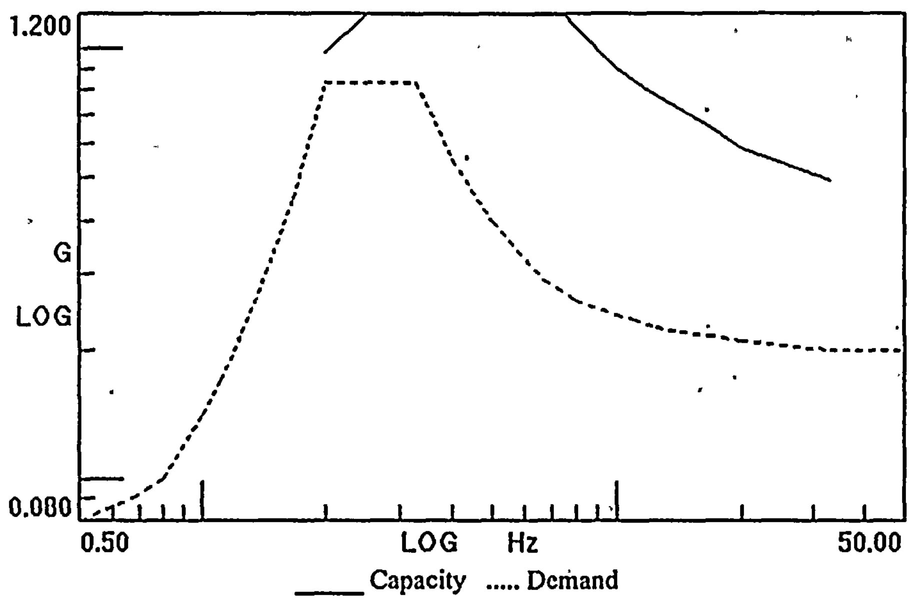
Component Type: MCC
ISO Drawings:

Detailed Location: IN THE NW REGION OF THE ROOM, NEAR THE NORTH WALL

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input	587.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)	N/A
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency =)	N/A
4.	Capacity based on:	1.50 * Bounding Spectrum
5.	Demand based on:	1.00 * Realistic Median-Centered Floor Response Spectra



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0035\spectra.des	BUILDING|Auxiliary|ELEVATION|587|BROADEN|N
Demand 2	C:\GIP\PROJ0035\spectra.des	BUILDING|Auxiliary|ELEVATION|587|BROADEN|N

Does capacity exceed demand? Yes

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

CAVEATS - BOUNDING SPECTRUM

MCC/BS Caveat 1 - Earthquake Experience Data Base.	Yes
MCC/BS Caveat 2 - Rating of 600 V or Less.	Yes
MCC/BS Caveat 3 - Adjacent Cabinets Bolted Together.	Yes
MCC/BS Caveat 4 - Attached Weight of 100 Pounds or Less.	N/A
MCC/BS Caveat 5 - Externally Attached Items Rigidly Anchored.	Yes
MCC/BS Caveat 6 - General Configuration Similar to NEMA Standards.	Yes
MCC/BS Caveat 7 - Cutouts Not Large.	Yes
MCC/BS Caveat 8 - Doors/Buckets Secured.	Yes
MCC/BS Caveat 9 - Natural Frequency Relative to 8 Hz Limit Considered.	N/A
MCC/BS Caveat 10 - Adequate Anchorage.	Yes
MCC/BS Caveat 11 - Potential Chatter of Essential Relays Evaluated.	Yes
MCC/BS Caveat 12 - No Other Concerns	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	Yes
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	Yes
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

1-ABD-A & 1-ABD-B in the same box.

5 vertical panels on 4" concrete pad.

Anchorage by bolts in front 4 1/2" J-bolts and 2 1/2" expansion anchors. Anchorage by welds in back 6 2" long 3/16" fillet.

Anchor Pattern:

[x][x][x][x][x x]

Weight of MCC is a maximum of 800 lbs/cabinet x 5 = 4000 lbs, which was used in the anchor analysis.

The AEPSC Rev. 0 report " Fundamental Resonant Frequencies of Cook Nuclear Plant Cabinets, Panels, and Racks in Auxiliary Building Complex (Determined By In-Situ Modal Testing; Year 1985 and 1986)" dated August 10, 1994 documents the testing of four MCC assemblies. The minimum fundamental frequancy from these tests was 9.6 Hz for MCC assembly 2-ABD-B/ABD-A. The SRT based on this report judged that the frequancy for MCC assembly 1-ABD-A/ABD-B was above 8 Hz. However, for conservatism credit for MCC Assembly 1-ABD-A/ABD-B being above 8 Hz. was not taken, and therefore the caveats on this SEWs related to the 8 Hz issue were answered N/A. This enabled the conservative use of the 1.5 x Bounding Spectrum vs. floor spectrum comparison for capacity vs. demand and the use of the peak of the 5% damped floor spectrum for the anchorage calculations.

No interaction concern.

Zap 3-45 MCC ABD-A&B
Zap 3-46 Typ. Opening @ bottom.

Anchor Evaluation Performed by Bahaa Mahmoud - S&A
Checked by George Gary Thomas.

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)			GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 12
ID : 1-ABD-A (Rev. 0)		Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A			
Building : AUXILIARY	Floor El. : 587.00		Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER			

Anchor calculation additional margin = 1.634

Evaluated by Gary Thomas and Satyan Sharma on 7/17/92.

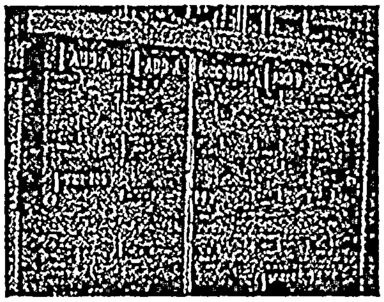
Evaluated by: George D. Thomas (signature) Date: 11/22/94

R/ Satyan Sharma (signature) 11/22/94

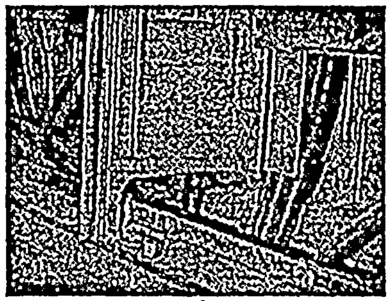
Attachment: Pictures
Attachment: ANCHOR Report

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

PICTURES



MCC ABD-A&B



TYP. OPENING AT BOTTOM.

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)			GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 12
ID : 1-ABD-A (Rev. 0)		Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A			
Building : AUXILIARY	Floor El. : 587.00		Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER			

ANCHOR Report

Earthquake :

Response Spectrum : Instructure Realistic

Frequency : GIP - Flexible

Percent Damping : GIP - 5.00

Spectral Values :

Direction	Acceleration (g's)
North - South	1.04
East - West	1.04
Vertical	0.17

Angle (N-S Direction makes with the X Axis) : 0.00

Combination Criteria : SRSS

Weights :

Number of Weights : 1

No	Weight	X	Y	Z
1	4000.00	50.000	10.000	45.000

Forces :

Number of External Forces : 0

Moments :

Number of External Moments : 0

Allowables :

Anchor :

Number of Anchor types : 2

						Tension	Shear	
				Ultimate	Ultimate	Inter	Inter	Saf

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 7 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

No.	Dia	Manufact	Product	Tension	Shear	Coeff	Coeff	Fact
1	1/2	Other	J-Bolt (90 deg)	6660.00	3330.00	1.00	0.30	1.00
2	1/2	Other	Unknown Expansion Anchor	2290.00	2380.00	1.00	0.30	1.00

Concrete :

Ultimate Stress : 3500.00 psi.

Reduction Factor : 0.85

Weld :

Allowable Stress : 30600 psi.

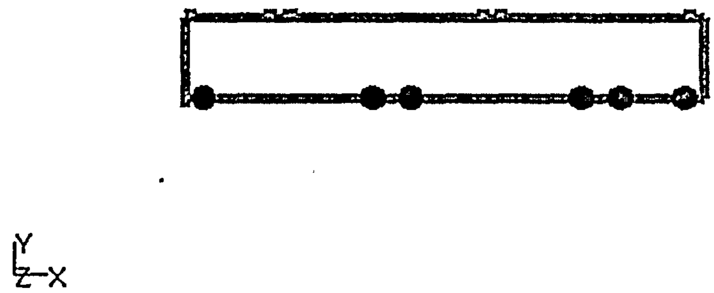
Surfaces :

Number of Surfaces : 1
Surface Orientation

	Direction	Direction	Direction
	Comp	Comp	Comp
No	Nx	Ny	Nz
1	0.000	0.000	1.000

Anchor Pattern for Surface # 1

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 8 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		



Legend for Anchor Patterns

Anchor Bolts :

Concrete Lines :

Concrete Points :

Weld Lines :

Geometry :

Anchor :

Number of Anchors : 6

	Anch	X	Y	Z	Surf
No.	Id	Coord	Coord	Coord	Id
1	1	3.750	1.500	0.000	1
2	1	36.500	1.500	0.000	1
3	1	43.800	1.500	0.000	1
4	2	76.600	1.500	0.000	1
5	2	83.900	1.500	0.000	1
6	1	96.300	1.500	0.000	1

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 9 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

Concrete Lines :

# of elements per line : 1

Number of Concrete Lines : 4

No	Start X-Coord	Start Y-Coord	Start Z-Coord	End X-Coord	End Y-Coord	End Z-Coord	Sf Id	Line Width
1	0.000	1.500	0.000	100.000	1.500	0.000	1	2.000
2	100.000	1.500	0.000	100.000	17.000	0.000	1	2.000
3	100.000	17.000	0.000	0.000	17.000	0.000	1	2.000
4	0.000	17.000	0.000	0.000	0.000	0.000	1	2.000

Concrete Points :

Number of Concrete Points : 0

Weld Lines :

# of elements per line : 1

Number of Weld Lines : 6

No	Start X-Coord	Start Y-Coord	Start Z-Coord	End X-Coord	End Y-Coord	End Z-Coord	Sf Id	Line Width
1	0.000	18.500	0.000	2.250	18.500	0.000	1	0.125
2	15.400	18.500	0.000	17.600	18.500	0.000	1	0.125
3	19.400	18.500	0.000	21.600	18.500	0.000	1	0.125
4	56.500	18.500	0.000	58.600	18.500	0.000	1	0.187
5	59.900	18.500	0.000	62.100	18.500	0.000	1	0.187
6	96.100	18.500	0.000	98.400	18.500	0.000	1	0.187

Determination of Reduction Factors :

Reduction Factor Input for Anchor # 1

Embedment Length : (13.60 in. Min Reqd. to achieve full capacity) :=27.25 in.
Essential Relays in Cabinet : Yes

Reduction Factor Input for Anchor # 2

Embedment Length : (13.40 in. Min Reqd. to achieve full capacity) :=27.25 in.
Essential Relays in Cabinet : Yes

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 10 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

Reduction Factor Input for Anchor # 3

Embedment Length : (13.60 in. Min Reqd. to achieve full capacity) :=27.25 in.
Essential Relays in Cabinet : Yes

Reduction Factor Input for Anchor # 4

Essential Relays in Cabinet : Yes

Reduction Factor Input for Anchor # 5

Essential Relays in Cabinet : Yes

Reduction Factor Input for Anchor # 6

Embedment Length : (13.50 in. Min Reqd. to achieve full capacity) :=27.25 in.
Essential Relays in Cabinet : Yes

Reduction Factors Data Current : Yes

No	Anc Id	Pall/ Vall	Pallr/ Vallr	RT	RN	RL	RG	RS	RE	RF	RC	RR	RP	RB	RM
1	1	3750.91	N/A	X	X	0.56	X	X	X	X	X	1.00	X	X	X
		3330.00	N/A	X	X	1.00	X	X	X	X	X	1.00	X	X	X
2	1	3708.29	N/A	X	X	0.56	X	X	X	X	X	1.00	X	X	X
		3330.00	N/A	X	X	1.00	X	X	X	X	X	1.00	X	X	X
3	1	3750.91	N/A	X	X	0.56	X	X	X	X	X	1.00	X	X	X
		3330.00	N/A	X	X	1.00	X	X	X	X	X	1.00	X	X	X
4	2	1717.50	N/A	X	X	X	X	X	X	X	X	0.75	X	X	X
		1785.00	N/A	X	X	X	X	X	X	X	X	0.75	X	X	X
5	2	1717.50	N/A	X	X	X	X	X	X	X	X	0.75	X	X	X
		1785.00	N/A	X	X	X	X	X	X	X	X	0.75	X	X	X
6	1	3729.60	N/A	X	X	0.56	X	X	X	X	X	1.00	X	X	X
		3330.00	N/A	X	X	1.00	X	X	X	X	X	1.00	X	X	X

Legend :

N/A	= Not Applicable
Pall	= Allowable Pull without Reduced Inspection
Vall	= Allowable Shear without Reduced Inspection
Pallr	= Allowable Pull with Reduced Inspection
Vallr	= Allowable Shear with Reduced Inspection
*	= Outlier
X	= Reduction Factor Not Used
RT	= Reduction Factor for Type of Anchorage
RN	= Reduction Factor for Installation Adequacy

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 11 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

RL	= Reduction Factor for Embedment
RG	= Reduction Factor for Gap at Anchors
RS	= Reduction Factor for Spacing
RE	= Reduction Factor for Edge Distance
RF	= Reduction Factor for Concrete Strength
RC	= Reduction Factor for Concrete Cracks
RR	= Reduction Factor for Essential Relays
RP	= Reduction Factor for Base Stiffness and Prying Action
RB	= Reduction Factor for Base Strength and Load Path
RM	= Reduction Factor for Embed. Steel and Pads

Analysis Results :

Analysis Performed : Yes

Type of Analysis : Regular

	Spectral Accelerations (G's)			
No	N-S	E-W	Vertical	Safety Factor
1	1.038	0.415	0.067	3.653
2	-1.038	-0.415	-0.067	7.048
3	-1.038	0.415	0.067	3.526
4	1.038	-0.415	-0.067	7.085
5	1.038	-0.415	0.067	6.863
6	-1.038	0.415	-0.067	3.652
7	1.038	0.415	-0.067	3.787
8	-1.038	-0.415	0.067	6.819
9	0.415	1.038	0.067	1.634
10	-0.415	-1.038	-0.067	3.990
11	0.415	-1.038	0.067	3.976
12	-0.415	1.038	-0.067	1.676
13	-0.415	1.038	0.067	1.643
14	0.415	-1.038	-0.067	4.055
15	0.415	1.038	-0.067	1.666
16	-0.415	-1.038	0.067	3.912
17	0.415	0.415	0.167	3.816
18	-0.415	-0.415	-0.167	9.487
19	0.415	0.415	-0.167	4.302
20	-0.415	-0.415	0.167	8.494
21	-0.415	0.415	0.167	3.838
22	0.415	-0.415	-0.167	9.573
23	0.415	-0.415	0.167	8.579

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 12 of 12
ID : 1-ABD-A (Rev. 0)	Class : 1. Motor Control Centers	
Description : 600VAC MCC ABD-A		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE NW REGN OF THE RM, NEAR THE N WALL
Manufacturer, Model, Etc. : CUTLER-HAMMER		

24	-0.415	0.415	-0.167	4.333

Minimum Safety Factor : 1.634.

The Anchorage Capacity is 1.634 times greater than the Demand

ANCHOR INSPECTION DATA SHEET

Unit #: 1
Bldg.: Aux
Location: AB Emerg. Die. Gen. Rm

Installation dwg. / Rev.: 12-3462-32
Equipment No.: 1-ABD-A

Anchorage Arrangement Sketch

1-ABD-A / 1-ABC-B

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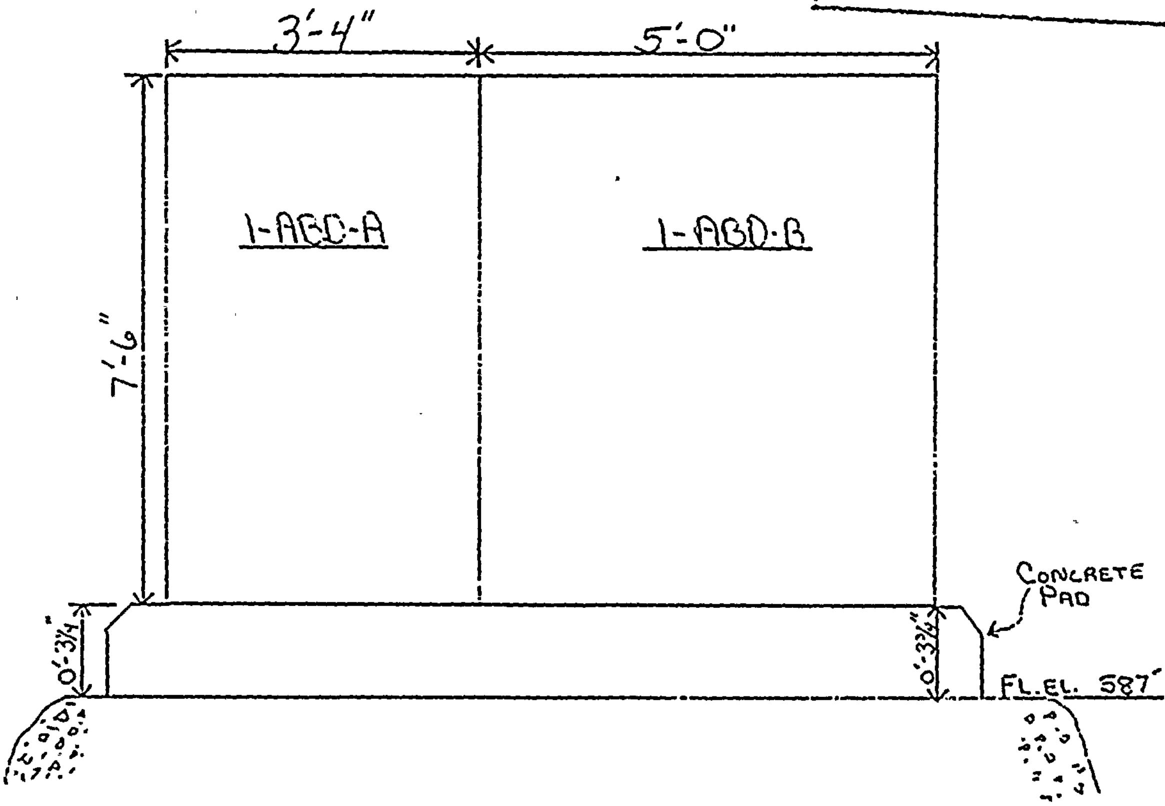
JUL 24 1992
CLERK



ELEV. VIEW LOOKING NORTH

Drawn by: James Wisniewski — Date: 7/22/92

Verified by: [signature] — Date: 7-22-92
Qual./Cert. Inspector

Reviewed by: James Wisniewski — Date: 7/22/92
Construction Anchor Review Engineer

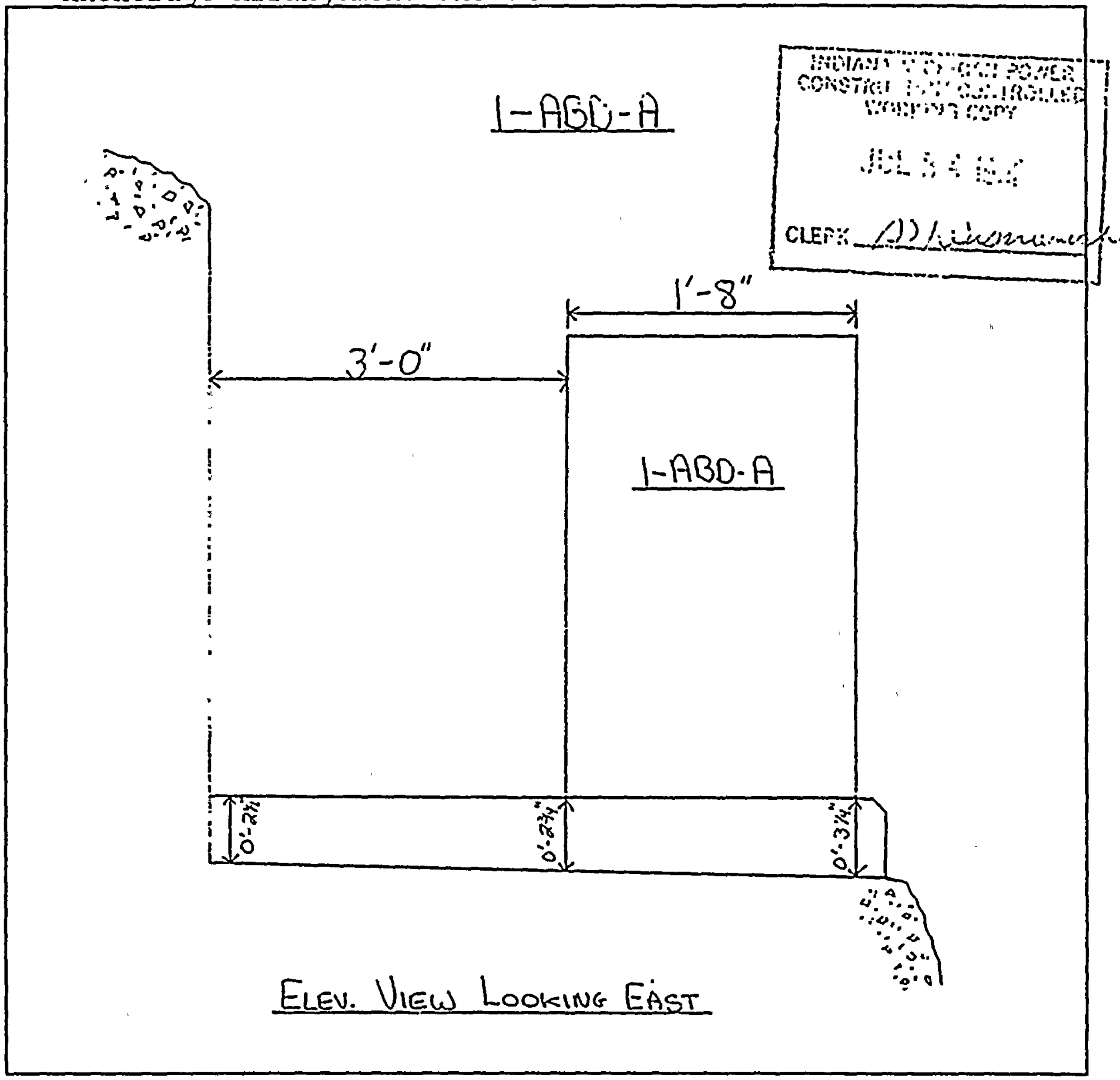
**12 CHP 5021.CCD.019
ˆTTACHMENT NO. 1

ANCHOR INSPECTION DATA SHEET

1	Aux	AB Emerg. Dies. Gen Rm
Unit #	Bldg.	Location

12-3462-32	1-ABD-A
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: James Wisniewski Date: 7/22/92

Verified by: [signature] Date: 7-22-92
Qual./Cert. Inspector

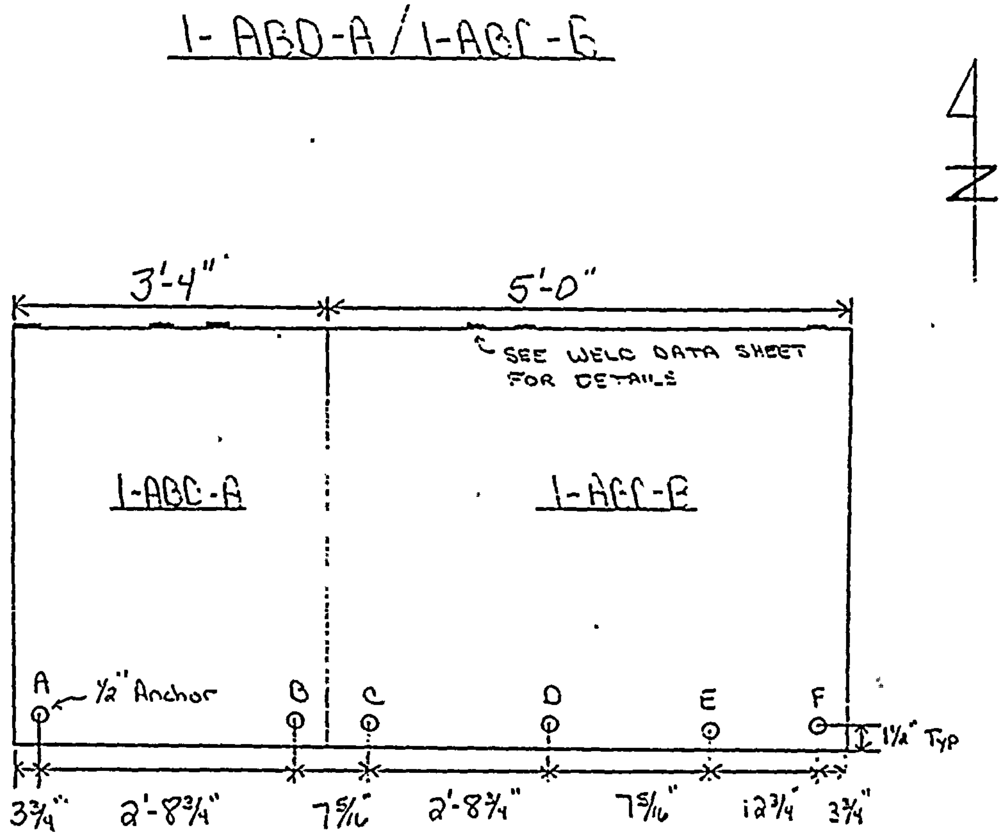
Reviewed by: James Wisniewski Date: 7/22/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1 — Unit #
Aux — Bldg.
AB Emerg. Die. Gen Rm — Location

12-3462-32 — Installation dwg. / Rev.
1-ABD-A — Equipment No.

Anchorage Arrangement Sketch



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CONSTRUCTION CONTROLLED
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JUL 24 1992
CLERK [signature]

Drawn by: [signature] Date: 7/22/92

Verified by: [signature] Date: 7-22-92
Qual./Cert. Inspector

Reviewed by: [signature] Date: 7/22/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-ABD-A Dwg No.: 12-34682-32

Anchor type: Anchor A,B,C,F Type 2 J-Bolt; Anchors D,E Rem Anchor Dia: 1/2" Dwg No.: 12-3305-27

Tightness established by: ☒ "Snug Fit" ☐ Torque

Torque Wrench No.: N/A Cal. Due Date: N/A

Tightness verified? ☒ Yes ☐ No James Wisniewski Construction ARE Date: 7/18/92

Equipment base flexible? ☐ Yes ☒ No James Wisniewski Construction ARE Date: 7/22/92

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D	E	F			Comments
Gaps	0"	0"	0"	0"	0"	0"			
Anchor length	1'-7"	1'-7"	1'-7"	10½"	10½"	1'-7"			
Protruding length	5 3/8"	5 5/8"	5 3/8"	5½"	5¼"	5½"			
Embedment	1'-1 5/8"	1'-1 3/8"	1'-1 5/8"	5"	5¼"	1'-~~0~~ 1½"			
Bolt grip	4 3/4"	4 7/8"	4 3/4"	4 7/8"	4 3/4"	4 5/8"			
Concrete condition	ok	ok	ok	ok	ok	ok			
Edge distance	N/A	N/A	N/A	N/A	N/A	N/A			
Anchor spacing	2'-8 3/4"	7 5/16"	7 5/16"	7 5/16"	7 5/16"	12 3/4"			
Anchor angularity	0°	0°	0°	0°	0°	0°			
Thread engagement	ok	ok	ok	ok	ok	ok			

Comments: Anchors A thru F were tightened during the tightness verification jcw 7/22/92
Anchors A,B,C&F: Anchor length taken from drawings 12-34682-32 and 12-30730-8 jcw 8/4/92
Anchors A,B,C&F do not meet the requirements for embedment. Anchor A thru F exceed the requirements for bolt grip. jcw 8/4/92 THE DISCREPENCIES MENTIONED ABOVE DO NOT DICTATE ANY OPERABILITY CONCERN. T. [illegible] 8-11-92

Verified by: [signature] Date: 8-5-92
Qual./Cert. Inspector

Reviewed by: James Wisniewski Date: 8/4/92
Construction ARE

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ANCHOR INSPECTION DATA SHEET

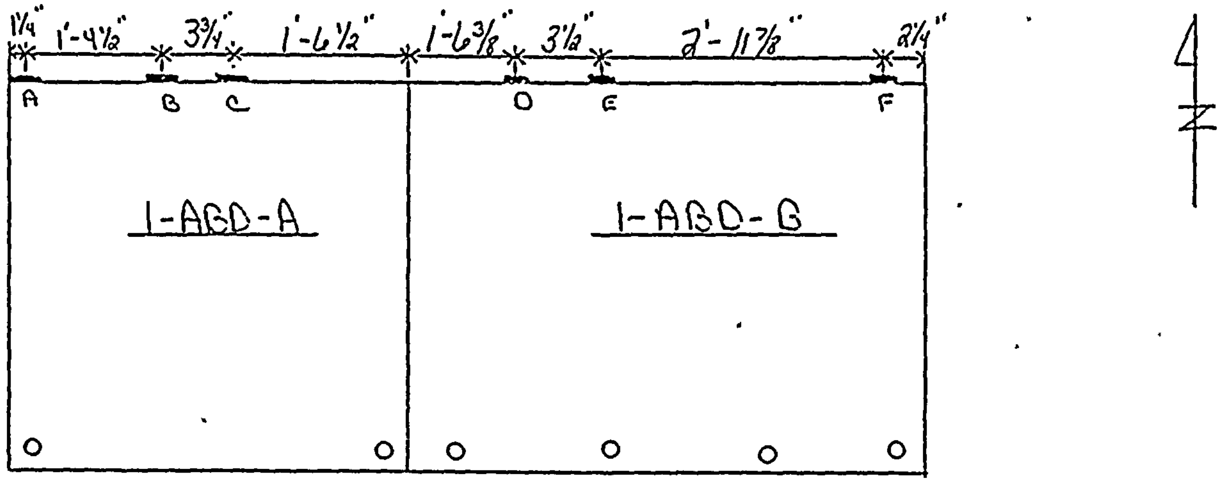
Equipment No.: 1-ABD-A Dwg No.: 12-3462-32

Embedded Steel Dwg. No.: 12-3463-16

PHYSICAL CHARACTERISTICS

Weld ID	A	B	C	D	E	F		
Type	1	1	1	1	1	1		
Size	1/8"	1/8"	1/8"	3/16"	3/16"	3/16"		
Length	2 1/4"	2 1/4"	2 1/4"	2"	2 1/4"	1 1/2"		
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove



Welds A thru F anchor the cabinet to an embedded plate.

WELD DETAIL

Equipment base flexible: ☐ Yes ☒ No Construction Are Date: 7/22/92

Reviewed by: Construction Anchor Review Engineer Date: 7/22/92

Verified by: Qual./Cert. Inpsector Date: 7-23-92

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Equipment No.: 1-ABD-A

Tightness established by "Snug Fit"

Tightness verified by: [signature] Date: 7-22-92

Qual./Cert. Inspector

Comments: Anchors A thru F were tightened during the tightness verification [illegible] 7/22/92

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 8/1/92 REQUEST NO. N/A

IDENTIFICATION

Unit ONE
Component 1-ABD-A/B
Item ANCHOR BOLTS
Material CARBON STEEL
Other SQUG PROGRAM

TECHNIQUE

Test Unit/ S/N MAGNAFLUX FXS/CAC-1
Freq./Diameter 5MHZ/.250
Reference Standard QC-6, QC-10, QC-60
Couplant/Batch No. ULTRAGEL II #908

TEST DATA/REMARKS

ULTRASONIC READINGS TAKE TO DETERMINE LENGTH OF ANCHOR BOLTS. SEE BELOW FOR RESULTS.

ANCHOR #	LENGTH
A	NO BACK REFLECTION
B	NO BACK REFLECTION
C	NO BACK REFLECTION
D	10 1/2"
E	10 1/2"
F	NO BACK REFLECTION

PERFORMED BY: [signature] LEVEL: II DATE: 8/1/92
REVIEWED BY: [signature] LEVEL: II DATE: 8/3/92

FORM NO. 12 SHP 5050 NDE.008-1

Page 1 of 1
Revision 0

Equip Id: 2-CRID-I-CVT Train: 2 Equip Class: 4

Drawing No.: 2-12050

Function: 120 VAC SYSTEM

System: 120V CONTROL ROOM INSTRUMENTATION DISTRIBUTION

Equip Desc: 10KVA TRANSFORMER - CONSTANT VOLTAGE

Building: AUXILIARY Room: 4KV ROOM - 600 VOLTS SWITCHGEAR AREA

Elev: 609 Sort: S,R Notes:

Normal State: Desired State: Power Req'd:

Support System Drawing: 2-98077, 2-12050

Req'd Support Comp:

Safety Related Status: STANDARD Min/Opt: MIN

Alias No: Power Train: A

Comp Served:

MFR: SOLIDSTATE CONTROLS INC.

Model: ISL12100

Panel:

Elem. Drawing: 2-98077

Wiring Drawing: 2-91332

Power Source: 2-EZC-C-5AR

Walkdown: F Relay Eval: Y

Comp Type: TRANSFORMER

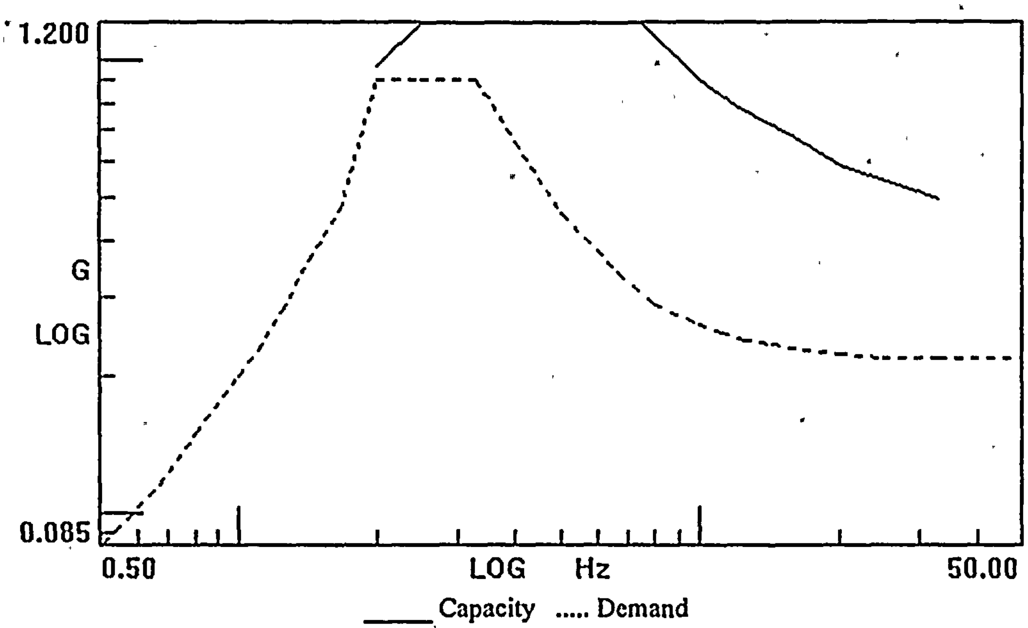
Iso Drawing:

Location: IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)			GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 11
ID : 2-CRID-I-CVT (Rev. 0)		Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE			
Building : AUXILIARY	Floor El. : 609.00		Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100			

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		633.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)		N/A
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 8.00)		N/A
4.	Capacity based on:	1.50 * Bounding Spectrum	
5.	Demand based on:	1.00 * Realistic Mean-Centered Floor Response Spectra	



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0032\spectra.des	BUILDING|Auxiliary|ELEVATION|633|BROADEN|N
Demand 2	C:\GIP\PROJ0032\spectra.des	BUILDING|Auxiliary|ELEVATION|633|BROADEN|N

Does capacity exceed demand? Yes

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

CAVEATS - BOUNDING SPECTRUM

TRN/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
TRN/BS Caveat 2 - Rating of 4.16 KV or Less.	Yes
TRN/BS Caveat 3 - Transformer Coils Postively Restrained Within Cabinet.	Yes
TRN/BS Caveat 4 - Coils Top Braced or Analyzed for Large Transformers.	N/A
TRN/BS Caveat 5 - Clearance Between Energized Component and Cabinet.	Yes
TRN/BS Caveat 6 - Adequate Slack in High Voltage Leads.	Yes
TRN/BS Caveat 7 - Wall-Mounted Units Anchored Close to Enclosure Structure.	N/A
TRN/BS Caveat 8 - Weak-Way Bending of Thin Webs Evaluated.	Yes
TRN/BS Caveat 9 - Adjacent Cabinets Bolted Together.	N/A
TRN/BS Caveat 10 - Doors Secured.	Yes
TRN/BS Caveat 11 - Adequate Anchorage.	Yes
TRN/BS Caveat 12 - Potential Chatter of Essential Relays Evaluated.	N/A
TRN/BS Caveat 13 - No Other Concerns.	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: George G. Thomas (S&A) and Satyan Sharma -- 10/29/92

Anchorage: Anchorage is 1/2" diameter wedge expansion bolts. Most likely they are Phillips anchors based on the Unit 1 CRID-CVT's. Used unknown expansion anchor in ANCHOR analysis for conservatism. Minimum embedment is 2-13/16" above GIP minimum embedment for all types of 1/2" expansion anchors.

Weight estimate based on maximum weight for an inverter in Table C.1-1 of the GIP (configuration similar to an inverter). Weight estimate is 45 lbs/ft^3.

Weight = (4.5' x 2.5' x 2.33') x 45 lbs/ft^3 = 1180 lb

Fluorescent light above unit could come out. However interaction judged non-damaging.

Thin 3/16" thick angles at base of transformer that is bolted to the base channel is gusseted in two locations. (No weak way bending).

Frequency judged by the SRT to be at least 8 Hz.

ANCHOR analysis indicates an additional factor of safety of 1.97.

Pictures: Zap shot 2629 --Inside Cabinet
Zap shot 2630 -- Outside of Transformer
Zap shot 2631 -- Braced Base Channels

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

Evaluated by: Date:

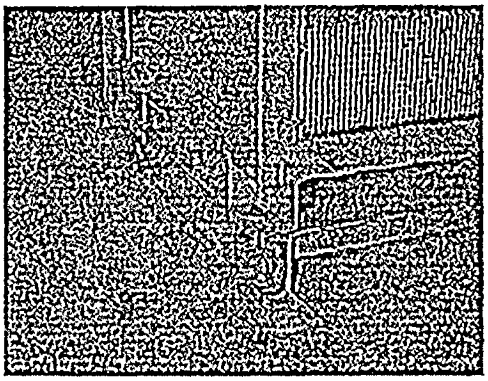
11/10/95

N Satyan Sharma 11/16/95

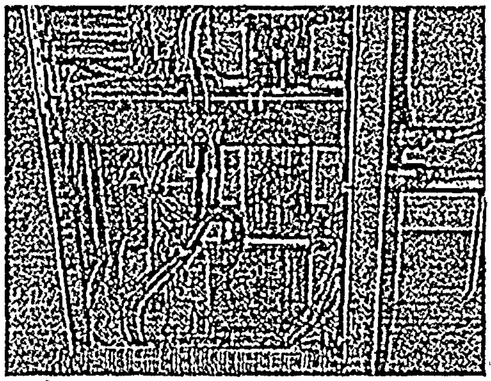
Attachment: Pictures
Attachment: ANCHOR Report

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

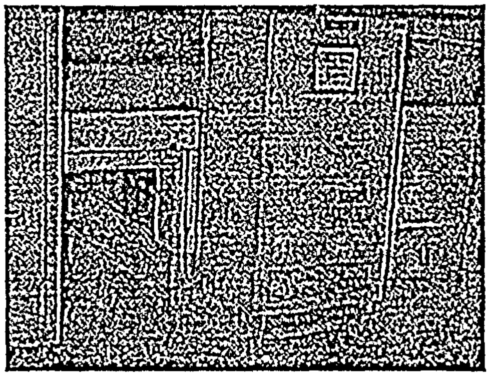
PICTURES



Braced Base Channels



Inside Cabinet



Outside of Transformer

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

ANCHOR Report

Earthquake :
Response Spectrum : Instructure Realistic
Frequency : User - 8.00
Percent Damping : User - 5.00

Spectral Values :

Direction	Acceleration (g's)
North - South	0.36
East - West	0.36
Vertical	0.18

Angle (N-S Direction makes with the X Axis) : 0.00
Combination Criteria : SRSS

Weights :
Number of Weights : 1

No	Weight	X	Y	Z
1	1180.00	14.000	14.250	35.375

Forces :
Number of External Forces : 0

Moments :
Number of External Moments : 0

Allowables :
Anchor :
Number of Anchor types : 1

No.	Dia	Manufact	Product	Ultimate Tension	Ultimate Shear	Tension Inter Coeff	Shear Inter Coeff	Saf Fact
1	1/2	Other	Unknown Expansion Anchor	2290.00	2380.00	1.00	0.30	1.00

Concrete :
Ultimate Stress : 3500.00 psi.

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 7 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

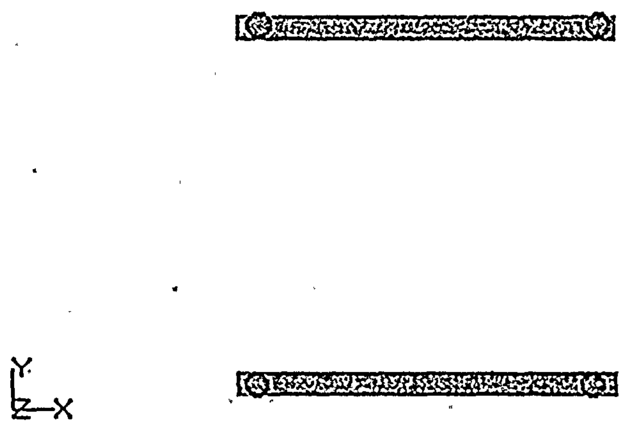
Reduction Factor : 0.85

<u>Weld :</u>
Allowable Stress : 0 psi.

<u>Surfaces :</u>
Number of Surfaces : 1
Surface Orientation

	Direction	Direction	Direction
	Comp	Comp	Comp
No	Nx	Ny	Nz
1	0.000	0.000	1.000

Anchor Pattern for Surface # 1



Legend for Anchor Patterns

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 8 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

Anchor Bolts :

Concrete Lines :

Concrete Points :

Weld Lines :

Geometry :
Anchor :
Number of Anchors : 4

No.	Anch Id	X Coord	Y Coord	Z Coord	Surf Id
1	1	1.500	0.750	0.000	1
2	1	26.438	0.750	0.000	1
3	1	1.750	27.750	0.000	1
4	1	26.875	27.750	0.000	1

Concrete Lines :
# of elements per line : 1
Number of Concrete Lines : 2

No	Start X-Coord	Start Y-Coord	Start Z-Coord	End X-Coord	End Y-Coord	End Z-Coord	Sf Id	Line Width
1	0.000	0.891	0.000	28.063	0.891	0.000	1	1.781
2	0.000	27.609	0.000	28.000	27.609	0.000	1	1.781

Concrete Points :
Number of Concrete Points : 0

Weld Lines :
# of elements per line : 5
Number of Weld Lines : 0

Determination of Reduction Factors :
Reduction Factor Input for Anchor # 1

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)	GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 9 of 11

ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

Adequately Installed : Yes
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 5.00 in.
Crack Size : 0.000 in. - Cracks Affect <= 50% Bolts
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 2

Adequately Installed : Yes
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 5.00 in.
Crack Size : 0.000 in. - Cracks Affect <= 50% Bolts
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 3

Adequately Installed : Yes
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 5.00 in.
Crack Size : 0.000 in. - Cracks Affect <= 50% Bolts
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 4

Adequately Installed : Yes
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 5.00 in.
Crack Size : 0.000 in. - Cracks Affect <= 50% Bolts
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factors Data Current : Yes

No	Anc Id	Pall/ Vall	Pallr/ Vallr	RT	RN	RL	RG	RS	RE	RF	RC	RR	RP	RB	RM
1	1	1202.25	N/A	0.60	1.00	X	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00
		1428.00	N/A	0.60	1.00	X	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1	1202.25	N/A	0.60	1.00	X	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 10 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

		1428.00	N/A	0.60	1.00	X	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	1	1202.25	N/A	0.60	1.00	X	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00
		1428.00	N/A	0.60	1.00	X	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1	1202.25	N/A	0.60	1.00	X	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00
		1428.00	N/A	0.60	1.00	X	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Legend :

N/A	= Not Applicable
Pall	= Allowable Pull without Reduced Inspection
Vall	= Allowable Shear without Reduced Inspection
Pallr	= Allowable Pull with Reduced Inspection
Vallr	= Allowable Shear with Reduced Inspection
*	= Outlier
X	= Reduction Factor Not Used
RT	= Reduction Factor for Type of Anchorage
RN	= Reduction Factor for Installation Adequacy
RL	= Reduction Factor for Embedment
RG	= Reduction Factor for Gap at Anchors
RS	= Reduction Factor for Spacing
RE	= Reduction Factor for Edge Distance
RF	= Reduction Factor for Concrete Strength
RC	= Reduction Factor for Concrete Cracks
RR	= Reduction Factor for Essential Relays
RP	= Reduction Factor for Base Stiffness and Prying Action
RB	= Reduction Factor for Base Strength and Load Path
RM	= Reduction Factor for Embed. Steel and Pads

Analysis Results :
Analysis Performed : Yes

Type of Analysis : Regular

	Spectral Accelerations (G's)			
No	N-S	E-W	Vertical	Safety Factor
1	0.362	0.145	0.073	1.969
2	-0.362	-0.145	-0.073	2.006
3	-0.362	0.145	0.073	2.009
4	0.362	-0.145	-0.073	1.971
5	0.362	-0.145	0.073	1.971
6	-0.362	0.145	-0.073	2.008
7	0.362	0.145	-0.073	1.969
8	-0.362	-0.145	0.073	2.007
9	0.145	0.362	0.073	3.820

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 11 of 11
ID : 2-CRID-I-CVT (Rev. 0)	Class : 4. Transformers	
Description : 10KVA TRANSFORMER - CONSTANT VOLTAGE		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 4KV RM - 600V SWGR AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 7 FEET SOUTH OF 600VAC BUS 21B SUPPLY TRAIN
Manufacturer, Model, Etc. : SOLIDSTATE CONTROLS INC. ISL12100		

10	-0.145	-0.362	-0.073	4.196
11	0.145	-0.362	0.073	3.811
12	-0.145	0.362	-0.073	4.198
13	-0.145	0.362	0.073	3.867
14	0.145	-0.362	-0.073	4.144
15	0.145	0.362	-0.073	4.146
16	-0.145	-0.362	0.073	3.869
17	0.145	0.145	0.183	4.917
18	-0.145	-0.145	-0.183	5.010
19	0.145	0.145	-0.183	4.922
20	-0.145	-0.145	0.183	5.016
21	-0.145	0.145	0.183	5.027
22	0.145	-0.145	-0.183	4.934
23	0.145	-0.145	0.183	4.928
24	-0.145	0.145	-0.183	5.022

Minimum Safety Factor : 1.969

The Anchorage Capacity is 1.969 times greater than the Demand

Cook Nuclear Plant

SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 2-CRID-I-CVT Class 4

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ___ (If yes, check items that apply.)

	Remarks
Anchor Type	
Anchor Diameter	
Anchor Spacing	
Anchor Number	
Anchor Embedment ✓	
Anchor Edge Distance	
Anchor Gap	
Anchor Thread Engagement	
Anchor Grip	
Anchor Angularity	
Concrete Crack	

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

NONE

Actions Taken:

NONE

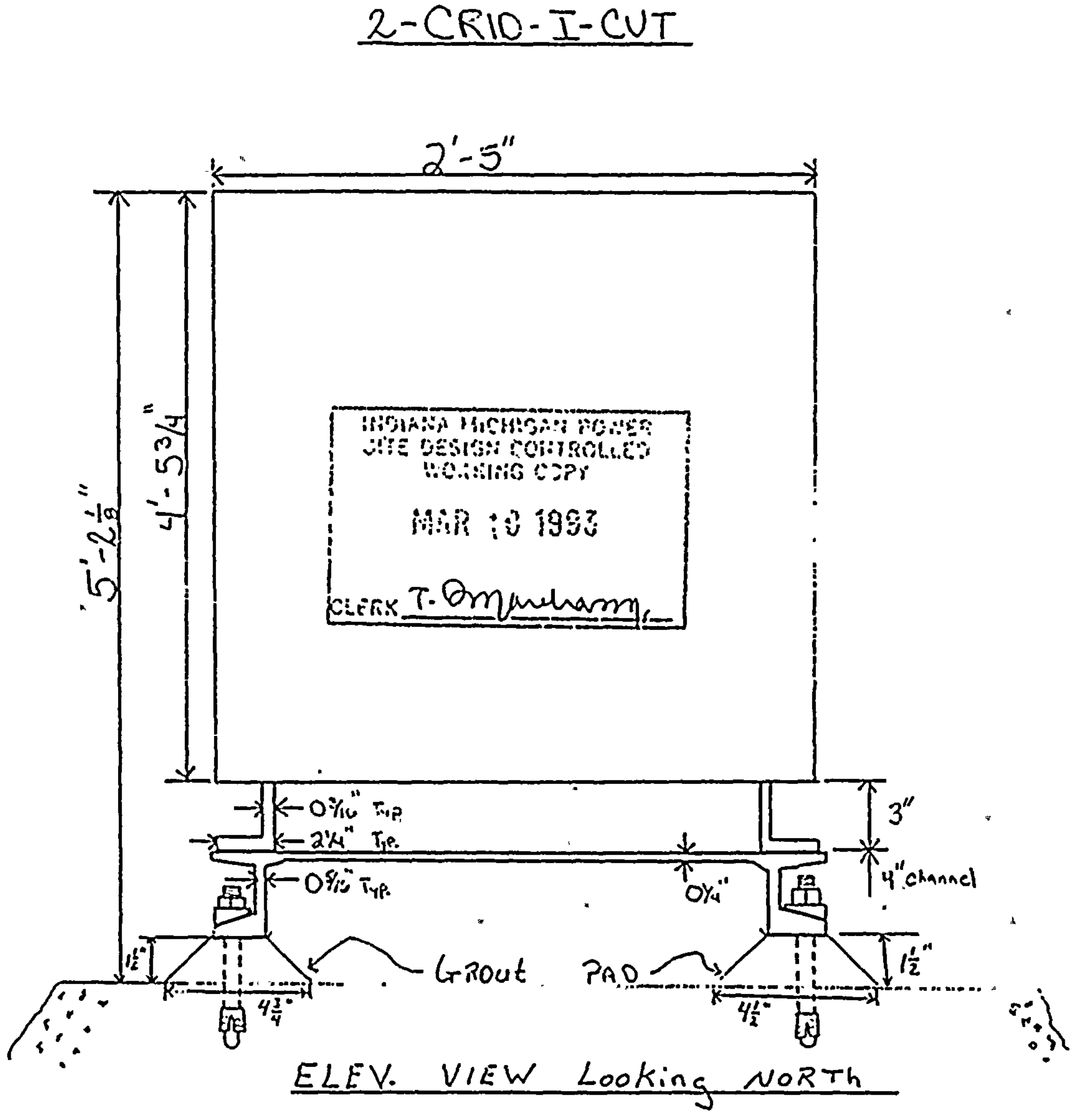
Prepared By T. Ongerham Date 3-10-93

ANCHOR INSPECTION DATA SHEET

2 — Unit #
Aux — Bldg.
4 KV Rm 609'-6" EL — Location

12-~~3494~~ 3476 / ~~27~~ 18 TJ 12-11-92 — Installation dwg. / Rev.
2 CRID-I-CVT — Equipment No.

Anchorage Arrangement Sketch



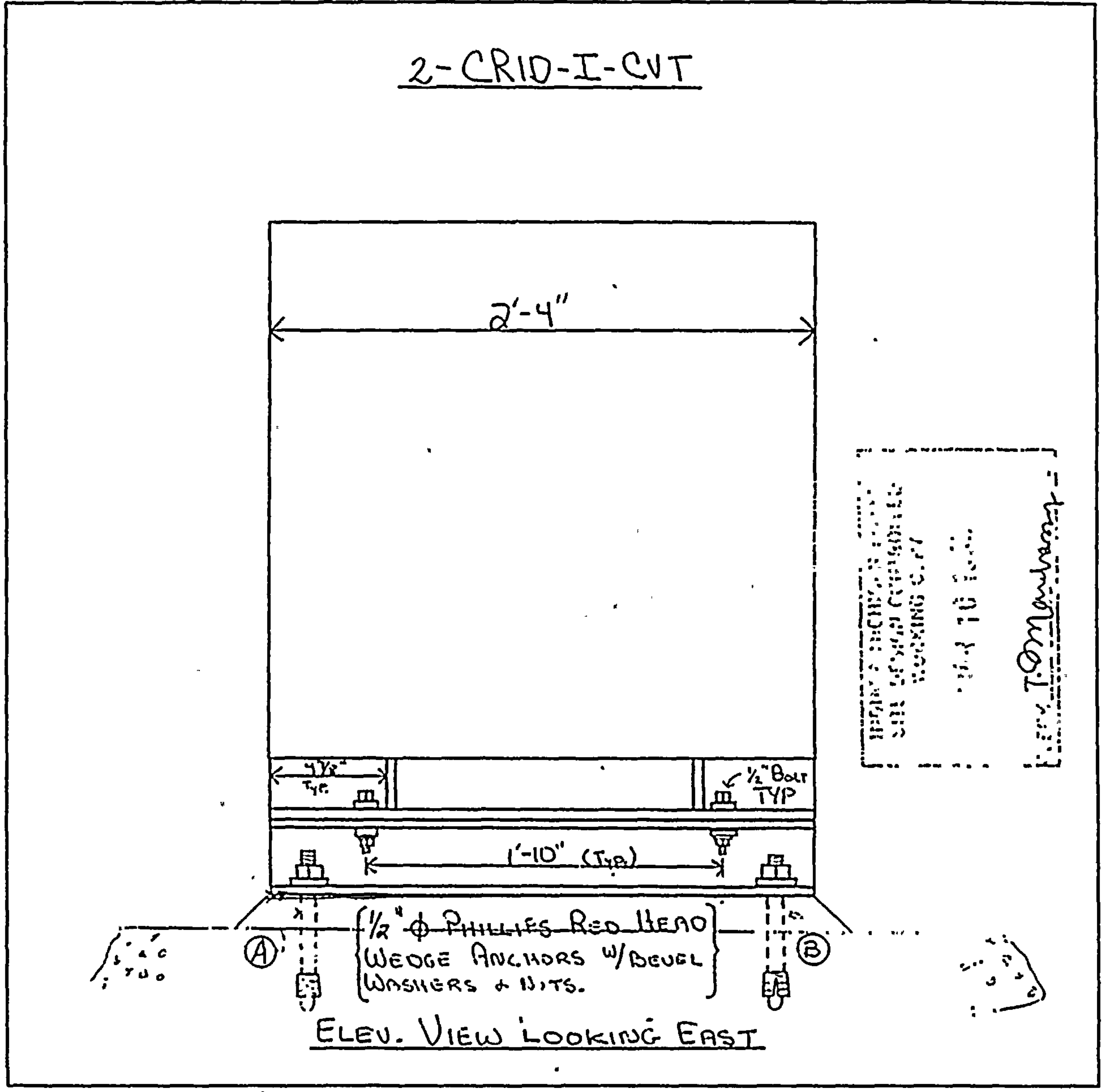
Drawn by: [signature] Date: 11/24/92
Verified by: [signature] Date: 12-7-92
Qual./Cert. Inspector
Reviewed by: T. Omanhawn Date: 12-11-92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

2	Aux	4Kv Room 609' El
Unit #	Bldg.	Location

12-3476-18 ~~12-3474-27~~ TJ 12-11-92	2-CRID-I-CVT
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: [signature] Date: 12/07/92

Verified by: JT Catlin Date: 12-7-92
Qual./Cert. Inspector

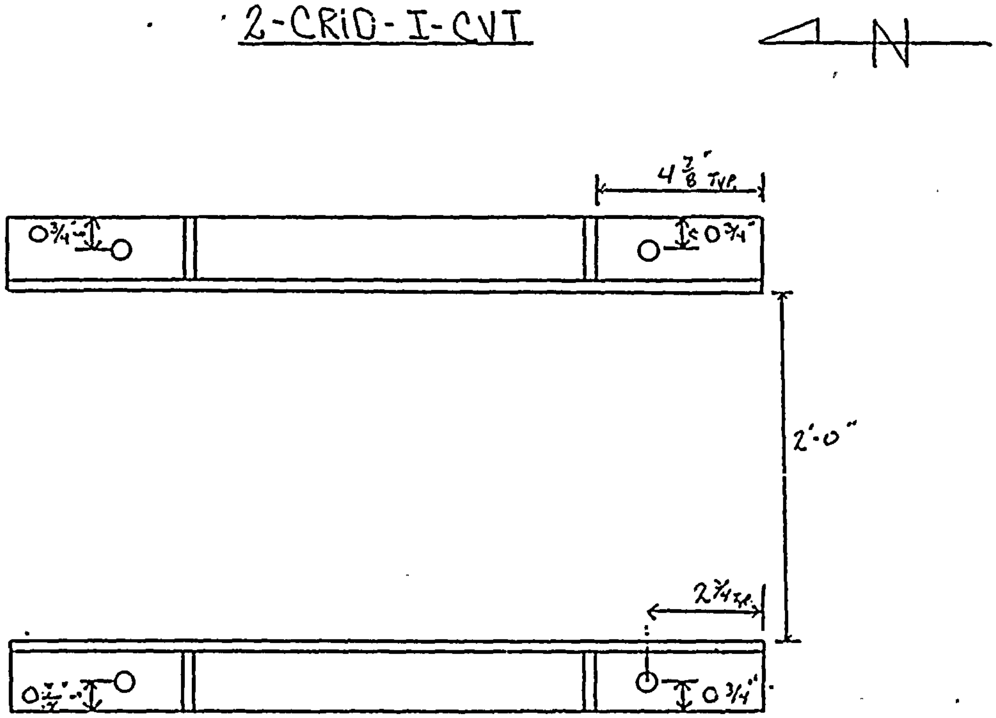
Reviewed by: T. Manlowski Date: 12-11-92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

2	Aux	4KV Room 609'6" EL
Unit #	Bldg.	Location
12-3476-18 ~~12-3474-27~~ TJ 12-11-92		2-CRID-I-CVT
Installation dwg. / Rev.		Equipment No.

Anchorage Arrangement Sketch

2-CRID-I-CVT



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
MAR 10 1993
CLERK T. Omarlaroy

PLAN VIEW OF TOP BRACKET

Drawn by: Jack Burford   Date: 11/24/92

Verified by: J.S.T. Cadle   Date: 12-7-92
Qual./Cert. Inspector

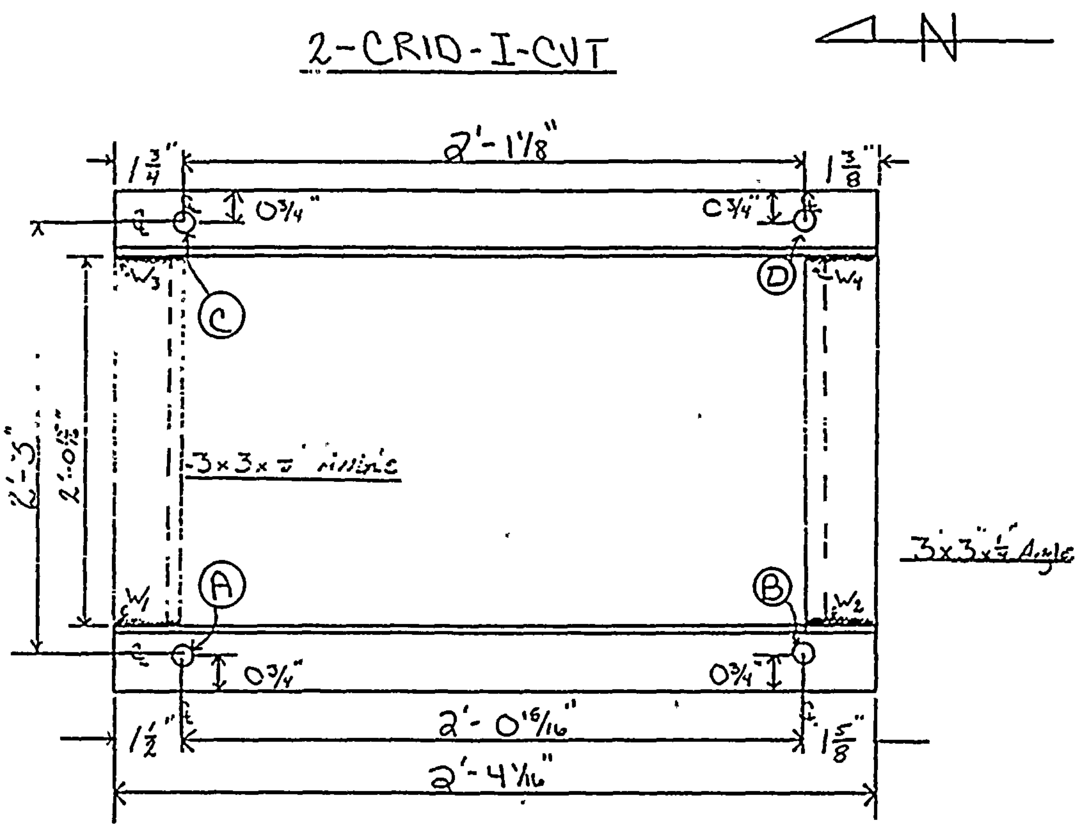
Reviewed by: T. Omarlaroy   Date: 12-11-92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

2	Aux	4KV-Rm. 609'-6" EL
Unit #	Bldg.	Location

~~12-3774-27~~ 12-3476-18 TJ 12-11-92 — 2-CRID-I-CVT
Installation dwg. / Rev. — Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
MAR 10 1993
CLERK T. Marham

PLAN VIEW OF BOTTOM BRACKET

Drawn by: Jack Bradford Date: 11/24/92

Verified by: J.S.T. Cahill Date: 12-7-92
Qual./Cert. Inspector

Reviewed by: T. Marham Date: 12-11-92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-CRID-I-CVT Dwg No.: ~~12-3474-27~~ 12-3476-18
Anchor type: Wedge Anchor. Dia: 1/2" Dwg No.: TJ 12-11-92
Tightness established by: ☒ "Snug Fit" ☐ Torque
Torque Wrench No.: N/A Cal. Due Date: N/A
Tightness verified? ☒ Yes ☐ No JOB T. Omanhany
Construction ARE Date: NA
Equipment base flexible? ☐ Yes ☒ No T. Omanhany
Construction ARE Date: 12-11-92

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	0"	0"	0"	0"					
Anchor length	6 3/8"	6"	6"	6"					
Protruding length	3"	3 3/16"	3"	3 1/4"					
Embedment	3 3/8"	2 13/16"	3"	2 3/4"					
Bolt grip	1 7/8"	2"	1 3/4"	1 7/8"					
Concrete condition	ok	ok	ok	ok					
Edge distance	N/A	N/A	N/A	N/A					
Anchor spacing	2'-0 15/16"	2'-0 15/16"	2'-0 15/16"	2'-0 15/16"			SITE	DESIGN C	AN POWER NTROLLED COPY
Anchor angularity	0°	0°	0°	0°				MAR 10	1993
Thread engagement	ok	ok	ok	ok			T	Omanhany	

Comments:

Verified by: SJ Cadl Date: 12-7-92
Qual./Cert. Inspector

Reviewed by: T. Omanhany Date: 12-11-92
Construction ARE

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-CRIO-I-CVT Dwg No.: ~~12-3474-27~~ 12-3476-18 TJ 12-11-9

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W1	W2	W3	W4				
Type	1	1	1	1				
Size	1/4"	1/4"	1/4"	1/4"				
Length	8 3/4"	8 3/4"	8 3/4"	8 3/4"				
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

FLORIDA [illegible] POWER
SITE DESIGN CONTROLLED
WORKING COPY
MAR 10 1993
CLERK T. Omarlason

Equipment base flexible: ☐ Yes ☒ No T. Omarlason Construction Are Date: 12-11-92

Reviewed by: T. Omarlason Construction Anchor Review Engineer Date: 12-11-92

Verified by: SJ Gadl Qual./Cert. Inpsector Date: 12-7-92

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 11/30/92 REQUEST NO. N/A

IDENTIFICATION

Unit Two
Component 2-CRID-I-CUT
Item 1/2"φ WEDGE ANCHORS
Material CS
Other SQUG PROGRAM

TECHNIQUE

Test Unit/ S/N KRAUTKRAMER USK7/CQC-41
Freq./Diameter 5MHZ/.250
Reference Standard QC-30 & QC-60
Couplant/Batch No. ULTRAGEL II #9088

TEST DATA/REMARKS

ANCHOR	LENGTH
A	6.4"
B	6"
C	6"
D	6"

PERFORMED BY: Stephen R. Vargo LEVEL: II DATE: 11/30/92
REVIEWED BY: [signature] LEVEL: II DATE: 11/30/92

FORM NO. 12 SHP 5050 NDE.008-1

Equipment No.: 2-CRTD-I-CVT

Tightness established by "Snug Fit"

Tightness verified by: SJ Castle Date: 12-7-92
Qual./Cert. Inspector

Comments: ______________________________

wk 1, 7...

SAFE SHUTDOWN EQUIPMENT LIST (SSELUP)

FUNCTION: CCW

Equipment Class: 5 Train: 1

Equipment ID: 1-PP-10W Drawing Number: 1-5135A

System: CCW

Equip Description: WEST CCW PUMP

Building: AUXILIARY Room: 609 HALLWAY Elevation: 609

Normal state: R/NR Desired state: R Power Required: Y Sort: W,R Notes:

Supporting System Drawing Number: 1-12001 1-12060 1-98405

Required Interconnections and Supporting Components: 1-T11A7 1-HCAB-3

Safety Related Status: NUCLEAR SR Min/Opt: MIN

ADDITIONAL INFORMATION

Alias Number: Power Train: B

Component Served: WEST CCW PUMP

Manufacturer: INGERSOLL-RAND CO Model: 9000GPM

Panel: 1-CCW 1-HSD1

Elem Drawing: 1-98405 Wiring Drawing: 1-93011

Power Source: 1-T11A7, 1-HCAB-3

Walkdown: F Relay Only: Y

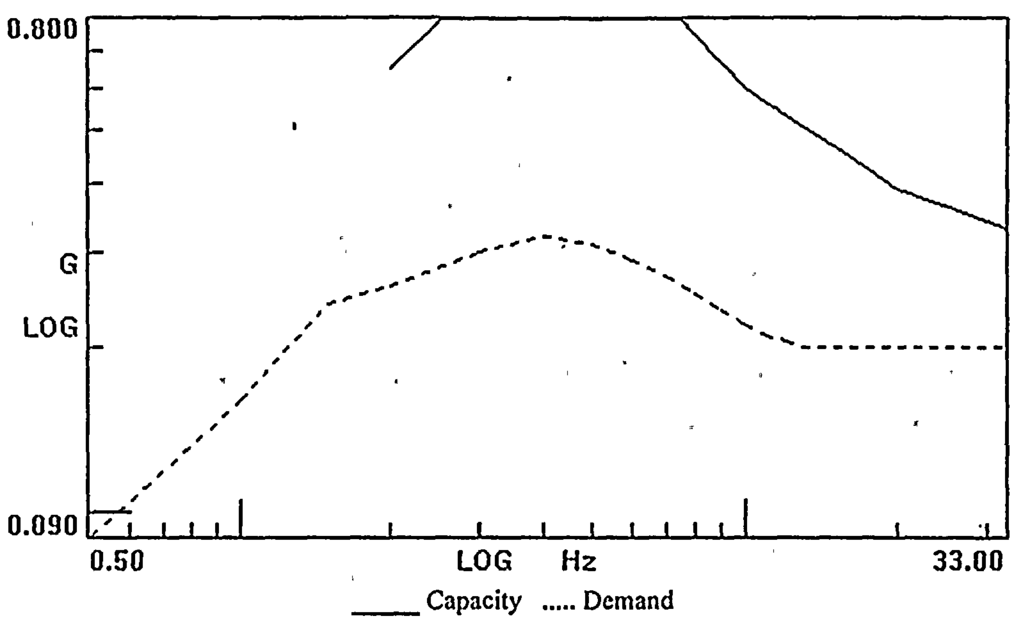
Component Type: PUMP
ISO Drawings:

Detailed Location:

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 11
ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		609.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)		Yes
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 20.00)		Yes
4.	Capacity based on:	1.00 * Bounding Spectrum	
5.	Demand based on:	1.00 * Design Basis Ground Response Spectrum	



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0035\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N
Demand 2	C:\GIP\PROJ0035\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N

Does capacity exceed demand? Yes

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 11
ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM		

CAVEATS - BOUNDING SPECTRUM

HP/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
HP/BS Caveat 2 - Driver and Pump on Rigid Skid.	Yes
HP/BS Caveat 3 - Thrust Bearings in Both Axial Directions.	Yes
HP/BS Caveat 4 - Check of Long Unsupported Piping.	Yes
HP/BS Caveat 5 - Base Vibration Isolation System Checked.	Yes
HP/BS Caveat 6 - Sufficient Slack and Flexibility of Attached Lines.	Yes
HP/BS Caveat 7 - Adequate Anchorage.	Yes
HP/BS Caveat 8 - Potential Chatter of Essential Relays Evaluated.	N/A
HP/BS Caveat 9 - No Other Concerns.	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes*

Are anchorage requirements met? Yes

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

<table>
<tr><td colspan="3">D.C. COOK Unit 1
SCREENING EVALUATION WORK SHEET (SEWS)</td><td>GIP Rev 2, Corrected, 2/14/92
Status: Yes
Sheet 3 of 11</td></tr>
<tr><td colspan="2">ID : 1-PP-10W (Rev. 0)</td><td colspan="2">Class : 5. Horizontal Pumps</td></tr>
<tr><td colspan="4">Description : WEST CCW PUMP</td></tr>
<tr><td>Building : AUXILIARY</td><td colspan="2">Floor El. : 609.00</td><td>Room, Row/Col : HALLWAY,</td></tr>
<tr><td colspan="4">Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM</td></tr>
</table>

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: John D. Stevenson, Paul Wilson, Rick Leonard, and Kailash Mahajan on 10/5/93.

MFG: INGERSOLL-RAND PUMP, 9000 G.P.M.

Anchorage: 6-3/4" J-Bolts.
Total WT=9580 lbs. C.G.=35" above base.

*Minor cracks in non-Struct. pad judged insignificant.

Nozzle loads were applied in the ANCHOR analysis. Nozzle loads were obtained from AEP "SUMMARY OF LOAD ON EQUIPMENT" 11/2/71, Summary of Loads on Pumps for CCW #1W PUMP, (microfilm page 00100020022) and included deadweight, thermal, thermal anchor movements, and seismic loads.

Ref. Drwgs.: Ingersoll-Rand C-14ALV86X51, W-16ALV500X17, AEPSC 12-3286-9, 12-3073B-2, 12-3073A-3, 12-3285-23, Livsey & Co. 1-CCW-37, Rev. 5, Sh. 2 of 2.

Picture # 12, Wk1, Tm1, Disk2

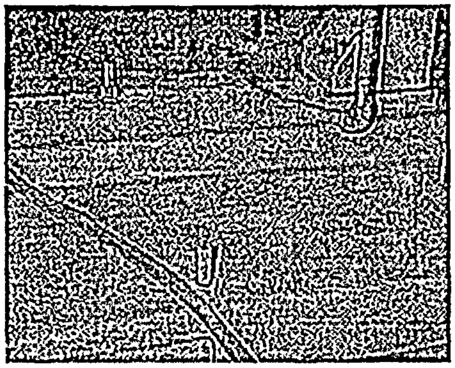
Evaluated by: John D. Stevenson Date: 8/29/95

Paul R. Wilson 8-25-95

Attachment: Pictures
Attachment: ANCHOR Report

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)			GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 11
ID : 1-PP-10W (Rev. 0)		Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP			
Building : AUXILIARY	Floor El. : 609.00		Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM			

PICTURES



1-PP-10W West CCW Pump--Anchorage

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 11
ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM		

ANCHOR Report

Earthquake :

Response Spectrum : SSE

Frequency : GIP - Rigid

Percent Damping : GIP - 5.00

Spectral Values :

Direction	Acceleration (g's)
North - South	0.38
East - West	0.38
Vertical	0.25

Angle (N-S Direction makes with the X Axis) : 0.00

Combination Criteria : SRSS

Weights :

Number of Weights : 1

No	Weight	X	Y	Z
1	9580.00	105.400	20.750	35.000

Forces :

Number of External Forces : 2

No	Fx	Fy	Fz	X	Y	Z
1	2.86E+003	1.24E+003	-3.24E+003	26.870	-5.250	17.000
2	-2.36E+003	2.24E+003	-4.85E+003	26.870	47.750	19.000

Moments :

Number of External Moments : 2

No	Mx	My	Mz
1	4.88E+004	1.68E+005	3.34E+004
2	6.32E+004	8.76E+004	-1.60E+004

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 11
ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM		

Allowables :

Anchor :

Number of Anchor types : 1

No.	Dia	Manufact	Product	Ultimate Tension	Ultimate Shear	Tension Inter Coeff	Shear Inter Coeff	Saf Fact
1	3/4	Other	J-Bolt (90 deg)	15030.00	7510.00	1.00	0.30	1.00

Concrete :

Ultimate Stress : 3500.00 psi.

Reduction Factor : 0.85

Weld :

Allowable Stress : 30600 psi.

Surfaces :

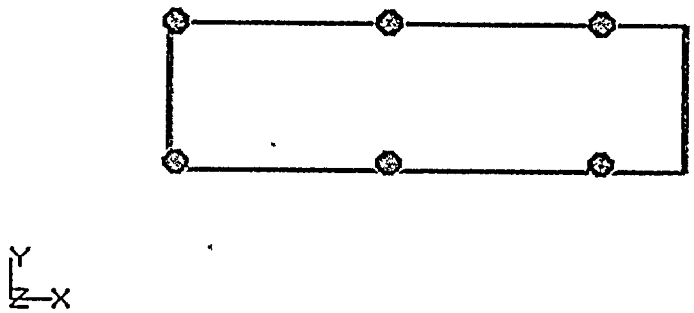
Number of Surfaces : 1
Surface Orientation

No	Direction Comp Nx	Direction Comp Ny	Direction Comp Nz
1	0.000	0.000	1.000

Anchor Pattern for Surface # 1

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)	GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 7 of 11

ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM		



Legend for Anchor Patterns

Anchor Bolts :

Concrete Lines :

Concrete Points :

Weld Lines :

Geometry :

Anchor :

Number of Anchors : 6

No.	Anch Id	X Coord	Y Coord	Z Coord	Surf Id
1	1	10.000	4.250	0.000	1
2	1	59.750	4.250	0.000	1
3	1	109.500	4.250	0.000	1
4	1	10.000	37.250	0.000	1
5	1	59.750	37.250	0.000	1
6	1	109.500	37.250	0.000	1

Concrete Lines :

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes
ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM		

# of elements per line : 1

Number of Concrete Lines : 4

No	Start X-Coord	Start Y-Coord	Start Z-Coord	End X-Coord	End Y-Coord	End Z-Coord	Sf Id	Line Width
1	8.250	2.625	0.000	129.000	2.625	0.000	1	1.000
2	8.250	2.625	0.000	8.250	37.250	0.000	1	1.000
3	8.250	37.250	0.000	129.000	37.250	0.000	1	1.000
4	129.000	2.625	0.000	129.000	37.250	0.000	1	1.000

Concrete Points :

Number of Concrete Points : 0

Weld Lines :

# of elements per line : 5

Number of Weld Lines : 0

Determination of Reduction Factors :

Reduction Factor Input for Anchor # 1

Adequately Installed : Yes
Embedment Length : (19.50 in. Min Reqd. to achieve full capacity) :=40.88 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.00 in.
Crack Size : 0.016 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 2

Adequately Installed : Yes
Embedment Length : (19.50 in. Min Reqd. to achieve full capacity) :=40.88 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.63 in.
Crack Size : 0.016 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 3

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)	GIP Rev 2, Corrected, 2/14/92 Status: Yes

ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps
Description : WEST CCW PUMP	
Building : AUXILIARY	Floor El. : 609.00 / Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM	

Adequately Installed : Yes
Embedment Length : (19.50 in. Min Reqd. to achieve full capacity) :=40.88 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.00 in.
Crack Size : 0.016 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 4

Adequately Installed : Yes
Embedment Length : (20.06 in. Min Reqd. to achieve full capacity) :=40.88 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.50 in.
Crack Size : 0.016 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 5

Adequately Installed : Yes
Embedment Length : (20.00 in. Min Reqd. to achieve full capacity) :=40.88 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.63 in.
Crack Size : 0.016 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 6

Adequately Installed : Yes
Embedment Length : (19.25 in. Min Reqd. to achieve full capacity) :=40.88 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.016 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factors Data Current : Yes

No	Anc Id	Pall/ Vall	Pallr/ Vallr	RT	RN	RL	RG	RS	RE	RF	RC	RR	RP	RB	RM
1	1	5342.33	N/A	1.00	1.00	0.54	1.00	1.00	0.65	1.00	1.00	1.00	1.00	1.00	1.00
		2798.39	N/A	1.00	1.00	1.00	1.00	1.00	0.37	1.00	1.00	1.00	1.00	1.00	1.00

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 10 of 11
ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM		

2	1	5508.76	N/A	1.00	1.00	0.54	1.00	1.00	0.67	1.00	1.00	1.00	1.00	1.00	1.00
		3741.21	N/A	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00
3	1	5342.33	N/A	1.00	1.00	0.54	1.00	1.00	0.65	1.00	1.00	1.00	1.00	1.00	1.00
		2798.39	N/A	1.00	1.00	1.00	1.00	1.00	0.37	1.00	1.00	1.00	1.00	1.00	1.00
4	1	5562.31	N/A	1.00	1.00	0.56	1.00	1.00	0.67	1.00	1.00	1.00	1.00	1.00	1.00
		3541.72	N/A	1.00	1.00	1.00	1.00	1.00	0.47	1.00	1.00	1.00	1.00	1.00	1.00
5	1	5586.05	N/A	1.00	1.00	0.55	1.00	1.00	0.67	1.00	1.00	1.00	1.00	1.00	1.00
		3741.21	N/A	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00
6	1	5403.66	N/A	1.00	1.00	0.54	1.00	1.00	0.67	1.00	1.00	1.00	1.00	1.00	1.00
		3347.69	N/A	1.00	1.00	1.00	1.00	1.00	0.45	1.00	1.00	1.00	1.00	1.00	1.00

Legend :

N/A	= Not Applicable
Pall	= Allowable Pull without Reduced Inspection
Vall	= Allowable Shear without Reduced Inspection
Pallr	= Allowable Pull with Reduced Inspection
Vallr	= Allowable Shear with Reduced Inspection
*	= Outlier
X	= Reduction Factor Not Used
RT	= Reduction Factor for Type of Anchorage
RN	= Reduction Factor for Installation Adequacy
RL	= Reduction Factor for Embedment
RG	= Reduction Factor for Gap at Anchors
RS	= Reduction Factor for Spacing
RE	= Reduction Factor for Edge Distance
RF	= Reduction Factor for Concrete Strength
RC	= Reduction Factor for Concrete Cracks
RR	= Reduction Factor for Essential Relays
RP	= Reduction Factor for Base Stiffness and Prying Action
RB	= Reduction Factor for Base Strength and Load Path
RM	= Reduction Factor for Embed. Steel and Pads

Analysis Results :

Analysis Performed : Yes

Type of Analysis : Regular

	Spectral Accelerations (G's)			
No	N-S	E-W	Vertical	Safety Factor
1	0.375	0.150	0.100	3.680
2	-0.375	-0.150	-0.100	4.948
3	-0.375	0.150	0.100	4.002
4	0.375	-0.150	-0.100	4.555

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 11 of 11
ID : 1-PP-10W (Rev. 0)	Class : 5. Horizontal Pumps	
Description : WEST CCW PUMP		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : INGERSOLL-RAND CO 9000GPM		

5	0.375	-0.150	0.100	4.428
6	-0.375	0.150	-0.100	4.181
7	0.375	0.150	-0.100	3.741
8	-0.375	-0.150	0.100	4.641
9	0.150	0.375	0.100	2.376
10	-0.150	-0.375	-0.100	3.601
11	0.150	-0.375	0.100	3.403
12	-0.150	0.375	-0.100	2.503
13	-0.150	0.375	0.100	2.479
14	0.150	-0.375	-0.100	3.448
15	0.150	0.375	-0.100	2.400
16	-0.150	-0.375	0.100	3.418
17	0.150	0.150	0.250	4.907
18	-0.150	-0.150	-0.250	7.950
19	0.150	0.150	-0.250	5.450
20	-0.150	-0.150	0.250	6.260
21	-0.150	0.150	0.250	4.909
22	0.150	-0.150	-0.250	7.606
23	0.150	-0.150	0.250	6.417
24	-0.150	0.150	-0.250	5.768

Minimum Safety Factor : 2.376

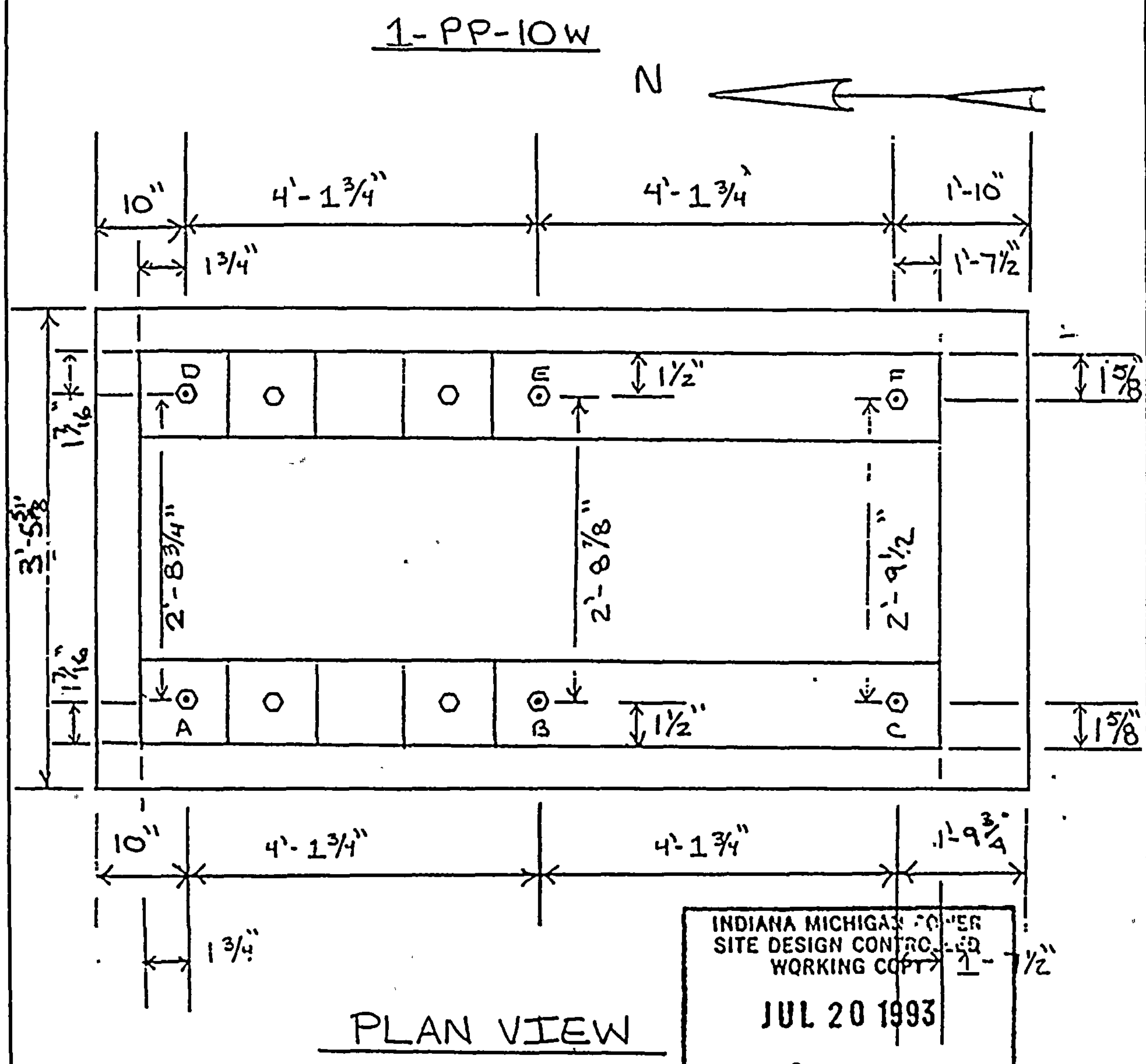
The Anchorage Capacity is 2.376 times greater than the Demand

ANCHOR INSPECTION DATA SHEET

1	AUX	609 HALLWAY
Unit #	Bldg.	Location

12-3286-9	1-PP-10W
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 20 1993
CLERK T. Amantrout

Drawn by: [signature] Date: 6/29/92

Verified by: [signature] Date: 7-14-93
Qual./Cert. Inspector

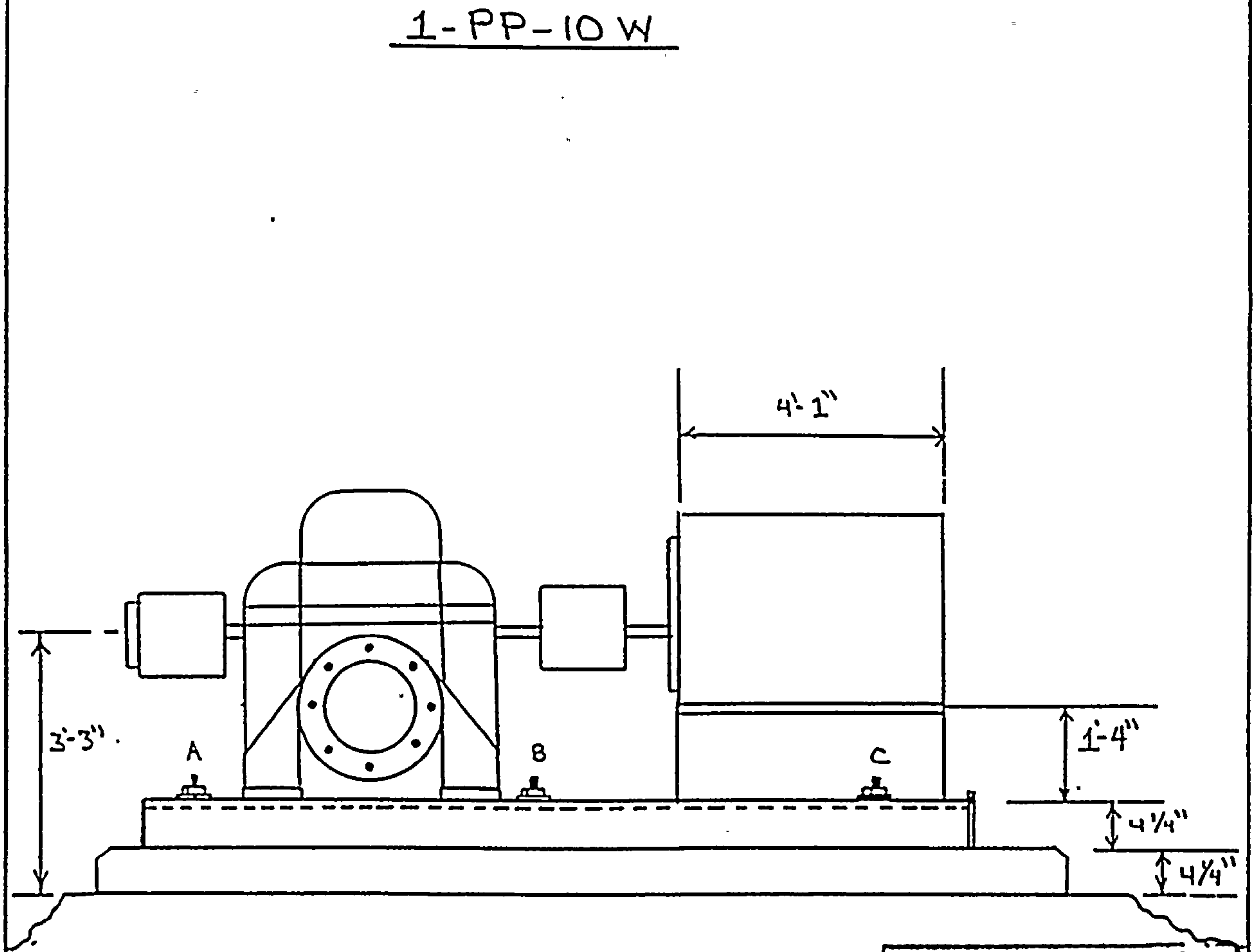
Reviewed by: T. [signature] Date: 7-19-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	AUX.	609 HALLWAY
Unit #	Bldg.	Location

12-3286-9	1-PP-10W
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 20 1993
CLERK T. Ompuleny

Drawn by: Ed S Tam Date: 6/22/92

Verified by: RW Trahan Date: 7-14-93
Qual./Cert. Inspector

Reviewed by: T. Ompuleny Date: 7-19-93
Construction Anchor Review Engineer

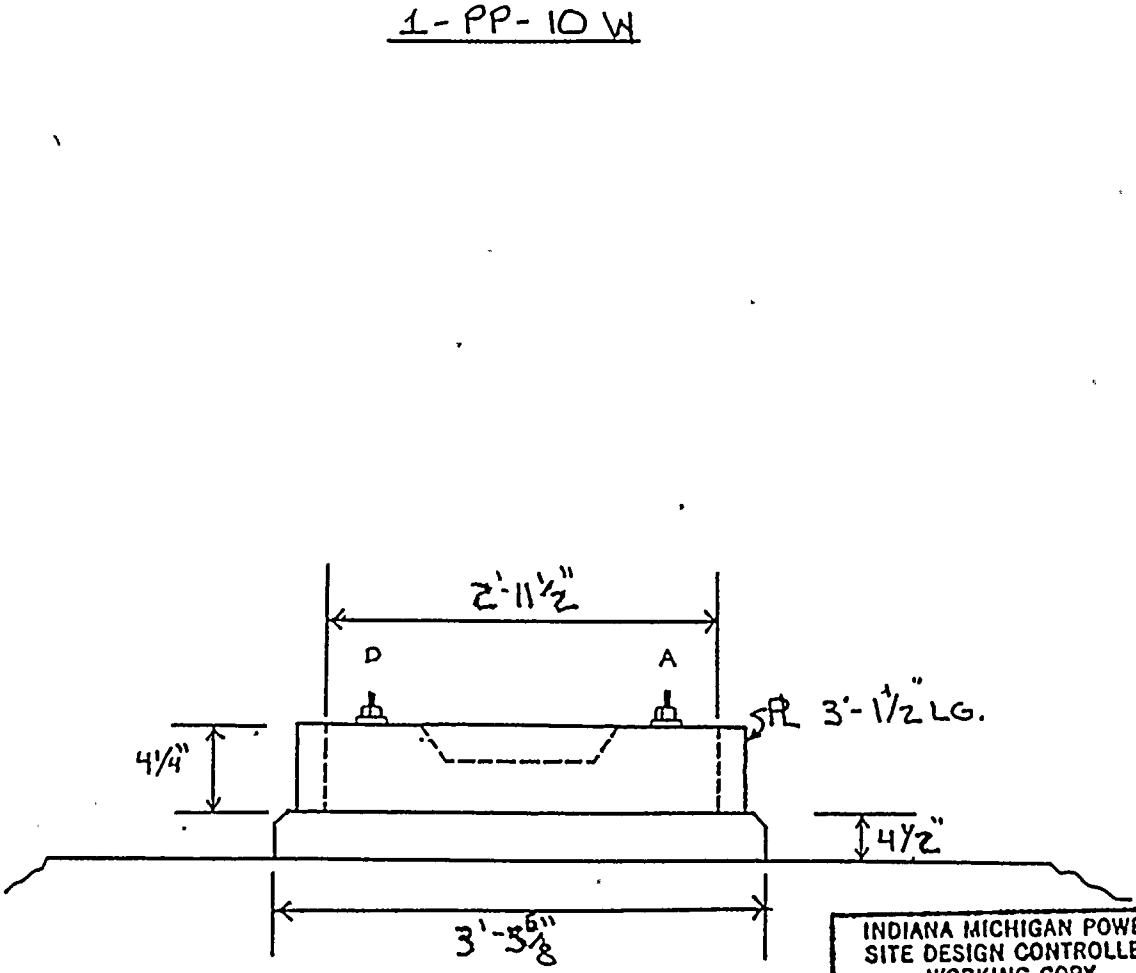
ANCHOR INSPECTION DATA SHEET

1	AUX	609 HALLWAY
Unit #	Bldg.	Location

12-3286-9 — Installation dwg. / Rev.

1-PP-10W — Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 20 1993
CLERK T. Omaraos

Drawn by: [signature] Date: 6/22/92

Verified by: [signature] Date: 7-14-93
Qual./Cert. Inspector

Reviewed by: T. Omaraos Date: 7-19-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-PP-10W Dwg No.: 12-3286-9

Anchor type: J-BOLT - TYPE 2 Dia: 3/4" Dwg No.: 12-3073B-2

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date: ______

Tightness verified? ☐ Yes ☐ No NA T. Omanlaong Construction ARE Date: 7-9-93

Equipment base flexible? ☐ Yes ☒ No T. Omanlaong Construction ARE Date: 7-9-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D	E	F			Comments
Gaps	No	No	No	No	No	No			
Anchor length	2'-6 3/4"	2'-6 3/4"	2'-6 3/4"	2'-6 3/4"	2'-6 3/4"	2'-6 3/4"			
Protruding length RWB 7-14-93	~~10 5/8"~~ 11 1/4"	~~10 7/8"~~ 11 1/4"	~~10 7/8"~~ 11 1/4"	~~10 5/16"~~ 10 11/16"	~~10 3/8"~~ 10 3/4"	~~11 1/8"~~ 11 1/2"			
Embedment RWB 7-14-93	~~1'-8 1/8"~~ 19 1/2"	~~1'-7 7/8"~~ 19 1/2"	~~1'-7 7/8"~~ 19 1/2"	~~1'-8 7/16"~~ 20 1/16"	~~1'-8 3/8"~~ 20"	~~1'-7 5/8"~~ 19 1/4"			
Bolt grip RWB 7-14-93	~~8 3/8"~~ 9"	~~8 1/8"~~ 8 3/4"	~~8 1/4"~~ 8 7/8"	~~8 1/4"~~ 8 7/8"	~~8 1/8"~~ 8 3/4"	~~8 1/4"~~ 8 7/8"			
Concrete condition	*	*	*	*	*	*			
Edge distance	4"	4 5/8"	4"	4 1/2"	4 5/8"	4 3/8"			TO EDGE OF NON-STRUCT. PAD 4 1/4" THIC
Anchor spacing	2'-8 3/4"	2'-8 7/8"	2'-9 1/2"	2'-8 3/4"	2'-8 7/8"	2'-9 1/2"			
Anchor angularity	OK	OK	OK	OK	OK	OK			
Thread engagement	OK	OK	OK	OK	OK	OK			

Comments: ANCHOR LENGTHS ARE TAKEN FROM DRAWINGS 12-3286-9 AND 12-30
*-DENOTES SOME CRACKS IN NON-STRUCT. PAD AND ON FL. CRACKS ARE LESS THAN 1/64" ~~THICK~~ T. Omanlaong 7-19-93

Verified by: RWBradan Qual./Cert. Inspector Date: 7-14-93

Reviewed by: T. Omanlaong Construction ARE Date: ______

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 20 1993
CLERK T. Omanlaong

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 4-20-93 REQUEST NO. N/A

IDENTIFICATION

Unit One
Component 1-PP-10W
Item Anchors
Material c/s
Other Sqwg

TECHNIQUE

Test Unit/ S/N KB USK-7S CQC-405
Freq./Diameter 5mhz .250"
Reference Standard QC-8
Couplant/Batch No. Ultragel II #908

TEST DATA/REMARKS

Anchors B,C,D,E,F
A back reflection indicating anchor bolt length was not obtained during this exam. This would be indicative of a J-bolt type anchor.

Anchor (A) could not be done due to a 1" drain pipe above the bolt.

PERFORMED BY: [signature] LEVEL: II DATE: 4-20-93

REVIEWED BY: Stephen R. Vayo LEVEL: II DATE: 4/21/93

FORM NO. 12 SHP 5050 NDE.008-1

Equip Id: 2-PP-46-4 Train: 1 Equip Class: 5

Drawing No.: 12-5131 12-5131A

Function: _RI_

System: BORON MAKEUP (CVCS)

Equip Desc: BORIC ACID STORAGE TANKS TRANSFER PUMP #4

Building: AUXILIARY Room: BORIC ACID STORAGE TANK AREA

Elev: 587 Sort: S,R Notes:

Normal State: NR Desired State: R Power Req'd: Y

Support System Drawing: 2-12010 2-98272

Req'd Support Comp: 2-AB-A-1D

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: B

Comp Served: BAST

MFR: GOULDS PUMPS INC.

Model: 3196

[illegible]l: 2-BA 2-HSD2

Elem. Drawing: 2-98272

Wiring Drawing: 2-94217

Power Source: 2-AB-A-1D

Walkdown: F Relay Eval: Y

Comp Type: PUMP

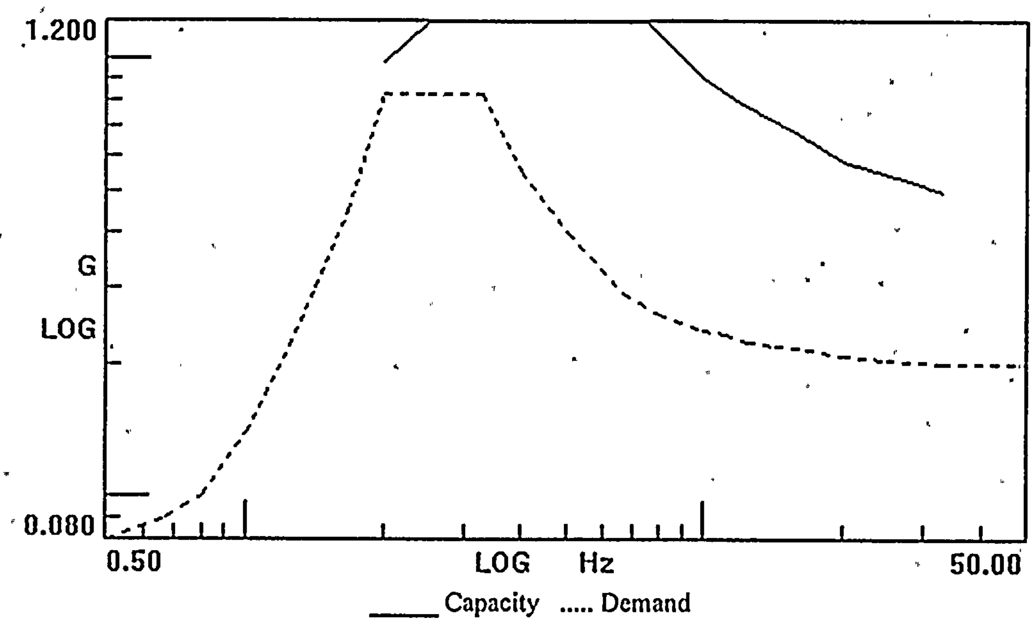
Iso Drawing: 0-DR-724

Location: IN THE MIDDLE EAST REGION OF THE ROOM, 15 FEET SOUTHEAST OF MIDDLE BORIC ACID STORAGE TANK #12-TK-12M, NEAR THE FLOOR

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 4
ID : 2-PP-46-4 (Rev. 0)	Class : 5. Horizontal Pumps	
Description : BORIC ACID STORAGE TANKS TRANSFER PUMP #4		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : BORIC ACID STOR TANK AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 15 FEET SOUTHEAST OF MIDDLE BORIC ACID STORAGE TANK #12-TK-12M, NEAR THE FLOOR
Manufacturer, Model, Etc. : GOULDS PUMPS INC. 3196		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		587.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)		N/A
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 20.00)		N/A
4.	Capacity based on:	1.50 * Bounding Spectrum	
5.	Demand based on:	1.00 * Realistic Median-Centered Floor Response Spectra	



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0034\spectra.des	BUILDING|Auxiliary|ELEVATION|587|BROADEN|N
Demand 2	C:\GIP\PROJ0034\spectra.des	BUILDING|Auxiliary|ELEVATION|587|BROADEN|N

Does capacity exceed demand? Yes

ID : 2-PP-46-4 (Rev. 0)	Class : 5. Horizontal Pumps	
Description : BORIC ACID STORAGE TANKS TRANSFER PUMP #4		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : BORIC ACID STOR TANK AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 15 FEET SOUTHEAST OF MIDDLE BORIC ACID STORAGE TANK #12-TK-12M, NEAR THE FLOOR
Manufacturer, Model, Etc. : GOULDS PUMPS INC. 3196		

CAVEATS - BOUNDING SPECTRUM

HP/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
HP/BS Caveat 2 - Driver and Pump on Rigid Skid.	Yes
HP/BS Caveat 3 - Thrust Bearings in Both Axial Directions.	Yes
HP/BS Caveat 4 - Check of Long Unsupported Piping.	Yes
HP/BS Caveat 5 - Base Vibration Isolation System Checked.	Yes
HP/BS Caveat 6 - Sufficient Slack and Flexibility of Attached Lines.	Yes
HP/BS Caveat 7 - Adequate Anchorage.	Yes
HP/BS Caveat 8 - Potential Chatter of Essential Relays Evaluated.	N/A
HP/BS Caveat 9 - No Other Concerns.	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes.
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 4
ID : 2-PP-46-4 (Rev. 0)	Class : 5. Horizontal Pumps	
Description : BORIC ACID STORAGE TANKS TRANSFER PUMP #4		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : BORIC ACID STOR TANK AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 15 FEET SOUTHEAST OF MIDDLE BORIC ACID STORAGE TANK #12-TK-12M, NEAR THE FLOOR
Manufacturer, Model, Etc. : GOULDS PUMPS INC. 3196		

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? <u>Yes</u>

<u>IS EQUIPMENT SEISMICALLY ADEQUATE?</u> <u>Yes</u>

<u>COMMENTS</u>

SRT: John D. Stevenson, Paul Wilson, Rick Leonard, and kailash Mahajan on 10/05/93.

GOULDS PUMP.
Anchorage Four 5/8" diameter Ram anchor expansion bolts.
Pump WT 511lbs, C.G=12 3/8" above base.

The 5/8" diameter expansion anchors have 4" embedment into the base concrete below the 8" pad, per the anchorage inspection.
This judged adequate by the SRT for the light (511 lbs) pump.
Attached piping is 2" or less. Nozzle loads judged not to be a problem by the SRT.

Picture # 49, Wk1, Tm1, Disk1.

Evaluated by: Date:

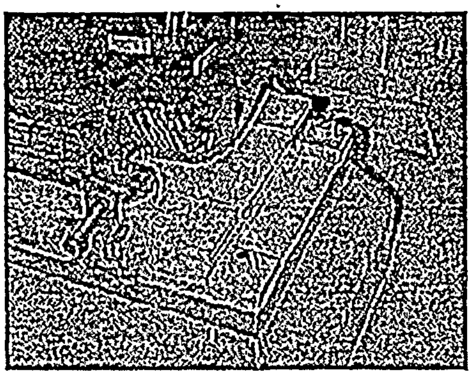
John D. Stevenson 8/29/95

Paul R. Wilson 8-25-95

<u>Attachment: Pictures</u>

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 4
ID : 2-PP-46-4 (Rev. 0)	Class : 5. Horizontal Pumps	
Description : BORIC ACID STORAGE TANKS TRANSFER PUMP #4		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : BORIC ACID STOR TANK AREA - IN THE MIDDLE EAST REGION OF THE ROOM, 15 FEET SOUTHEAST OF MIDDLE BORIC ACID STORAGE TANK #12-TK-12M, NEAR THE FLOOR
Manufacturer, Model, Etc. : GOULDS PUMPS INC. 3196		

<u>PICTURES</u>



Boric Acid Storage Tank Transfer Pump 2-PP-46-4-- Anchors

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 2-PP-46-4 Class 5

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ~~✓~~ (If yes, check items that apply.)

	Remarks
Anchor Type	
Anchor Diameter	
Anchor Spacing	
Anchor Number	
Anchor Embedment	
Anchor Edge Distance	
Anchor Gap	
Anchor Thread Engagement	
Anchor Grip ✓	
Anchor Angularity	
Concrete Crack	

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

~~NO WASHERS~~ Jy 7-16-93

Actions Taken:

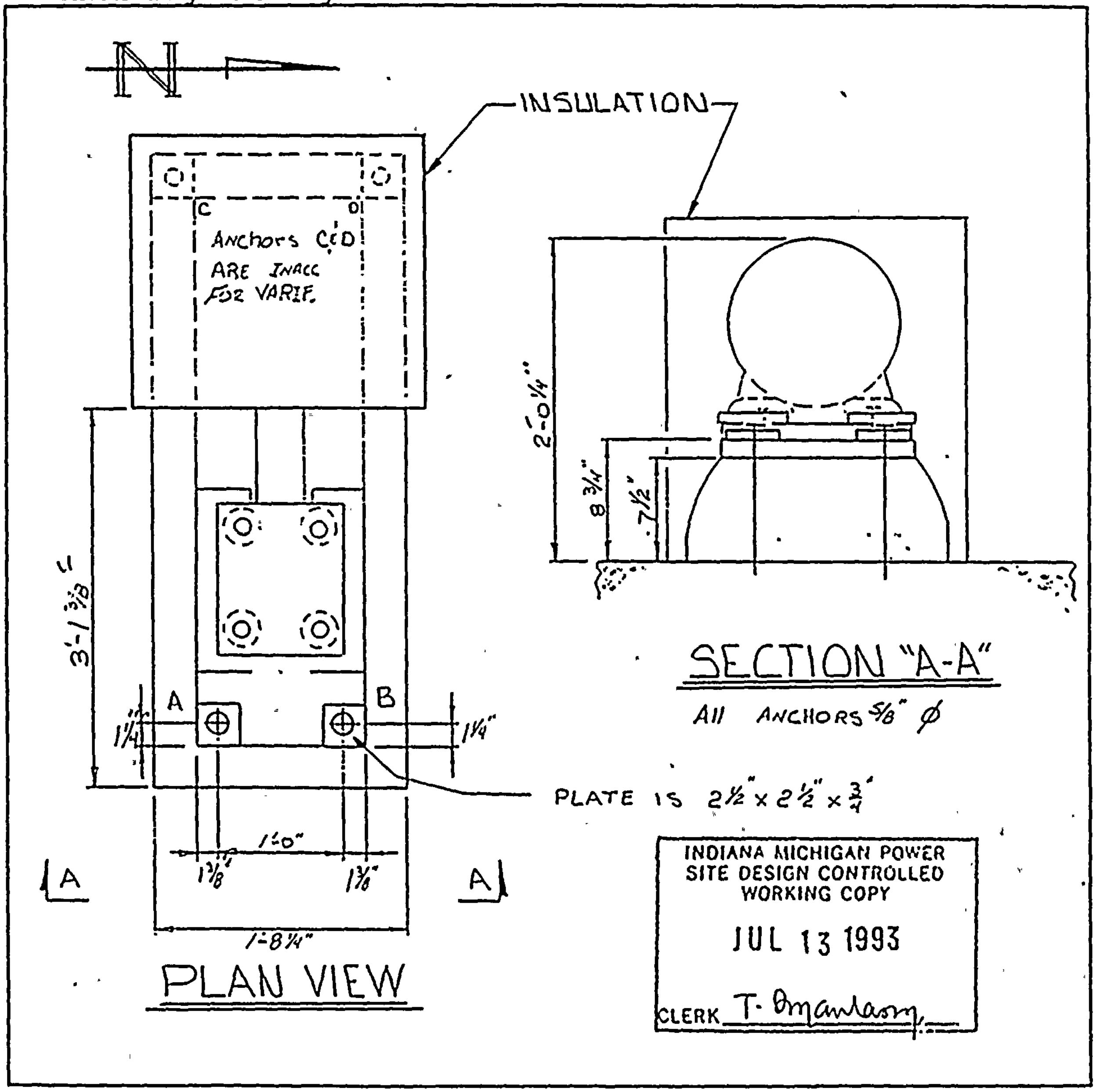
Prepared By T. Omarlang Date 7-13-93

ANCHOR INSPECTION DATA SHEET

TWO — Unit #
AUX — Bldg.
Boric Acid Storage Tank Area — Location

12-3237-23 — Installation dwg. / Rev.
2-PP-46-4 — Equipment No.

Anchorage Arrangement Sketch



Drawn by: Jack Bedford — Date: 5-10-93
Verified by: R W Fedlaw — Date: 6-2-93
Qual./Cert. Inspector
Reviewed by: T. Omanlasm — Date: 7-13-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-PP-46-4 Dwg No.: 12-3237-23

Anchor type: RAM ANCHOR NON-SHELL TYPE Dia: 5/8" Ø Dwg No.: 12-3238-7

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: CPM 647 Cal. Due Date: OCT 20, 1993

Tightness verified? ☒ Yes ☐ No S. Thakkar Construction ARE Date: 5-18-93

Equipment base flexible? ☐ Yes ☒ No S. Thakkar Construction ARE Date: 5-18-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	0"	0"	*	*					
Anchor length	1'-3"	1'-3"	*	*					
Protruding length	10 5/16"	10 1/2"	*	*					
Embedment	4 11/16"	4 1/2"	*	*					
Bolt grip	9 1/2"	9 9/16"	*	*					
Concrete condition	ok	ok	*	*					
Edge distance	~~>10"~~	~~>10"~~	*	*					
	~~4"~~ >10"	~~4"~~ >10"	T. Omanlaszy 7-13-93						
Anchor spacing	12"	12"	*	*					
Anchor angularity	0°	0°	*	*					
Thread engagement	ok	ok	*	*					

Comments: NO WASher USED with ANchoRS. (℞ 2 1/2 x 2 1/2 x 3/4" PLATE WASHER)
* ANchoRS C & D are INAccessible FOR VARIFICATION.

Verified by: R W Graham / TIGHTNESS B. [illegible] 6-2-93 Date: 6-2-93
Qual./Cert. Inspector

Reviewed by: T. Omanlaszy Date: 7-13-93
Construction ARE

SITE DESIGN CONTROL
WORKING COPY
JUL 13 1993
T. Omanlaszy

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 32

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 3-23-93 REQUEST NO. N/A

IDENTIFICATION

Unit Two
Component 2-PP-46-4
Item Anchor Bolts
Material C/S
Other Sqcz

TECHNIQUE

Test Unit/ S/N USK-7S KB CQC-405
Freq./Diameter 5mhz .250"
Reference Standard QC-8.
Couplant/Batch No. Ultragel II #908

TEST DATA/REMARKS

Anchor	Length
A	15"
B	15"
C	Inaccessable
D	Inaccessable

PERFORMED BY: [signature] LEVEL: II DATE: 3-23-93
REVIEWED BY: Stephen R. Veigs LEVEL: II DATE: 3/23/93

FORM NO. 12 SHP 5050 NDE.008-1

Database: K:SSEL1B.DBF

Equip ID: 1-HV-AFP-M1 Train: 2 Equip Class:9

Drawing No.: 12-5148B

Function: HVAC

System: TURBINE BUILDING VENTILATION

Equip Desc:. EAST MOTOR DRIV AUX FEEDWATER PUMP ROOM EXHAUST FAN

Building: TURBINE Room: EAST MOTOR DRIV. AUX FEEDWATER PUMP ROOM

Elev: 591 Sort: S,R Notes:

Normal State: Desired State: Power Req'd: Y

Support System Drawing: 1-12030 1-98214

Req'd Support Comp: 1-AB-D-R2D

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: A

Comp Served: EAST MOTOR DRIV AUX FEED PUMP

MFR:

Vol: 10000 FT^3/MIN

Panel:

Elem. Drawing: 1-98214

Wiring Drawing: 1-94228

Power Source: 1-AB-D-R2D

Walkdown: F Relay Eval : Y

Comp Type: VENT FAN

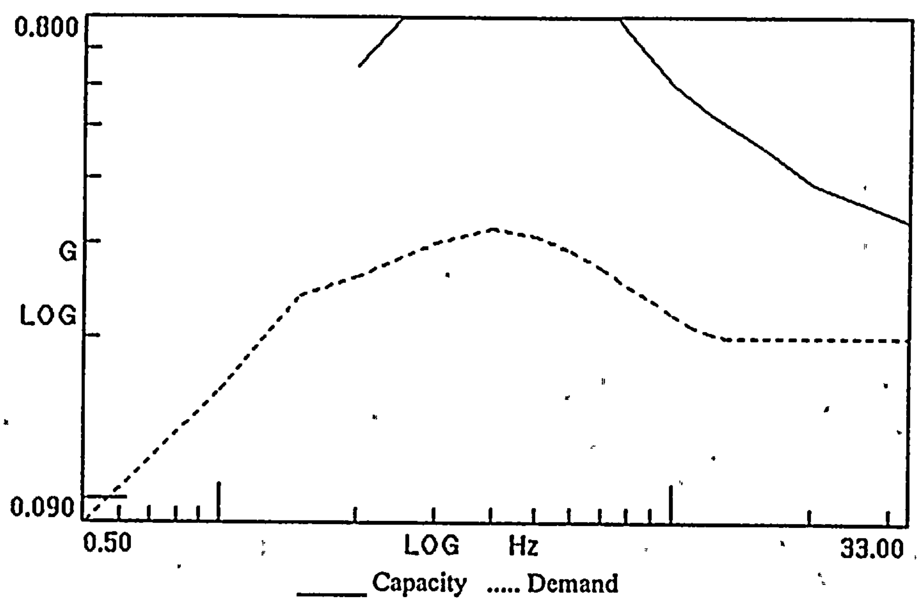
Iso Drawing:

Location: IN THE SW CORNER OF THE ROOM, 10' SW OF EAST MDAFWP, ON THE WEST WALL, 12' ABOVE THE FLOOR.

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 3
ID : 1-HV-AFP-M1 (Rev. 0)	Class : 9. Fans	
Description : EAST MOTOR DRIV AUX FEEDWATER PUMP ROOM EXHAUST FAN		
Building : TURBINE	Floor El. : 591.00	Room, Row/Col : E MOTOR DRIV AUX FDWTR PUMP RM, IN THE SW CORNER OF THE RM, 10' SW OF E MDAFWP, ON THE W WALL, 12' ABOVE THE FLR.
Manufacturer, Model, Etc. : JOY MANUFACTURING CO., 10000 FT^3/MIN		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input	591.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)	Yes
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 10.00)	Yes
4.	Capacity based on:	1.00 * Bounding Spectrum
5.	Demand based on:	1.00 * Design Basis Ground Response Spectrum



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0035\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N
Demand 2	C:\GIP\PROJ0035\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N

Does capacity exceed demand? <u>Yes</u>

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 3
ID : 1-HV-AFP-M1 (Rev. 0)	Class : 9. Fans	
Description : EAST MOTOR DRIV AUX FEEDWATER PUMP ROOM EXHAUST FAN		
Building : TURBINE	Floor El. : 591.00	Room, Row/Col : E MOTOR DRIV AUX FDWTR PUMP RM, IN THE SW CORNER OF THE RM, 10' SW OF E MDAFWP, ON THE W WALL, 12' ABOVE THE FLR.
Manufacturer, Model, Etc. : JOY MANUFACTURING CO., 10000 FT^3/MIN		

CAVEATS - BOUNDING SPECTRUM

FAN/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
FAN/BS Caveat 2 - Drive Motor and Fan Mounted on Common Base.	Yes
FAN/BS Caveat 3 - Long Shafts Supported at Fan and at Motor.	Yes
FAN/BS Caveat 4 - No Possibility of Excessive Duct Distortion Causing Binding or Misalignment of Fan.	Yes
FAN/BS Caveat 5 - Base Vibration Isolation System Checked.	N/A
FAN/BS Caveat 6 - Sufficient Slack and Flexibility of Attached Lines.	Yes
FAN/BS Caveat 7 - Adequate Anchorage.	Yes
FAN/BS Caveat 8 - No Other Concerns	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 3
ID : 1-HV-AFP-M1 (Rev. 0)	Class : 9. Fans	
Description : EAST MOTOR DRIV AUX FEEDWATER PUMP ROOM EXHAUST FAN		
Building : TURBINE	Floor El. : 591.00	Room, Row/Col : E MOTOR DRIV AUX FDWTR PUMP RM, IN THE SW CORNER OF THE RM, 10' SW OF E MDAFWP, ON THE W WALL, 12' ABOVE THE FLR.
Manufacturer, Model, Etc. : JOY MANUFACTURING CO., 10000 FT^3/MIN		

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Gunnar Harstead and Harry Young on 10/20/93.

Anchorage:
Fan mounted to embedded plate structure with at least 16 steel to steel bolts at least 1/2" in diameter.

Weight of fan 500 lbs.

No anchorage calculation required for a fan of this size with this robust anchorage. Therefore anchorage is OK based on SRT judgement and inspection.

Interaction:
Insulated pipe running outside the room the fan services could impact the outside screen of the fan. Pipe well insulated and will cushion the impact, therefore the SRT judged this as non-damaging.

Photo: Fan mounted outside the room with the damper on the inside, therefore could not get a good picture of fan.

Evaluated by: Date:

Harry H. Young 6/8/95

Gunnar A. Harstead 6/22/95

ANCHOR INSPECTION DATA SHEET

1	TURBINE DRIVEN AUX FEED WATER PUMP ROOM	WEST WALL, 12' ABOVE FLOOR SOUTHWEST CORNER
Unit #	Bldg.	Location

12-5684-5	1-HV-AFP-M1
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch

UNABLE TO TAKE ANY DIMENSIONS BECAUSE OF THE 24" φ PIPE IN FRONT OF THE FAN MOUNTING R. BY ENGINEERING REVIEW THE FAN APPEARS TO BE ADEQUATELY SUPPORTED.

Drawn by: T. Omanchany Date: 3-8-93

Verified by: NA Date:
Qual./Cert. Inspector

Reviewed by: T. Omanchany Date: 3-8-93
Construction Anchor Review Engineer

Database: K:SSEL1B.DBF

Equip ID: 12-HV-ESW-7 Train: 2 Equip Class:9

Drawing No.: 12-5148B

Function: HVAC

System: SCREENHOUSE VENTILATION

Equip Desc: UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN

Building: SCREENHOUSE Room: EAST ESW PUMP ROOM

Elev: 591 Sort: S,R Notes:

Normal State: Desired State: Power Req'd: Y

Support System Drawing: 1-12033 1-98415

Req'd Support Comp: 1-PS-D-2B

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: A

Comp Served: EAST ESW PUMP

MFR: BUFFALO FORGE CO

Model: 5000 FT^3/MIN

Panel:

Elem. Drawing: 1-98415 1-98721

Wiring Drawing: 1-95103

Power Source: 1-PS-D-2B

Walkdown: F Relay Eval : Y

Comp Type: VENT FAN

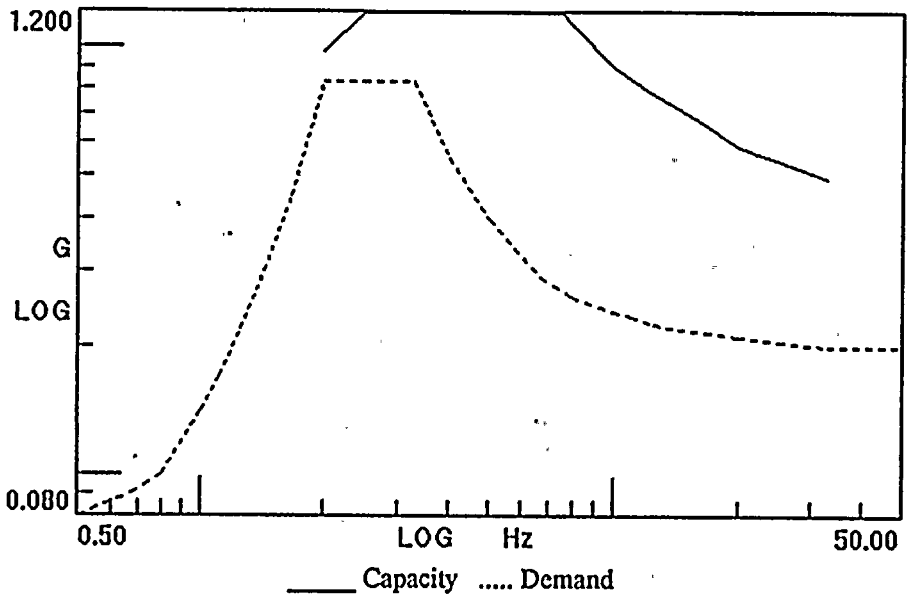
Iso Drawing:

Location: IN THE SW CORNER OF THE ROOM, 15' SE OF EAST ESW PP, 13' ABOVE THE FLOOR.

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input	587.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)	N/A
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 10.00)	N/A
4.	Capacity based on:	1.50 * Bounding Spectrum
5.	Demand based on:	1.00 * Realistic Median-Centered Floor Response Spectra



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0035\spectra.des	BUILDING|Auxiliary|ELEVATION|587|BROADEN|N
Demand 2	C:\GIP\PROJ0035\spectra.des	BUILDING|Auxiliary|ELEVATION|587|BROADEN|N

Does capacity exceed demand? Yes

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

CAVEATS - BOUNDING SPECTRUM

FAN/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
FAN/BS Caveat 2 - Drive Motor and Fan Mounted on Common Base.	Yes
FAN/BS Caveat 3 - Long Shafts Supported at Fan and at Motor.	Yes
FAN/BS Caveat 4 - No Possibility of Excessive Duct Distortion Causing Binding or Misalignment of Fan.	Yes
FAN/BS Caveat 5 - Base Vibration Isolation System Checked.	N/A
FAN/BS Caveat 6 - Sufficient Slack and Flexibility of Attached Lines.	Yes
FAN/BS Caveat 7 - Adequate Anchorage.	Yes
FAN/BS Caveat 8 - No Other Concerns	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

IS EQUIPMENT SEISMICALLY ADEQUATE? **Yes**

COMMENTS

SRT: Gary Thomas, Gunnar Harstead and Harry Young on 10/19/93.

Capacity vs Demand:
Component is in Screenhouse building using Auxiliary building Response Spectra for calculation.

Anchorage:
Fan sits on steel platform, bolted to the wall on two sides with 2 - 3/4" through bolts on each side, and hung at opposite corner by a 4x4x3/8" angle.

Calculation should be rerun. This fan is the limiting analysis fo 12-HV-ESW-1,2,3,4,5,6,7,&8.

Anchorage is adequate. The calculated anchorage safety factor is 32.8.

Photo: Wk. 2, Tm. 2, Disk 1, Picture 29 Fan; 30 Underside of frame showing two bolts to wall; 31 Top of angle hanger support for platform.

Evaluated by: Gunnar Harstead Date: 6/22/95

George D. [illegible] 7/13/95

Attachment: Pictures
Attachment: ANCHOR Report

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

PICTURES

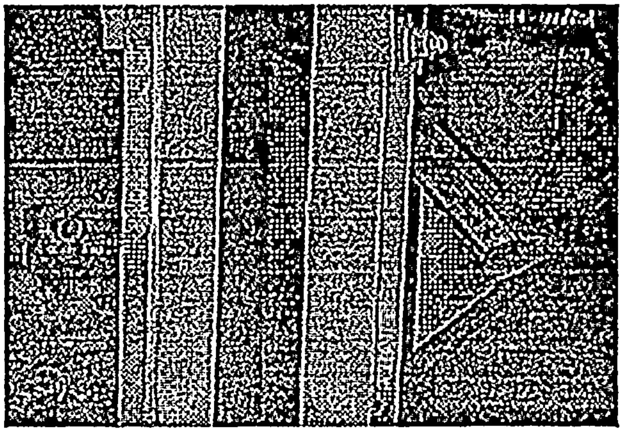


Figure 1: Fan 12-HV-ESW-7

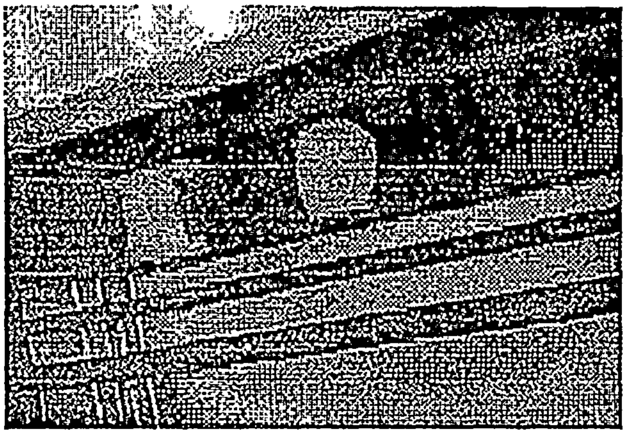


Figure 2: Underside of frame showing two bolts to wall

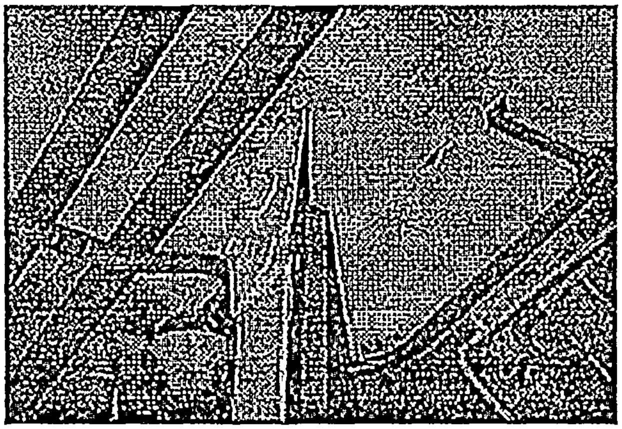


Figure 3: Top of angle hanger support for platform

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

ANCHOR Report

Earthquake :

Response Spectrum : SSE

Frequency : GIP - Flexible

Percent Damping : GIP - 5.00

Spectral Values :

Direction	Acceleration (g's)
North - South	0.60
East - West	0.60
Vertical	0.25

Angle (N-S Direction makes with the X Axis) : 0.00

Combination Criteria : SRSS

Weights :

Number of Weights : 1

No	Weight	X	Y	Z
1	500.00	35.000	23.000	18.000

Forces :

Number of External Forces : 0

Moments :

Number of External Moments : 0

Allowables :

Anchor :

Number of Anchor types : 1

No.	Dia	Manufact	Product	Ultimate Tension	Ultimate Shear	Tension Inter Coeff	Shear Inter Coeff	Saf Fact

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

1	3/4	Other	Grouted In Place	1500.00	7510.00	1.00	0.30	1.00

Concrete :

Ultimate Stress : 3500.00 psi.

Reduction Factor : 0.85

Weld :

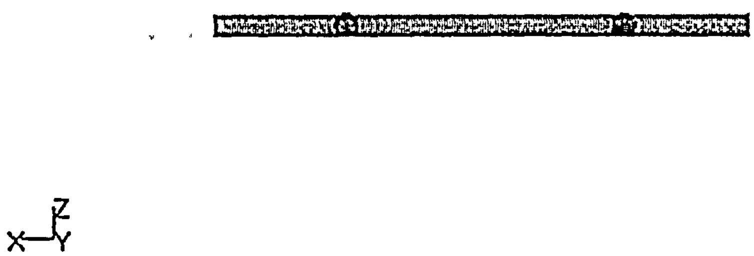
Allowable Stress : 31200 psi.

Surfaces :

Number of Surfaces : 2
Surface Orientation

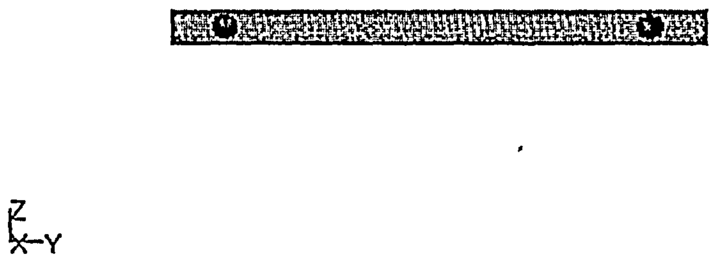
	Direction	Direction	Direction
	Comp	Comp	Comp
No	Nx	Ny	Nz
1	0.000	1.000	0.000
2	1.000	0.000	0.000

Anchor Pattern for Surface # 1



Anchor Pattern for Surface # 2

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 7 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		



Legend for Anchor Patterns

Anchor Bolts :

Concrete Lines :

Concrete Points :

Weld Lines :

Geometry :

Anchor :

Number of Anchors : 4

No.	Anch Id	X Coord	Y Coord	Z Coord	Surf Id
1	1	16.100	46.000	4.000	1
2	1	52.600	46.000	4.000	1
3	1	70.000	41.300	4.000	2
4	1	70.000	4.800	4.000	2

Concrete Lines :

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 8 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

# of elements per line : 1

Number of Concrete Lines : 2

No	Start X-Coord	Start Y-Coord	Start Z-Coord	End X-Coord	End Y-Coord	End Z-Coord	Sf Id	Line Width
1	0.000	46.000	4.000	70.000	46.000	4.000	1	3.000
2	70.000	0.000	4.000	70.000	46.000	4.000	2	3.000

Concrete Points :

Number of Concrete Points : 0

Weld Lines :

# of elements per line : 5

Number of Weld Lines : 0

Determination of Reduction Factors :

Reduction Factor Input for Anchor # 1

Adequately Installed : Yes
Embedment Length : (7.50 in. Min Reqd. to achieve full capacity) := 7.50 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 6.63 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 2

Adequately Installed : Yes
Embedment Length : (7.50 in. Min Reqd. to achieve full capacity) := 7.50 in.
Gap at Threaded Anchor : 0.06 in.
Edge Distance - Edge 1 : 6.63 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 3

Adequately Installed : Yes

ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

Embedment Length : (7.50 in. Min Reqd. to achieve full capacity) := 7.50 in.
Gap at Threaded Anchor : 0.13 in.
Edge Distance - Edge 1 : 6.63 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 4

Adequately Installed : Yes
Embedment Length : (7.50 in. Min Reqd. to achieve full capacity) := 7.50 in.
Gap at Threaded Anchor : 0.13 in.
Edge Distance - Edge 1 : 6.63 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factors Data Current : Yes

No	Anc Id	Pall/ Vall	Pallr/ Vallr	RT	RN	RL	RG	RS	RE	RF	RC	RR	RP	RB	RM
1	1	1500.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		7510.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1	1500.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		7510.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	1	1500.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		7510.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1	1500.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		7510.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

<u>Legend :</u>

N/A	= Not Applicable
Pall	= Allowable Pull without Reduced Inspection
Vall	= Allowable Shear without Reduced Inspection
Pallr	= Allowable Pull with Reduced Inspection
Vallr	= Allowable Shear with Reduced Inspection
*	= Outlier
X	= Reduction Factor Not Used
RT	= Reduction Factor for Type of Anchorage
RN	= Reduction Factor for Installation Adequacy
RL	= Reduction Factor for Embedment
RG	= Reduction Factor for Gap at Anchors
RS	= Reduction Factor for Spacing

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 10 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
Building : SCREENHOUSE	Floor El. : 591.00	Room, Row/Col : E ESW PUMP RM, IN THE SW CORNER OF THE RM, 15' SE OF E ESW PP, 13' ABOVE THE FLR.
Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

RE	= Reduction Factor for Edge Distance
RF	= Reduction Factor for Concrete Strength
RC	= Reduction Factor for Concrete Cracks
RR	= Reduction Factor for Essential Relays
RP	= Reduction Factor for Base Stiffness and Prying Action
RB	= Reduction Factor for Base Strength and Load Path
RM	= Reduction Factor for Embed. Steel and Pads

Analysis Results :

Analysis Performed : Yes

Type of Analysis : Regular

	Spectral Accelerations (G's)			
No	N-S	E-W	Vertical	Safety Factor
1	0.600	0.240	0.100	44.553
2	-0.600	-0.240	-0.100	59.948
3	-0.600	0.240	0.100	77.054
4	0.600	-0.240	-0.100	50.897
5	0.600	-0.240	0.100	48.716
6	-0.600	0.240	-0.100	59.565
7	0.600	0.240	-0.100	49.641
8	-0.600	-0.240	0.100	106.184
9	0.240	0.600	0.100	31.796
10	-0.240	-0.600	-0.100	53.068
11	0.240	-0.600	0.100	91.151
12	-0.240	0.600	-0.100	32.444
13	-0.240	0.600	0.100	33.585
14	0.240	-0.600	-0.100	56.103
15	0.240	0.600	-0.100	33.321
16	-0.240	-0.600	0.100	87.648
17	0.240	0.240	0.250	56.453
18	-0.240	-0.240	-0.250	59.642
19	0.240	0.240	-0.250	76.162
20	-0.240	-0.240	0.250	205.015
21	-0.240	0.240	0.250	67.138
22	0.240	-0.240	-0.250	67.333
23	0.240	-0.240	0.250	76.365
24	-0.240	0.240	-0.250	59.986

Minimum Safety Factor : 31.796

D.C. COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 11 of 11
ID : 12-HV-ESW-7 (Rev. 0)	Class : 9. Fans	
Description : UNIT #1 EAST ESW PUMP ROOM SUPPLY VENTILATION FAN		
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Manufacturer, Model, Etc. : BUFFALO FORGE CO., 5000 FT^3/MIN		

The Anchorage Capacity is 31.796 times greater than the Demand

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 12-HV-ESW-7 Class 9

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ___ No ✓ (If yes, check items that apply.)

	Remarks
Anchor Type	
Anchor Diameter	
Anchor Spacing	
Anchor Number	
Anchor Embedment	
Anchor Edge Distance	
Anchor Gap	
Anchor Thread Engagement	
Anchor Grip	
Anchor Angularity	
Concrete Crack	

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

Actions Taken:
NONE

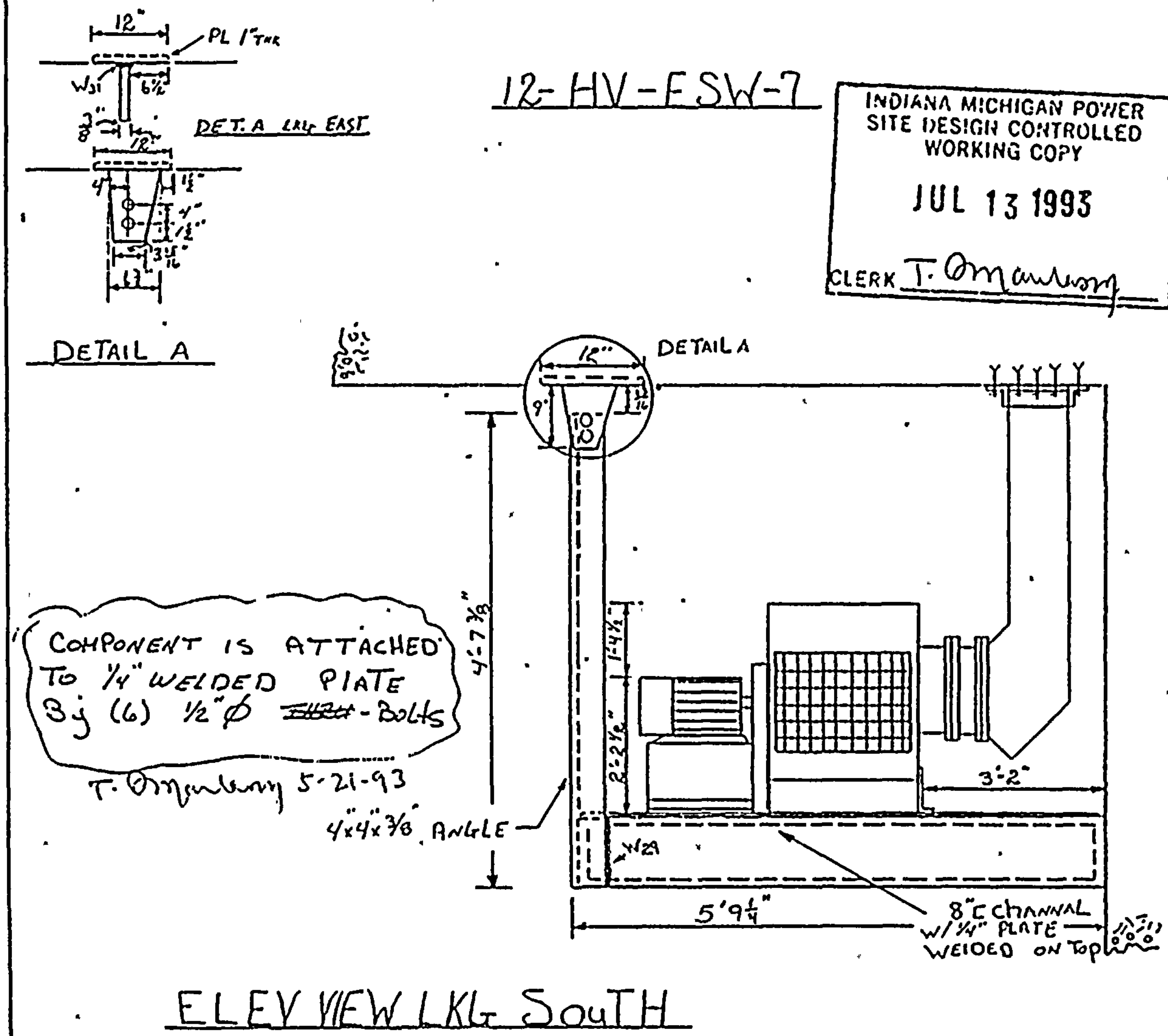
Prepared By T. Omarany Date 5-21-93

ANCHOR INSPECTION DATA SHEET

ONE	Screw House	E. ESW Pmp. Room
Unit #	Bldg.	Location

12-5682-7	12-HV-ESW-7
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Omanlasny

Drawn by: [signature] Date: 4/12/93

Verified by: [signature] Date: 4/19/93
Qual./Cert. Inspector

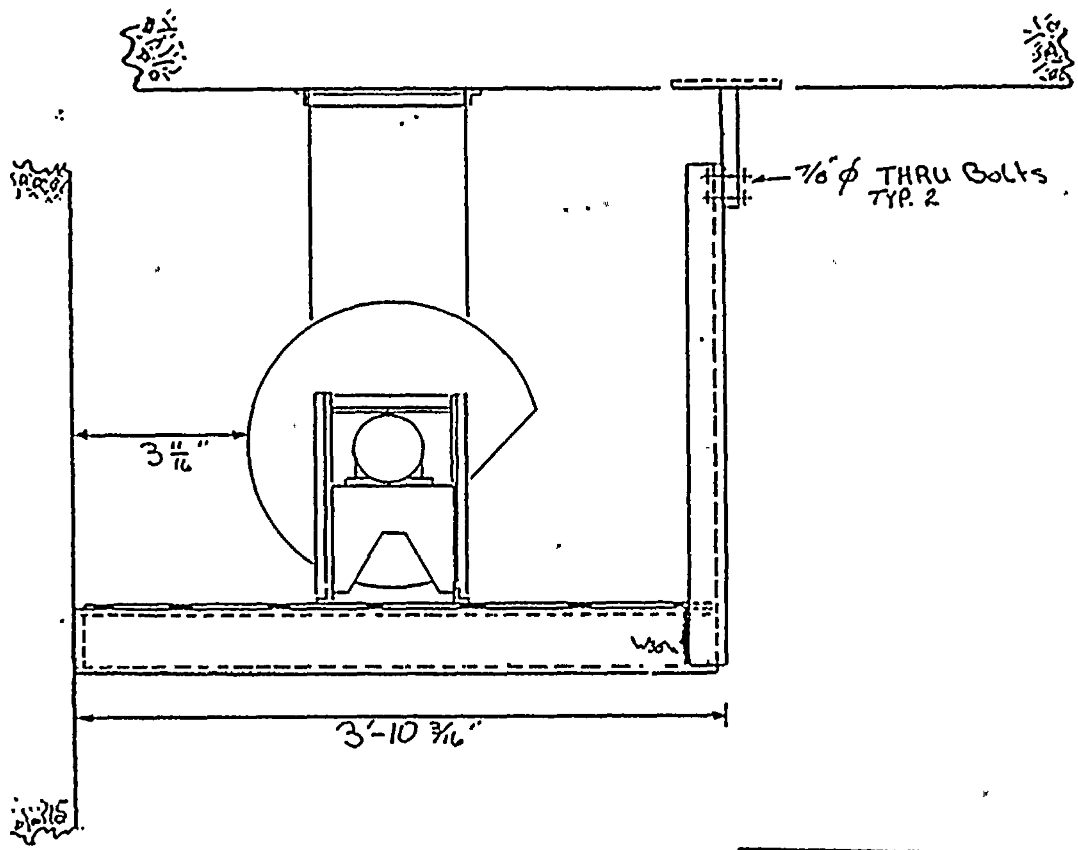
Reviewed by: T. Omanlasny Date: 5-21-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

ONE	ScreenHouse	E. ESW Pump Room
Unit #	Bldg.	Location

12-5682-7	12-HV-ESW-7
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



ELEV VIEW LKG WEST

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Omanson

Drawn by: [signature] Date: 4/12/93

Verified by: [signature] Date: 4/19/93
Qual./Cert. Inspector

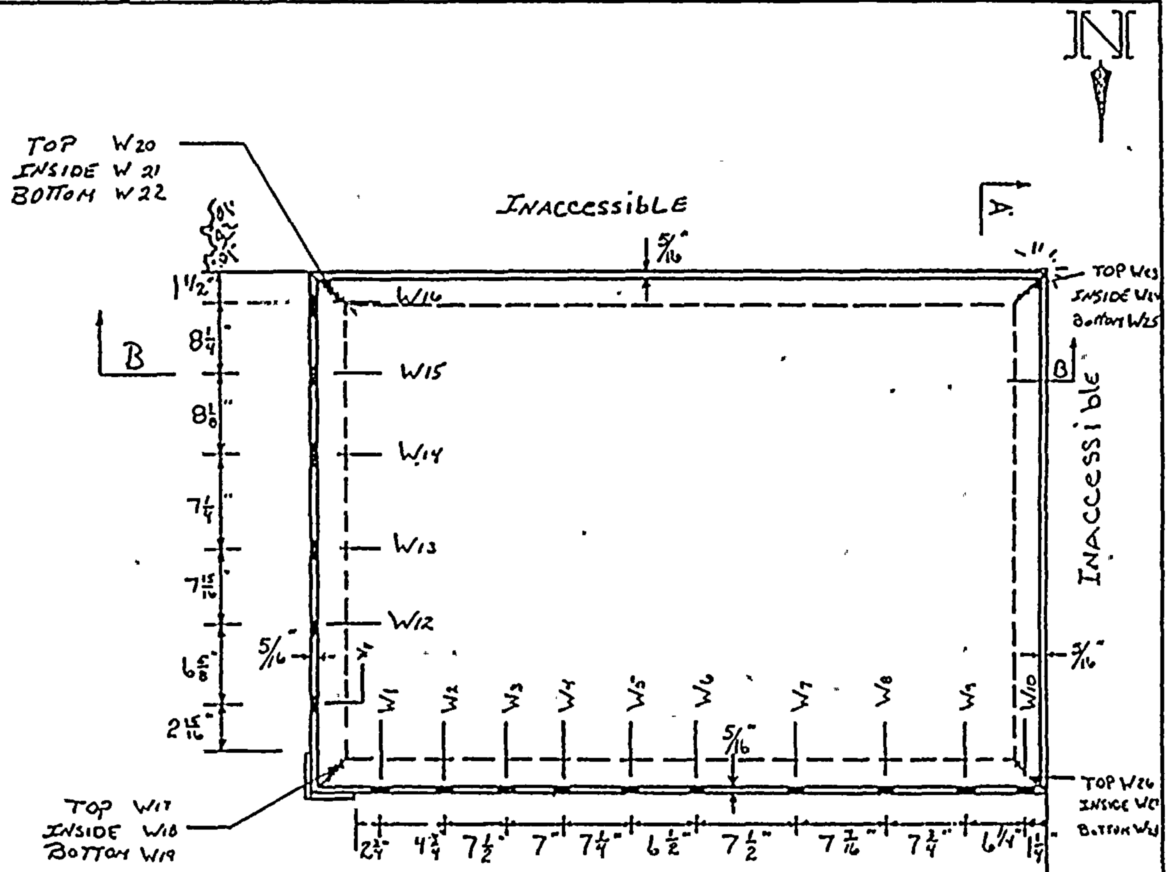
Reviewed by: T. Omanson Date: 5-21-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

ONE — Unit #
Screen House — Bldg.
E ESW Pmp Room — Location

12-5682-7 — Installation dwg. / Rev.
12-HV-ESW-7 — Equipment No.

Anchorage Arrangement Sketch



1/4" PLATE IS STITCH WELDED TO THE 8" CHANNEL.

8"C CHANNEL IS 45° CUT AT ENDS AND WELDED TOGETHER.

PLAN VIEW

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Ommelaan

Drawn by: [signature] Date: 4/2/93

Verified by: [signature] Date: 4/19/93
Qual./Cert. Inspector

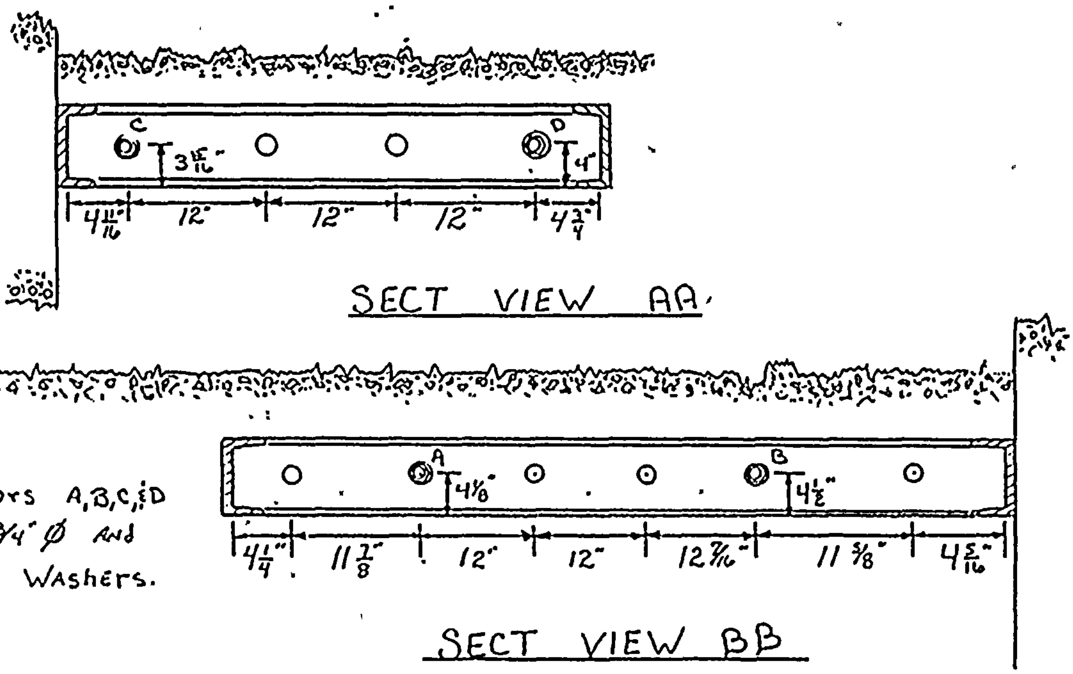
Reviewed by: T. Ommelaan Date: 5-21-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

ONE	ScreenHouse	E. ESW Pump Room
Unit #	Bldg.	Location

12-5682-7	12-HV-ESW-7
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Anchors A, B, C, & D ARE 3/4" Ø And HAVE Washers.

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Omanlaom

Drawn by: [signature] Date: 4/12/93

Verified by: [signature] Date: 4/19/93
Qual./Cert. Inspector

Reviewed by: T. Omanlaom Date: 5-21-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HV-ESW-7 Dwg No.: 12-5682-7

Anchor type: THRU-BOLT Dia: 3/4" ϕ. Dwg No.:

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date: NA

Tightness verified? ☐ Yes ☐ No NA Construction ARE Date: NA

Equipment base flexible? ☐ Yes ☒ No T. Omanlaom Construction ARE Date: 4-21-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	0"	1/16"	1/8"	1/8"					
Anchor length	22.5"	22.5"	22.5"	22.5"					
Protruding length	1 5/8"	1 9/16"	2 1/16"	2 1/2"					
Embedment	*	*	*	*					
Bolt grip	3/8"	7/16"	1/2"	1/2"					
Concrete condition	ok	ok	ok	ok					
Edge distance	NA	NA	NA	NA					
Anchor spacing	3'-0 1/2"	3'-0 1/2"	3'-0"	3'-0"				SITE DESIGN CONTROLLED WORKING COPY	
Anchor angularity	0°	2°	0°	0°				JUL 13 1993	
Thread engagement	ok	ok	ok	ok				CLERK T. Omanlaom	

Comments: * ~~NOT ABLE TO VARIFY~~ NOT APPLICABLE. T. Omanlaom 5-21-93
ANCHORS "C&D" GAP is Between THE 8" [channel And WAll
ANCHOR "B" THE GAP is BETWEEN THE WASHER And THE 8" [ChANNEL

Verified by: [signature] Qual./Cert. Inspector Date: 4-26-93

Reviewed by: T. Omanlaom Construction ARE Date: 5-21-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HV-ESW-7 Dwg No.: 12-5682-7

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W1	W2	W3	W4	W5	W6	W7	W8
Type	1	1	1	1	1	1	1	1
Size	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"
Length	1 3/8"	1 1/8"	1 3/8"	1 1/4"	1"	1 3/8"	1 1/4"	1 1/4"
Cracks	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO
Lack of Penetration	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO
Porosity	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO

Weld Type Codes

1 = Fillet

2 = Plug/Slot

3 = Groove

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Omanson

Equipment base flexible: ☐ Yes ☒ No T. Omanson Construction Are Date: 4-21-93

Reviewed by: T. Omanson Construction Anchor Review Engineer Date: 5-21-93

Verified by: Brian Potter Qual./Cert. Inpsector Date: 4-26-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HV-ESW7 Dwg No.: 12-5682-7

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W9	W10	W11	W12	W13	W14	W15	W16
Type	1	1	1	1	1	1	1	1
Size	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"	3/16"
Length	1 1/8"	1"	1"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 3/4"
Cracks	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO
Lack of Penetration	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO
Porosity	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO	Yes NO

Weld Type Codes

1 = Fillet

2 = Plug/Slot

3 = Groove

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. [illegible]

Equipment base flexible: ☐ Yes ☒ No T. [illegible] Date: 4-21-93
Construction Are

Reviewed by: T. [illegible] Date: 5-21-93
Construction Anchor Review Engineer

Verified by: [illegible] Date: 4-26-93
Qual./Cert. Inpsector

ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HV-ESW-7 Dwg No.: 12-5682-7

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W17	W18	W19	W20	W21	W22	W23	W24
Type	3	1	3	3	1	3	3	1
Size		3/16			3/16"			3/16"
Length	3"	6 3/4"	3"	3"	6 3/4"	3"	3"	6 3/4"
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Omarlarry

Equipment base flexible: ☐ Yes ☒ No T. Omarlarry Construction Are Date: 4-21-93

Reviewed by: T. Omarlarry Construction Anchor Review Engineer Date: 5-21-93

Verified by: Brian Foster Qual./Cert. Inpsector Date: 4-26-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HV-ESW-7 Dwg No.: 12-5682-7

Embedded Steel Dwg. No.: ~~NA~~ 12-3089

PHYSICAL CHARACTERISTICS

Weld ID	W25	W26	W27	W28	W29	W30	W31	
Type	3	3	1	3	1	1	1	
Size			3/16"		5/16"	5/16"	1/4"	
Length	3"	3"	6 3/4"	3"	7 3/4"	7 3/4"	*	
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

* DENOTES AN All AROUND WELD.

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Omanarry

Equipment base flexible: ☐ Yes ☒ No T. Omanarry Construction Are Date: 4-21-93

Reviewed by: T. Omanarry Construction Anchor Review Engineer Date: 5-21-93

Verified by: Brian [signature] Qual./Cert. Inpsector Date: 4-26-93

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 4-1-93 REQUEST NO. N/A

IDENTIFICATION

Unit One
Component 12-ESW-ESW-7
Item Anchors
Material C/S
Other Spray

TECHNIQUE

Test Unit/ S/N KB USK-7S CQC-405
Freq./Diameter 5mhz .250"
Reference Standard QC-30
Couplant/Batch No. Ultragel II #9088

TEST DATA/REMARKS

Anchor	Length	Plate
A	22.5"	1"
B	22.5"	
C	22.5"	
D	22.5"	

PERFORMED BY: [signature] LEVEL: II DATE: 4-1-93

REVIEWED BY: Stephen R. Vargo LEVEL: II DATE: 4/1/93

FORM NO. 12 SHP 5050 NDE.008-1

Equip ID: 1-AFW Train: 2 Equip Class: 14

Drawing No.: 1-12035

Function: 120 VAC SYSTEM

System: 120/208V MISC. SAFTEY RELATED POWER DISTRIBUTION

Equip Desc: POWER PANEL

Building: AUXILIARY Room: CD EMERGENCY DIESEL GENERATOR ROOM

Elev: 587 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd:

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: A

Comp Served:

Mfr: POWER ELECTRIC INC.

Model:

Serial:

Elem. Drawing: 1-98215

Wiring Drawing: 1-95022

Power Source: 1-ABD-C-2A

Walkdown: F Relay Eval : N

Comp Type: DISTRIBUTION PANEL

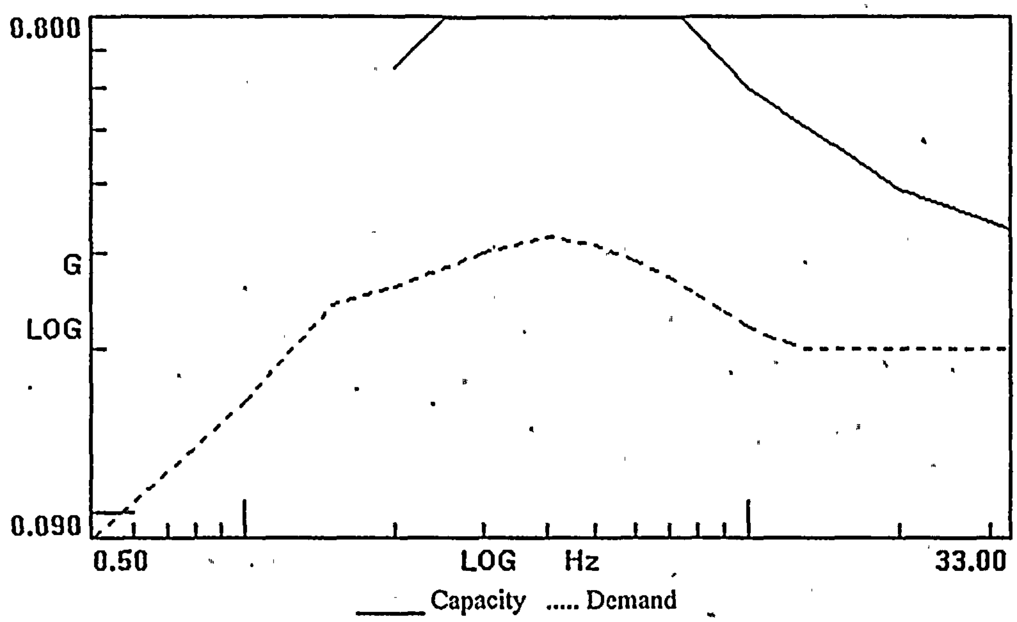
ISO Drawing:

Location: 10 FEET NW OF CD EMERGENCY DIESEL GENERATOR #1-OME-150-CD, ON THE NORTH WALL

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 3
ID : 1-AFW (Rev. 0)	Class : 14. Distribution Panels	
Description : POWER PANEL		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EDG RM, 10 FEET NW OF CD EMERGENCY DIESEL GENERATOR #1-OME-150-CD, ON THE N WALL
Manufacturer, Model, Etc. : POWELL ELECTRIC INC.		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		587.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)		Yes
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency =)		SRT
4.	Capacity based on:	1.00 * Bounding Spectrum	
5.	Demand based on:	1.00 * Design Basis Ground Response Spectrum	



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0031\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N
Demand 2	C:\GIP\PROJ0031\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N

Does capacity exceed demand? Yes

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 3
ID : 1-AFW (Rev. 0)	Class : 14. Distribution Panels	
Description : POWER PANEL		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EDG RM, 10 FEET NW OF CD EMERGENCY DIESEL GENERATOR #1-OME-150-CD, ON THE N WALL
Manufacturer, Model, Etc. : POWELL ELECTRIC INC.		

CAVEATS - BOUNDING SPECTRUM

DP/BS Caveat I - Earthquake Experience Equipment Class.	Yes
DP/BS Caveat 2 - Contains only Circuit Breakers and Switches.	Yes
DP/BS Caveat 3 - Doors Secured.	Yes
DP/BS Caveat 4 - Adjacent Cabinets Bolted Together.	N/A
DP/BS Caveat 5 - General Configuration Similar to NEMA Standards.	Yes
DP/BS Caveat 6 - Adequate Anchorage.	Yes
DP/BS Caveat 7 - Potential Chatter of Essential Relays Evaluated.	N/A
DP/BS Caveat 8 - No Other Concerns.	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	N/A
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 3
ID : 1-AFW (Rev. 0)	Class : 14. Distribution Panels	
Description : POWER PANEL		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EDG RM, 10 FEET NW OF CD EMERGENCY DIESEL GENERATOR #1-OME-150-CD, ON THE N WALL
Manufacturer, Model, Etc. : POWELL ELECTRIC INC.		

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: George Gary Thomas (S&A) and Tom Huang (AEP) on 10/7/1993

Ref. 1: Anchor Inspection Data Sheet: Anchorage Arrangement Sheet, 1/21/93.
Ref. 2: Dwg # 1-12035-12 (internal components dwg).

Capacity:
BSCav.2: Verified by walkdown and Ref. 2.

Anchorage:
Wall mounted panel with dimensions: 36"Hx20"Wx6"Deep. Anchorage was not accessible.

Panel estimated to weigh less than 50 lbs. Tug tested by G. Thomas to at least 100 lbs, OK; therefore, no explicit anchorage evaluation necessary.

Evaluated by: George G. Thomas Date: 11/20/95

T Chen Huang 11-29-95

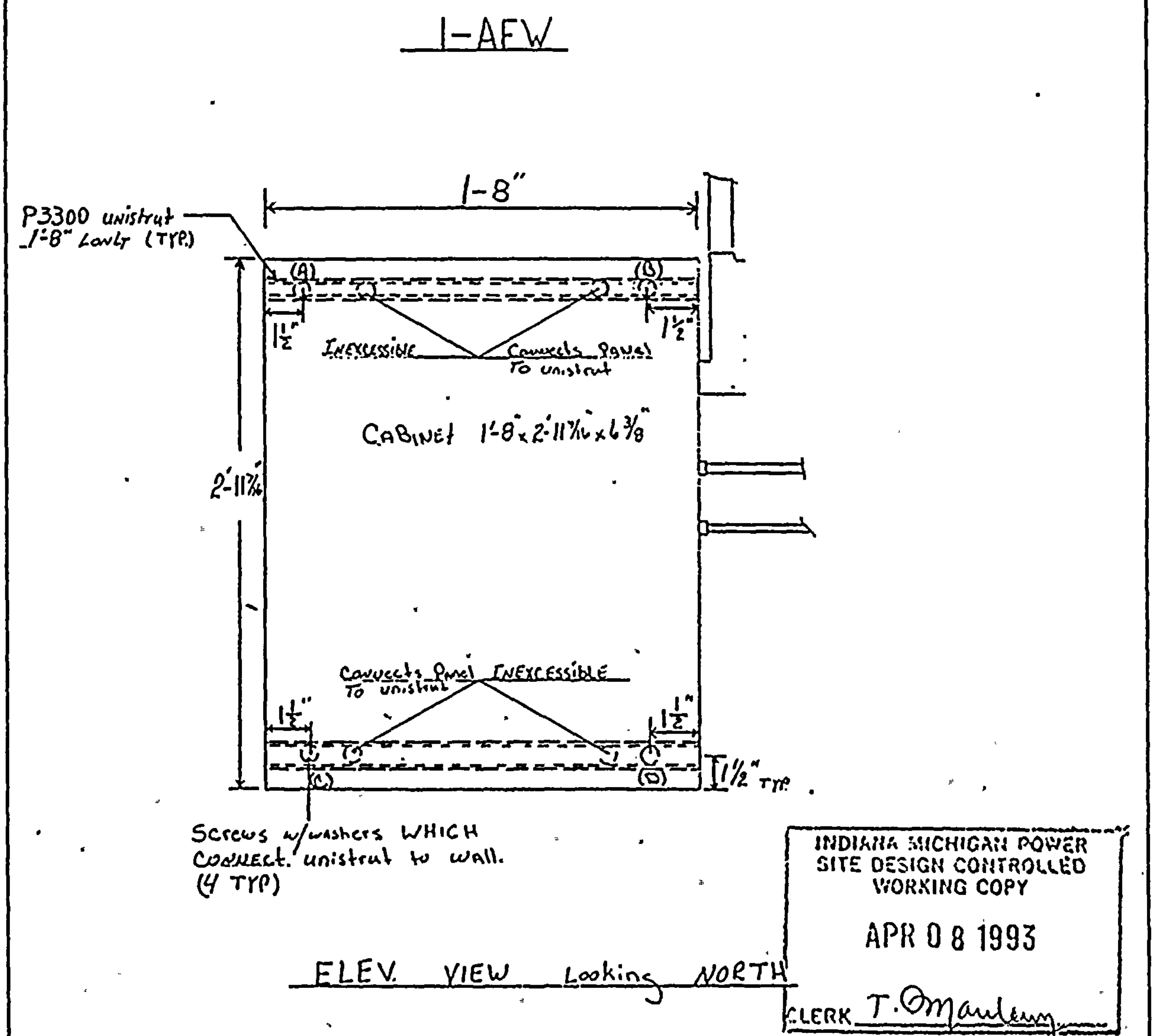
ANCHOR INSPECTION DATA SHEET

1	Aux	CD Emerg. Diesel Gen Room
Unit #	Bldg.	Location

Installation dwg. / Rev.: NA

Equipment No.: 1-AFW

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
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APR 08 1993
CLERK T. Marlenson

Drawn by: [signature] Date: 1-17-93

Verified by: [signature] Date: 1-21-93
Qual./Cert. Inspector

Reviewed by: T. Marlenson Date: 1-21-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-AFW Dwg No.: NA

Anchor type: SHEll TYPE Dia: 1/2" Screws Dwg No.:

Tightness established by: ☒ "Snug Fit" ☐ Torque
~~☒~~ N/A RPH 01-21-93

Torque Wrench No.: N/A Cal. Due Date: N/A

Tightness verified? ~~☒~~ Yes ☐ No N/A Date:
N/A RPH 01-21-93 Construction ARE

Equipment base flexible? ☐ Yes ☒ No RPH T. [signature] Date: 01-21-93
Construction ARE

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	1/32"	0"	0"	0"					
Anchor length	*	*	*	*					
Protruding length	5/8"	5/8"	5/8"	5/8"					
Embedment	*	*	*	*					
Bolt grip	1/4"	1/4"	1/4"	1/4"					
Concrete condition	ok	ok	ok	ok					
Edge distance	N/A	N/A	N/A	N/A					
Anchor spacing	1'-5"	1'-5"	1'-5"	1'-5"					
Anchor angularity	0°	0°	0°	0°					
Thread engagement	**	**	**	**					

Comments: * Anchors Are Screw and Are unable to be U.T.
Anchor "A" HAS 1/32" GAP between lockwasher and screw Head.
** unable TO Check Thread ENGAGEMENT.
SNUG FIT COULD NOT BE DONE DUE TO INACCESSABILITY

Verified by: X [signature] Date: 1-21-93
Qual./Cert. Inspector

Reviewed by: T. [signature] Date: 1-21-93
Construction ARE

STATION CONTROLLED
COPY
.. 1993
T. [signature]

Database: K:SSEL2C.DBF

Equip ID: 2-BATT-AB Train: 1 Equip Class:15

Drawing No.: 2-12003

Function: 250 VDC SYSTEM

System: 250VDC DISTRIBUTION

Equip Desc: PLANT BATTERY AB

Building: AUXILIARY Room: AB BATTERY EQUIPMENT AREA

Elev: 609 Sort: S,R Notes:

Normal State: Desired State: Power Req'd:

Support System Drawing: 2-98055, 2-12003

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: B

Comp Served:

MFR: C & D BATTERIES

Model: LC-25

Panel: 2-BC-AB

Elem. Drawing: 2-98055

Wiring Drawing: 2-91012, 2-91301

Power Source: 2-TDAB-5

Walkdown: C Relay Eval : Y

Comp Type: BATTERY, *RHR WALKDOWN COMPONENT

Iso. Drawing:

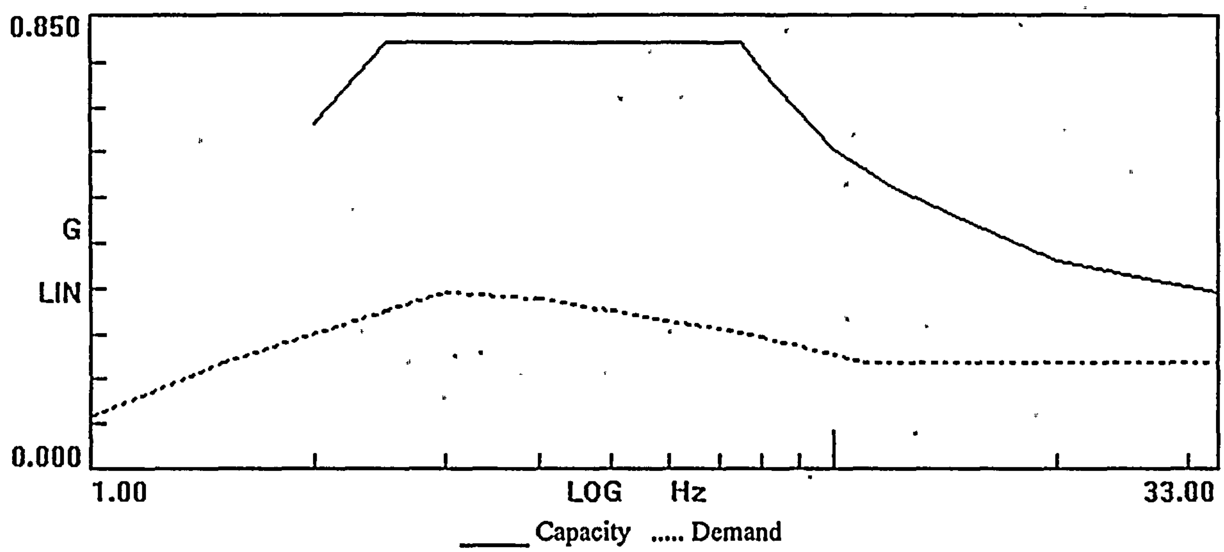
Location: IN THE CENTER OF THE ROOM, 3 FEET NORTH OF THE ENTRANCE DOOR

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)	GIP Rev 2, Corrected, 2/14/92 Status: No Sheet 1 of 6

ID: 2-BATT-AB (Rev. 0)	Class : 15. Batteries on Racks	
Description : PLANT BATTERY AB		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : AB BATTERY EQUIP AREA - IN THE CENTER OF THE ROOM, 3 FEET NORTH OF THE ENTRANCE DOOR
Manufacturer, Model, Etc.: C&D Power Systems LC-25 Cells		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input	609.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)	Yes
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 8.00)	SRT
4.	Capacity based on:	1.00 * Bounding Spectrum
5.	Demand based on:	1.00 * Design Basis Ground Response Spectrum



	File	Record
Capacity	H:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	H:\GIP\PROJ0058\spectra.des	BUILDING|Ground Spectrum|ELEVATION||BROADEN|
Demand 2	H:\GIP\PROJ0058\spectra.des	BUILDING|Ground Spectrum|ELEVATION||BROADEN|

Does capacity exceed demand? Yes

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: No Sheet 2 of 6
ID: 2-BATT-AB (Rev. 0)	Class : 15. Batteries on Racks	
Description : PLANT BATTERY AB		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : AB BATTERY EQUIP AREA - IN THE CENTER OF THE ROOM, 3 FEET NORTH OF THE ENTRANCE DOOR
Manufacturer, Model, Etc.: C&D Power Systems LC-25 Cells		

CAVEATS - BOUNDING SPECTRUM

BAT/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
BAT/BS Caveat 2 - Battery Cell Plates are Lead-Calcium Flat-Plate, Plante, or Manchex Design.	Yes
BAT/BS Caveat 3 - Each Individual Battery Weighs Less Than 450 Pounds.	Yes
BAT/BS Caveat 4 - Close-Fitting Spacers between Cells..	Yes
BAT/BS Caveat 5 - Batteries Restrained by Side and End Rails.	Yes
BAT/BS Caveat 6 - Battery Racks Have Longitudinal Cross Bracing.	Yes
BAT/BS Caveat 7 - Racks Constructed of Wood Evaluated.	N/A
BAT/BS Caveat 8 - Batteries Greater Than 10 Years Old Evaluated.	No
BAT/BS Caveat 9 - Adequate Anchorage.	Yes
BAT/BS Caveat 10 - No Other Concerns.	Yes

Is the intent of all the caveats met for Bounding Spectrum? No

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	N/A
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

<table>
<tr><td colspan="2">D. C. Cook Unit 2
Screening Evaluation Worksheet (SEWS)</td><td>GIP Rev 2, Corrected, 2/14/92
Status: No
Sheet 3 of 6</td></tr>
<tr><td>ID: 2-BATT-AB (Rev. 0)</td><td colspan="2">Class : 15. Batteries on Racks</td></tr>
<tr><td colspan="3">Description : PLANT BATTERY AB</td></tr>
<tr><td>Building : AUXILIARY</td><td>Floor El. : 609.00</td><td>Room, Row/Col : AB BATTERY EQUIP AREA - IN THE CENTER OF THE ROOM, 3 FEET NORTH OF THE ENTRANCE DOOR</td></tr>
<tr><td colspan="3">Manufacturer, Model, Etc.: C&D Power Systems LC-25 Cells</td></tr>
</table>

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? No

COMMENTS

Date: 10/18/93

SRT: Tom Huang (AEP), Steve Anagnostis (S&A), Paul Krugh (AEP), Randy Steele (AEP)

References:
1. Cook Dwgs 12-3476-18, 12-3073A-3, 12-3073D
2. C&D Power Systems Inc Dwgs K-5629-3, M-8654-C, M-8655-C, M-8665-D
3. Anchorage Package

Four substantial welded steel 2-step battery racks well braced in both directions. Two racks house 28 cells each, and two racks house 30 cells each. Each cell is a C&D Power Systems LC-25. The cells are well secured. Each rack is anchored with twelve (12) 3/8" anchors.- see references for details.

Frequency > 8 Hz by inspection.

BS Caveat 2: Batteries are C&D lead -calcium flat plate (per label on battery).
BS Caveat 3: Each cell weighs 325 lbs (Reference 2)
BS Caveat 8: Batteries were installed in 1985. SQUG Action Item 002 was written to address the aging issue.

ANCH Caveat 1: The anchorage package specifies the anchors as unknown 3/8" non-shell type expansion anchors. The original plant drawings (Ref 1) specify 3/8" J-bolts (90 degrees, 9" embedment), but when the current battery rack was replaced in 1985, a note was added to the plant drawing that, where necessary due to bolt hole misalignment in the rack, the original J bolts were to be cut off and replaced with 3/8" Kwik bolts. The current bolts are exactly where the original plant drawings locate the J bolts, and they look like J-bolts (cut-off threaded end).

ANCH Caveat 2: Per Ref 2, the 28 cell racks weigh 10231 lbs and the 30 cell racks weigh 10920 lbs. The cells are about 90% of the weight and the rack is about 10% of the weight. The attached "Battery Rack Weight Distribution" shows the geometry.

ANCH Caveat 4, 6: Installation checked per Ref 3.

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: No Sheet 4 of 6
ID: 2-BATT-AB (Rev. 0)	Class : 15. Batteries on Racks	
Description : PLANT BATTERY AB		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : AB BATTERY EQUIP AREA - IN THE CENTER OF THE ROOM, 3 FEET NORTH OF THE ENTRANCE DOOR
Manufacturer, Model, Etc.: C&D Power Systems LC-25 Cells		

ANCH Caveat 5: In the SRT's judgement, the anchors are the original J bolts. Per GIP Table C.4-1, these have nominal capacities of 3.74k pullout and and 1.87 kip shear. The pullout capacity is reduced by 0.51 to 1.91 kips due to the 9" embedment length. No other reductions are required.

Note that if the anchors were 3/8" Kwik bolts (the replacements specified in Ref 1), the nominal capacities would be 1.46 k pullout and 1.42 kip shear. The pullout capacity would be reduced by 0.88 to 1.28 kips due to 3.5 ksi concrete. No other reductions would be required.

ANCH Caveat 8: The racks are anchored through a pair of 3/4" thick plates that run along the front and back of the racks (see references and photos). This configuration may produce some prying on the anchors, although the plate may be stiff enough relative to the anchors to keep this to a minimum. Per the discussion for ANCH Caveat 11, the pullout load would have to increase by a factor of 6.2 for J-bolts (3.6 for Kwik bolts) to reach the allowable limits.

ANCH Caveat 11: The attached "Battery Rack Weight Distribution" shows that the front-to-back overturning moment for one rack is 55648 in-lbs. That moment is resisted by six anchors with a moment arm of 30", which produces a per bolt pullout load of 55648 / 6 / 30 = 309 lbs. The side-to-side seismic loads will not produce any significant pullout loads. The shear load is 4586 lbs for one horizontal direction of input. SRSS'ing the two horizontal directions and dividing by the number of bolts produces a per bolt shear load of 1.41 x 4586 / 12 = 539 lbs.

Using the bi-linear shear-tension interaction in GIP Figure C.3-2, the interaction for a J bolt anchor is 309/1910 = 0.16 (Note that the shear is less than 0.3 of the shear allowable). If a 3/8" Kwik bolt were assumed, the interaction would be 0.7 x (309 / 1280) + (539 / 1420) = 0.55.

Photos: W2T1.11, 12

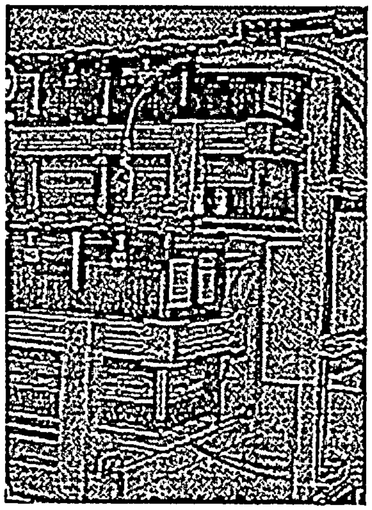
Evaluated by: [signature] Date: 10/30/95

[signature] 11-19-95

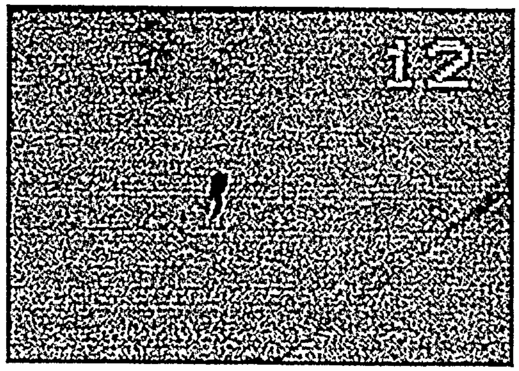
Attachment: Pictures
Attachment: Battery Rack Weight Distribution

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: No Sheet 5 of 6
ID: 2-BATT-AB (Rev. 0)	Class : 15. Batteries on Racks	
Description : PLANT BATTERY AB		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : AB BATTERY EQUIP AREA - IN THE CENTER OF THE ROOM, 3 FEET NORTH OF THE ENTRANCE DOOR
Manufacturer, Model, Etc.: C&D Power Systems LC-25 Cells		

PICTURES



0.11



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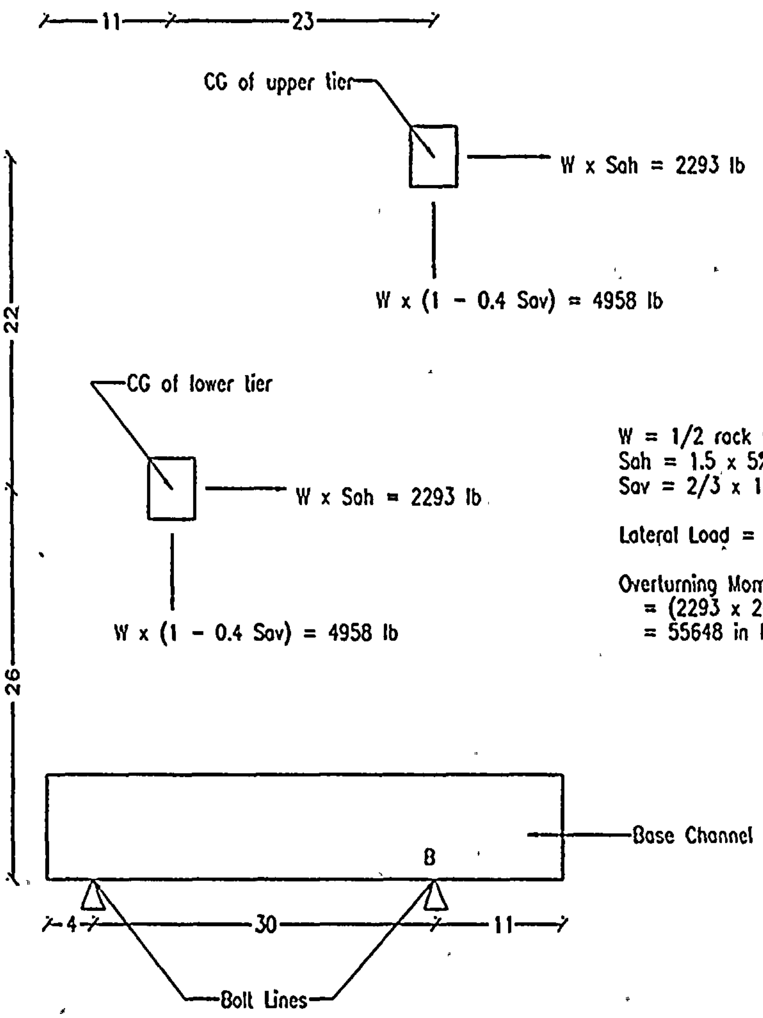
D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: No Sheet 6 of 6
ID: 2-BATT-AB (Rev. 0)	Class : 15. Batteries on Racks	
Description : PLANT BATTERY AB		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : AB BATTERY EQUIP AREA - IN THE CENTER OF THE ROOM, 3 FEET NORTH OF THE ENTRANCE DOOR
Manufacturer, Model, Etc.: C&D Power Systems LC-25 Cells		

Battery Rack Weight Distribution



W = 1/2 rack weight = 5460 lbs
Sah = 1.5 x 5% FRS @ 8 Hz = 0.42g
Sav = 2/3 x 1.5 x 5% FRS @ 20 Hz = 0.23g

Lateral Load = 2 x 2293 lb = 4586

Overturning Moment (sum moments about B)
= (2293 x 26) + (2293 x 48) - (4958 x 23)
= 55648 in lbs

D. C. Cook Unit 2 Outlier Seismic Verification Sheet (OSVS)		GIP Rev 2, Corrected 2/14/92 Sheet 1 of 4
ID : 2-BATT-AB (Rev. 0)	Class : 15. Batteries on Racks	
Description : PLANT BATTERY AB		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : AB BATTERY EQUIP AREA - IN THE CENTER OF THE ROOM, 3 FEET NORTH OF THE ENTRANCE DOOR

1. OUTLIER ISSUE DEFINITION - Mechanical and Electrical Equipment

a. Identify all the screening guidelines which are not met. (Check more than one if several guidelines could not be satisfied.)

Capacity vs. Demand	
Caveats	X
Anchorage	
Seismic Interaction	
Other	

b. Describe all the reasons for the outlier (i.e., if all the listed outlier issues were resolved, then the signatories would consider this item of equipment to be verified for seismic adequacy).

The battery rack is an outlier due to BAT/BS Caveat 8 - Batteries Greater Than 10 Years Old.

2. PROPOSED METHOD OF OUTLIER RESOLUTION (Optional)

a. Defined proposed method(s) for resolving outlier.

The attached "Position Paper on the Replacement of the Safety Related Batteries at the Donald C. Cook Nuclear Plant" (R. J. Roman May 10, 1993) states that AEPSC has committed to adopting the replacement criteria stated in ANSI/IEEE Std 450-1987. AEPSC's position is that this commitment resolves the outlier.

b. Provide information needed to implement proposed method(s) for resolving outlier (e.g., estimate of fundamental frequency).

3. COMMENTS

4. CERTIFICATION:

The information on this OSVS is, to the best of our knowledge and belief, correct and accurate, and resolution of the outlier issues listed on the previous page will satisfy the requirements for this item of equipment to be verified for seismic adequacy:

Approved by: [signature] Date: 10/30/95

[signature] 11-19-95

Attachment: Position Paper on the Replacement of Safety Related Batteries

SQUG VERIFICATION AND WALKDOWN
ACTION ITEM FORM

SQUG Action Item #	002	Page 1 of 1	
SQUG System:	250v DC	Unit 12	
Equipment Identifier No.:	1/2-Batt-AB, CD and N Trn	Equipment Description:	
Equipment Class:	15	250v Batteries	

SQUG Action Item Description:
Since there is no commitment to replace batteries every 10 years and some of the battery cells wil be greater than 10 years old by the time of the SQUG submittal (oldest cells are from June '84), batteries will be made outliers.

References:	Initiated by: L. Huang/ S. Anagnostis/ P. Krugh Date: 10/21/93

SQUG Action Item Classification		Priority	
X	SQUG Outlier	☐	Condition Report
☐	Potential Problem	x	45 days
☐	Completion Item	☐	Action Request
☐	Recommendation	☐	No Action

Action Request #: (if applicable)	Condition Report #: (if applicable)

SQUG Action Item Evaluation/ Resolution: Batteries are qualified for a 20 year life based on IEEE 344-1975 seismic testing of artificially aged batteries which are equivalent in configuration, design and materials to the installed batteries. The LC-25 and LC-33 batteries are qualified based on testing of aged LC-25 batteries. The 3DCU-9 batteries are qualified based on testing of aged 3DCU-5, 3DCU-7 and DCU-17 batteries.

Closure References: C&D Test Reports QR2-28441-1 and QR2-45352-1
Memo from Graham Walker to Ron Roman dated 2-26-94

Classified/ Prioritized By: G. P. Arent	Date: 01/14/94
Assigned To: J. Jeffrey 2-17-94	Date: 03/18/94

Reviewed By: ______________ Date: Reviewed By: ______________ Date:
SRT Member SRT Member

Memorandum

CHARTER POWER SYSTEMS, INC.

Plymouth Meeting, Pennsylvania

DATE: 16 February 1994

TO: Ron Roman
American Electric Power Service Corp.

FROM: Graham Walker
C&D Charter Power Systems, Inc.

SUBJECT: D.C. Cook Nuclear Plant
Train N, 250 Volt Safety Related Battery
Seismic and Life Qualification

In response to your 16 Feb 94 memo, our files indicate the following:

1. The Train N batteries were originally purchased in May 1979 under P.O. No. 09978-821-9, as the Train C Auxiliary Feedwater System batteries.

2. The original Technical Specification, DCCEE-183-QCN, Rev. 2, 1 May 1979, required only seismic qualification.

3. The C&D Seismic Qualification Report submitted for these batteries and racks is No. VL7610-02, Rev. 2, dated 16 July 1979. All documentation at that time was submitted the AEPSC offices in New York City.

4. The 3DCU-9 has a 20 qualified life at a 77F annual average operating temperature. Qualification is by equivalence of configuration, design and materials to previously tested 3DCU-5, 3DCU-7 and DCU-17 models which were 20 years artificially aged in accordance with IEEE-535 prior to seismic testing. The IEEE-344 seismic qualification testing these cells experienced envelopes the D.C. Cook floor response spectrum. The reports for these qualification tests are located at C&D Headquarters in Plymouth Meeting, PA, and are available for review.

If you have any questions, please call me.

Sincerely,

Graham Walker

Graham Walker
Manager, Applications Engineering

RS-607

Post-it® Fax Note 7671	Date 9/12	# of pages ▸ 3
To Steve Anagnostis	From Saltan	
Co./Dept. SGIA	Co. AEP.	
Phone #	Phone #	
Fax # 617-933-4428	Fax #	

AMERICAN ELECTRIC POWER

Date May 10, 1993

Subject Position Paper on the Replacement of the Safety Related Batteries at the Donald C. Cook Nuclear Plant

RJRoman

From R.J. Roman/D.R. Smith

5/11/93 JAK

Age and cell voltages are the key parameters for battery life determination.

JAK

To. 1) ~~J.A. Kobyra~~ JAK 5/11 1A) ~~W.G. Smith~~ 5/11/93
2) ~~E.E. Fitzpatrick~~ EEF OK 5/11/93
3) ~~W.G. Smith~~ 5/11/93

Based on a review of the surveillance reports, history, and maintenance records/trend charts for the 2AB battery, the decision has been made to replace this battery during the 1994 Unit 2 refueling outage. The results of similar reviews for the five other safety-related batteries has led to the decision to not replace any of these batteries during the upcoming refueling outages. The following discussion addresses the details of the reviews that led to this decision.

AEPSC's plan had been to replace the safety-related batteries at the Donald C. Cook Nuclear Plant every 10 years even though they are purchased as 20 year batteries. This plan, which was never translated into a written commitment, was developed based on previous premature failures of the batteries and high temperatures experienced in the battery rooms.[1] Before the decision was made to adopt this plan, a study was conducted by HVAC showing that it would be less expensive to replace the batteries every ten years than to air condition the battery rooms. Based on this plan alone, the 1AB battery should be replaced in 1995 (since it was manufactured in 1985), the 1CD battery in 1995, the 1N battery in 1999, the 2AB battery in 1994, the 2CD battery in 1996, and the 2N in 1998.

AGE

During the EDSFI, the 10 year replacement plan came into question during a review of the original battery sizing calculations. After lengthy discussions between the inspector and Mr. Roman, AEPSC committed to adopting the replacement criteria stated in ANSI/IEEE Std 450-1987, IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations. Specifically, IEEE 450 recommends replacing a battery when its capacity, as determined by the 60 month performance test, is below 80% of the manufacturer's rating. Under ideal conditions,[2] a battery would reach

[1] A rule of thumb regarding high temperature is that, for every 15°F above a 77°F average temperature, a battery's life is shortened by 50%. The average temperatures in the battery rooms at the DCCNP are less than 92°F (77°F + 15°F) however other factors, as discussed in the body of this report, lead to accelerated aging and/or early replacement of large lead-acid storage batteries.

[2] 77°F average temperature, thorough maintenance throughout battery life, etc.

this point somewhere around 20 years. Under current DCCNP conditions, a battery could reach this point sooner (due to the high battery room temperatures mentioned previously). As implied in the previous two statements however, factors other than age affect the viability of the battery. Physical characteristics, such as plate condition together with age, are often determinants for complete battery replacement. Failure to hold a charge, as shown by cell voltage and specific gravity readings, is a good indicator for further investigation into the need for replacement. It is a combination of these factors, and not simply the age or capacity alone, that has led to the decision to replace the 2AB battery during the 1994 Unit 2 refueling outage. Neither these factors, nor the age or capacity alone, indicate the need to replace any of the other safety-related batteries at this time.

In support of the decision to not replace any of the other safety-related batteries during 1994 refueling outages, the following information is provided.

CELL VOLTAGE

1) March/April voltage trends of these batteries indicate that all of the cells have voltages in the normal range of 2.20 - 2.24 volts (on a float charge). For comparison purposes, thirteen (13) of the 2AB cell voltages were less than (or equal to) 2.20 volts.[3]
2) A cursory review of the past ten year's worth of these safety-related battery files reveals few occurrences, if any, involving cell low voltages, electrolyte/specific gravity concerns, and overall less than desireable physical conditions. As a contrast, there were many instances of these same concerns regarding the 2AB battery.
3) The files do not indicate that an issue was made regarding the temperatures of the 1AB, 1CD, 1N, 2CD, & 2N battery rooms. The files do show, however, that, upon procurement & installation of the 2AB battery, the manufacture's representative stated that the battery life would be shortened due to the high ambient temperatures in the battery room. While this is a recognized attribute for all of the batteries/rooms, it appeared to be more severe at the time for the 2AB battery room.[4]
4) Routine preventive and corrective maintenance is a part of any battery's life. This maintenance should be fairly consistent from one safety-related battery to another, as they are all large, lead-acid stationary batteries. For the most part, this maintenance has been consistent for the majority of the Class 1E batteries. As expected then, these Class 1E batteries are experiencing a normal, predictable decrease in their service life. The 2AB battery, however, has demanded considerable additional maintenance and engineering time in the past couple of years

---

[3] Nine (9) cells had voltages less than 2.20 VDC and four (4) cells had voltages equal to 2.20 VDC.

[4] The aforementioned study comparing the cost of more frequent battery replacement versus air conditioning the battery rooms supports this statement. The ambient temperatures are generally higher in the AB battery rooms, when compared to the CD and N Train rooms, due to their physical location in the plant and their ventilation systems.

> resolving issues concerning low voltages, specific gravities, etc. As the additional time spent maintaining this battery is significant, it is believed that this is signaling the end of this battery's useful life and that it will most probably not stay within the Tech Spec range for individual cell voltages beyond the upcoming refueling outage.

Lead acid storage batteries are dynamic electrochemical devices. As such, the ability to predict their future performance and/or capacity represents a near formidable task. The decision to <u>not</u> replace any of the other safety-related batteries outside of 2AB during the upcoming refueling outages was arrived at after careful consideration of all the factors involved. The information available simply does not support their replacement at this time. Therefore, it is recommended that these batteries continue to be maintained and tested in accordance with the IEEE standards and the recommendation to replace them come when the maintenance/testing data supports it.

Prepared By/Date: RJ Roman / 051093

Concurrence By/Date: RJ Roman for DR Smith per phone conversation of 050793.

Concurrence Statement:

DR Smith has been the Battery Maintenance Engineer at DCCNP for the past several years and is extremely knowledgable about all battery issues. He stated his concurrence over the phone while reviewing a fax copy of this memo.

c: J.C. Jeffrey/J.R. Anderson/R.J. Roman
R.L. Shoberg
J.A. Kobyra
D.R. Smith/J. Murtha - Bridgman
T.A. Kratt - Bridgman
AEPSC/NEEP Safety Related Battery File

(c:\rjr\battery\eefmemo.wp)

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-BATT-AB Dwg No.: 12-3289-9

Anchor type: EXPANSION NON-SHELL Dia: 3/8" Dwg No.: 12-3476-18

Tightness established by: ☐ "Snug Fit" ☒ Torque

Torque Wrench No.: CPM 481 Cal. Due Date: 26 OCT 93

Tightness verified? ☑ Yes ☐ No T. Ommanson Construction ARE Date: 9-24-93

Equipment base flexible? ☐ Yes ☑ No T. Ommanson Construction ARE Date: 9-24-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D	E	F	G	H	Comments
Gaps	OK	1/8"	1/16"	1/8"	1/4"	1/8"	1/16"	1/16"	GAP IS BETWEEN BA PL & CONCRETE
Anchor length	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	
Protruding length	1 11/16"	2 1/16"	1 5/8"	1 7/8"	1 13/16"	1 15/16"	2 1/4"	1 11/16"	
Embedment	3 13/16"	3 7/16"	3 7/8"	3 5/8"	3 11/16"	3 9/16"	3 1/4"	3 13/16"	
Bolt grip	15/16"	1 1/16"	1"	1 1/16"	1 3/16"	1 1/16"	1 3/8"	1"	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	>12"	>12"	>12"	>12"	>12"	>12"	>12"	>12"	
Anchor spacing	2'-4 7/16"	2'-4 5/16"	2'-4 1/16"	1'-4 3/8"	1'-4 3/8"	2'-2 1/2"	2'-2 1/2"	1'-4"	
Anchor angularity	OK	OK	OK	OK	OK	OK	OK	OK	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: ALL GAPS ARE BETWEEN THE BASE PLATE & THE STRUCTURAL CONCRETE. ALL ANCHORS HAVE FLAT & LOCK WASHERS.
GAPS DID NOT CLOSE DURING TIGHTNESS.

Tightness Verified by: [signature] 9-28-93 / Dims. [signature] 9-28-93 Date:
Qual./Cert. Inspector

Reviewed by: T. Ommanson Date: 10-5-93
Construction ARE

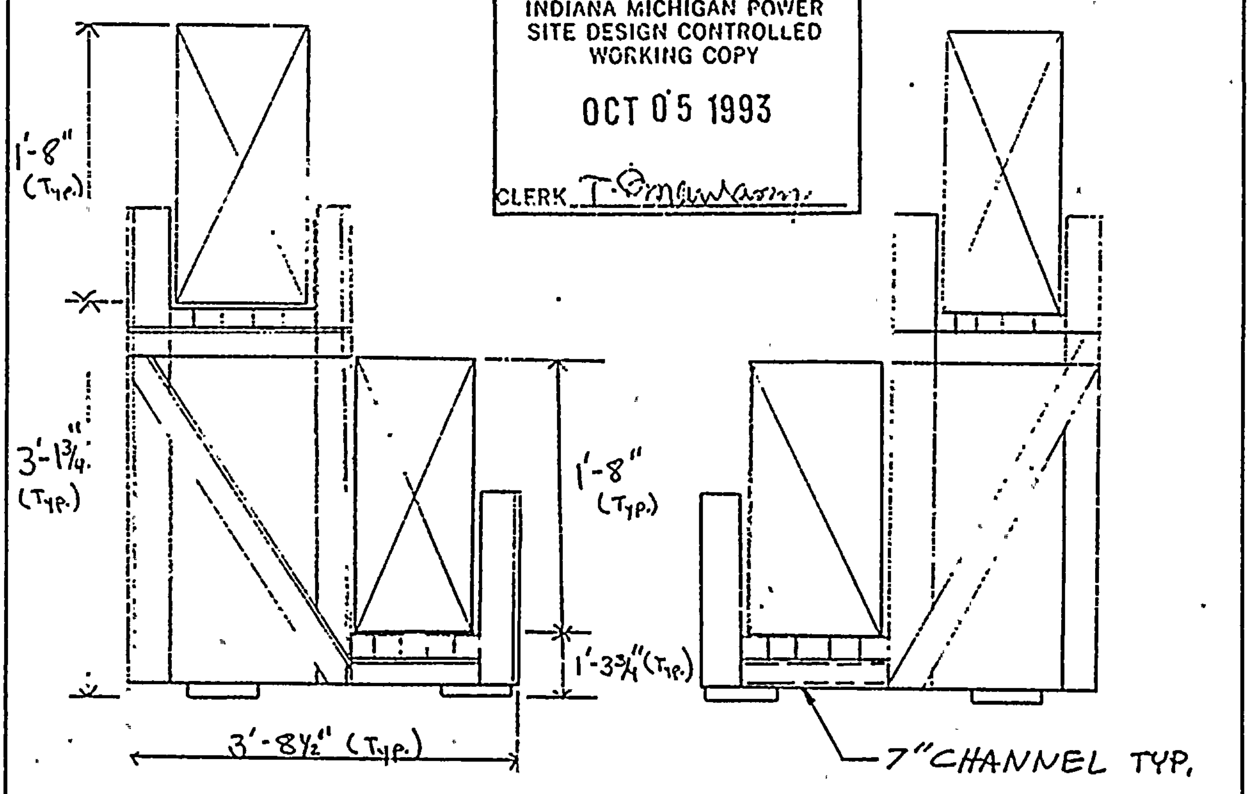
INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
OCT 05 1993
CLERK T. Ommanson

ANCHOR INSPECTION DATA SHEET

TWO — Unit #
AUX — Bldg.
4 KV AB BATTERY ROOM — Location

12-3476-18 12-3289-9 — Installation dwg. / Rev.
2-BATT-AB — Equipment No.

Anchorage Arrangement Sketch



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CLERK T. Ormanson

Drawn by: Garry Malick Date: 9/24/93

Verified by: G.T. Catlin Date: 9-28-93
Qual./Cert. Inspector

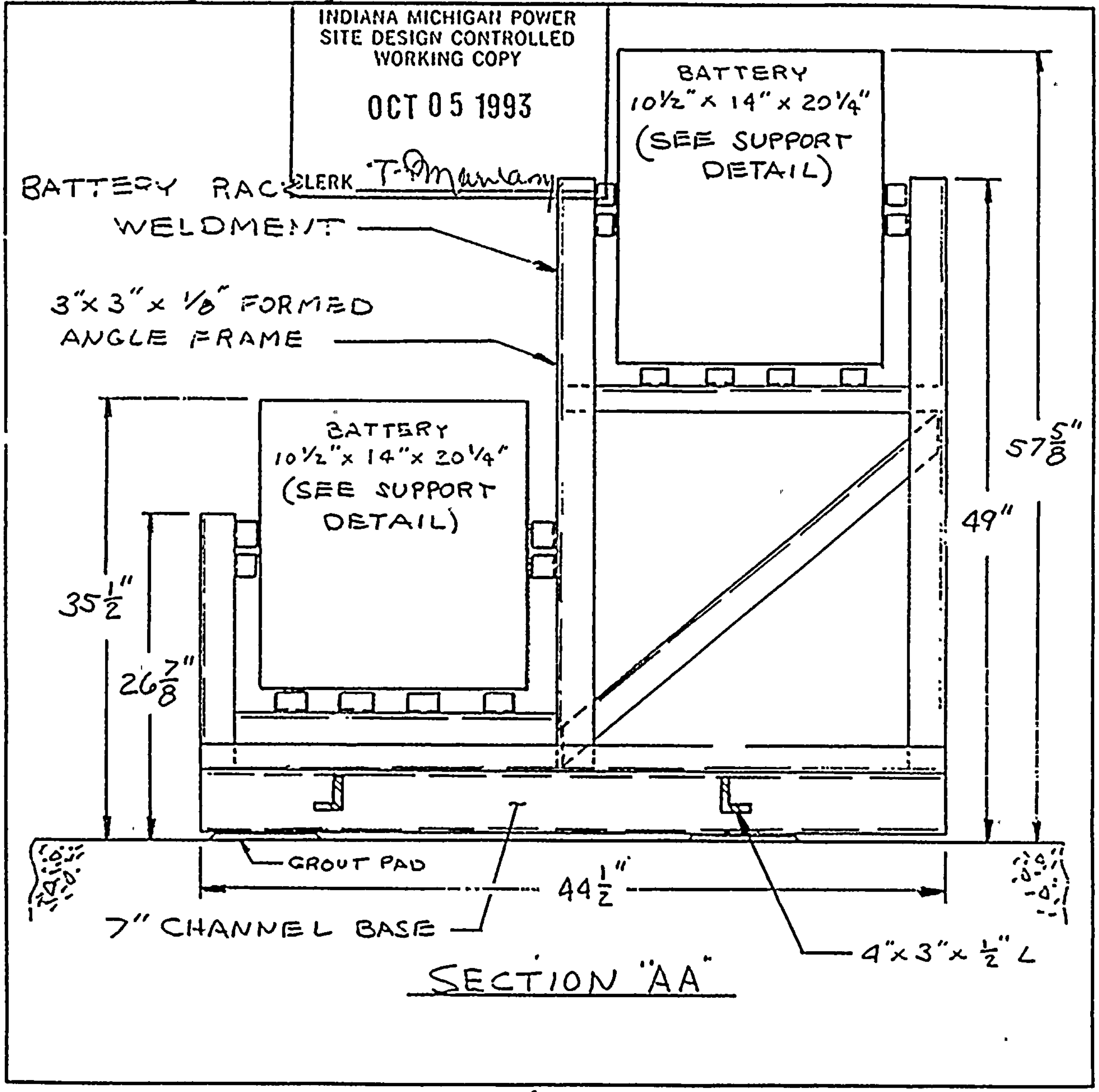
Reviewed by: T. Ormanson Date: 10-5-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Two	Aux 609'	AB BATTERY EQUIPMENT ROOM
Unit #	Bldg.	Location

12-3227-9	2-BATT-AB
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



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CLERK T. Omanleary

Drawn by: Garry Malick Date: 9/24/93

Verified by: RWhalam Date: 9-28-93
Qual./Cert. Inspector

Reviewed by: T. Omanleary Date: 10-5-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

TWO — Unit #

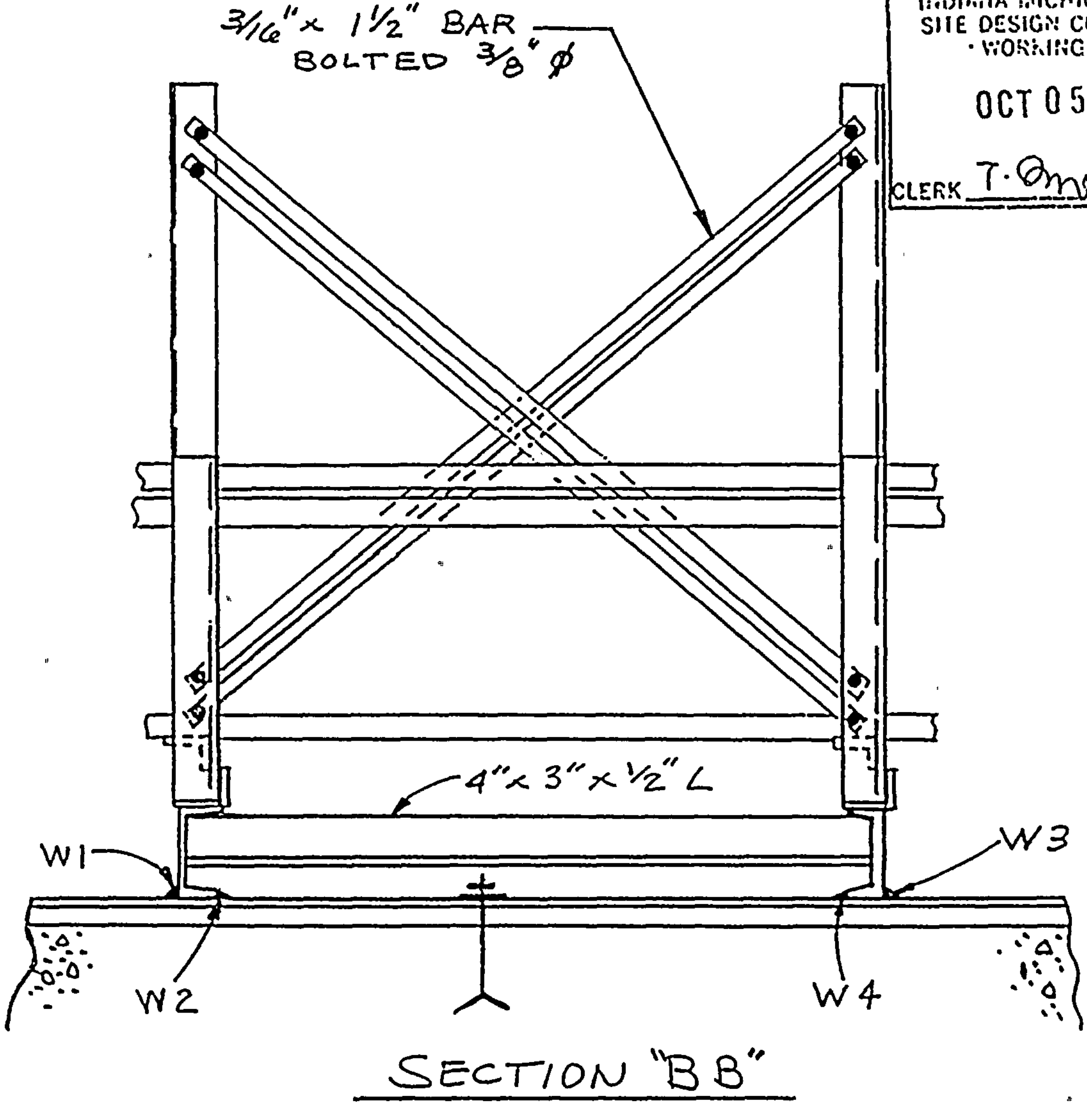
AUX 609' — Bldg.

AB BATTERY EQUIPMENT ROOM — Location

12-3289-9 — Installation dwg. / Rev.

2-BATT-AB — Equipment No.

Anchorage Arrangement Sketch



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CLERK T. Omwakey

Drawn by: Garry Malick Date: 9/24/93

Verified by: K. Cahan Date: 9-28-93
Qual./Cert. Inspector

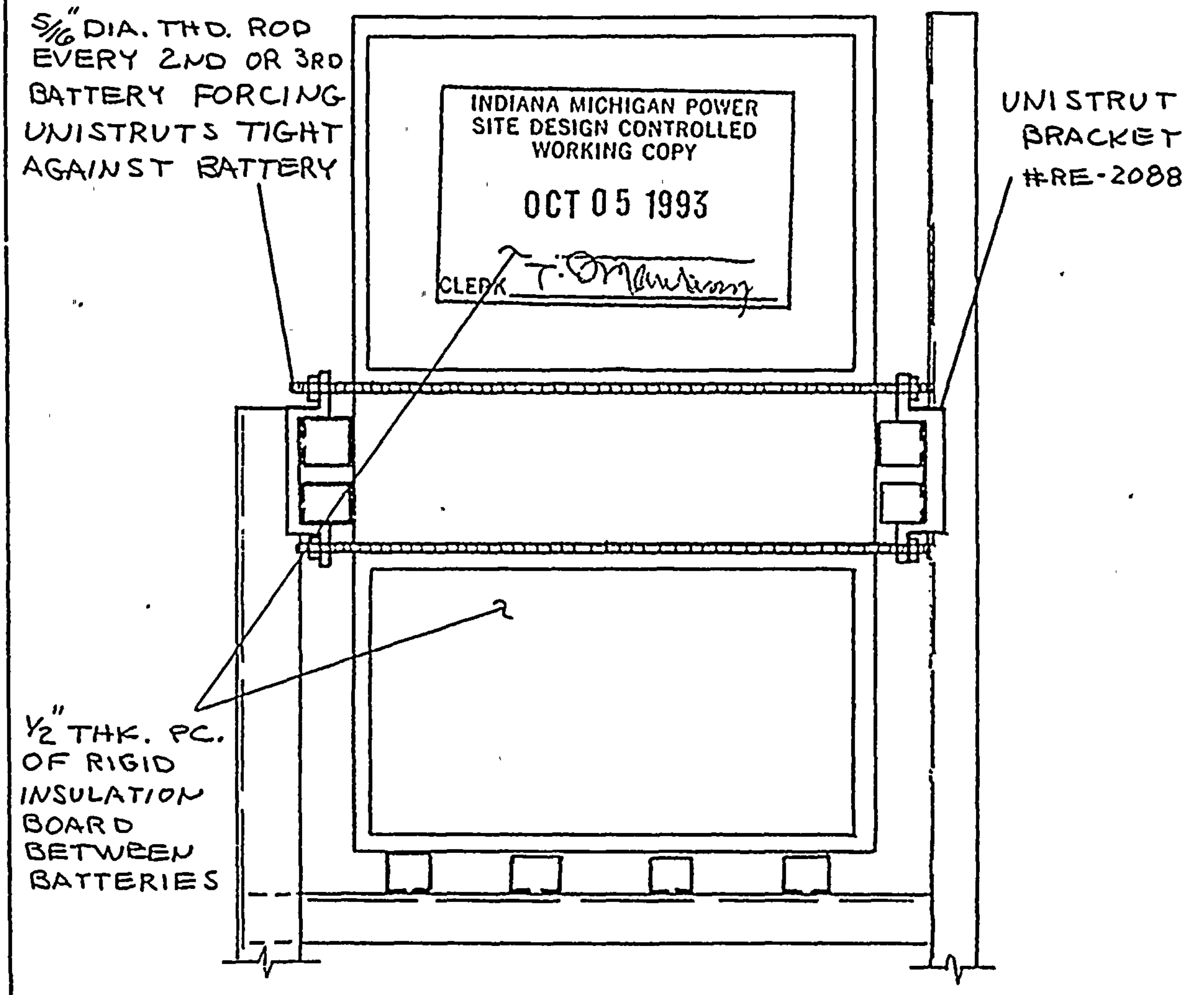
Reviewed by: T. Omwakey Date: 10-5-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Unit #	Bldg.	Location
TWO	AUX 609'	AB BATTERY EQUIPMENT ROOM

Installation dwg. / Rev.	Equipment No.
12-3289-9	2-BATT-AB

Anchorage Arrangement Sketch



BATTERY SUPPORT DETAIL

Drawn by: Harry Malick Date: 9/24/93

Verified by: [signature] Date: 9-28-93
Qual./Cert. Inspector

Reviewed by: T. Ommundsen Date: 10-5-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-BATT-AB Dwg No.: 12-3289-9

Embedded Steel Dwg. No.: ____________

PHYSICAL CHARACTERISTICS

Weld ID	W1	W2	W3	W4				
Type	1	1	1	1				
Size	3/16"	1/8"	3/16"	1/8"				
Length	6"	6"	6"	6"				
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

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Equipment base flexible: ☐ Yes ☒ No T. Omanson, Construction Are Date: 9-24-93

Reviewed by: T. Omanson Construction Anchor Review Engineer Date: 10-5-93

Verified by: R.W. Galson Qual./Cert. Inpsector Date: 9-28-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-BATT-AB Dwg No.: 12-3289-9

Anchor type: EXPANSION NON-SHELL Dia: 3/8" Dwg No.: 12-3476-18

Tightness established by: ☐ "Snug Fit" ☒ Torque

Torque Wrench No.: CPM 481 Cal. Due Date: 26OCT93

Tightness verified? ☒ Yes ☐ No T. Ommundson Construction ARE Date: 9-24-93

Equipment base flexible? ☐ Yes ☒ No T. Ommundson Construction ARE Date: 9-24-93

PHYSICAL CHARACTERISTICS

Bolt ID	I	J	K	L	M	N	P	Q	Comments
Gaps	1/4"	3/16"	1/4"	1/8"	1/8"	1/8"	1/16"	OK	GAP IS BETWEEN BASE PL & CONCRETE
Anchor length	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	
Protruding length	2 3/8"	1 11/16"	1 13/16"	3"	2 1/4"	2"	2 3/8"	2 1/4"	
Embedment	3 1/8"	3 13/16"	3 11/16"	2 1/2"	3 1/4"	3 1/2"	3 3/8"	3 1/4"	
Bolt grip	1 9/16"	1 1/8"	1 1/4"	1 1/2"	1 1/16"	1 1/16"	1"	15/16"	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	>12"	>12"	>12"	>12"	>12"	>12"	>12"	>12"	
Anchor spacing	2'-3 15/16	2'-3 15/16"	2'-3 5/16"	1'-4"	1'-1"	2'-4 1/2"	2'-4"	2'-4"	
Anchor angularity	OK	OK	OK	OK	OK	OK	OK	OK	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: ALL GAPS ARE BETWEEN THE BASE PLATE AND THE STRUCTURAL CONCRETE.
ANCHOR I HAS (5) FLAT & (1) LOCK WASHER.
ANCHOR L HAS (6) FLAT & (1) LOCK WASHER.
ALL OTHERS HAVE (1) FLAT & (1) LOCK WASHER.
GAPS DID NOT CLOSE DURING TIGHTNESS.

Verified by: Tightness [signature] 9-28-93 / Dims. [signature] 9-28-93 Date:
Qual./Cert. Inspector

Reviewed by: T. Ommundson Date: 10-5-93
Construction ARE

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T. Ommundson

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-BATT-AB   Dwg No.: 12-3289-9

Anchor type: EXPANSION NON-SHELL Dia: 3/8"   Dwg No.: 12-3476-18

Tightness established by: ☐ "Snug Fit" ☑ Torque

Torque Wrench No.: CPM 481   Cal. Due Date: 26 OCT 93

Tightness verified? ☑ Yes ☐ No T. Omanson Construction ARE Date: 9-24-93

Equipment base flexible? ☐ Yes ☑ No T. Omanson Construction ARE Date: 9-24-93

PHYSICAL CHARACTERISTICS

Bolt ID	R	S	T	U	V	W	X	Y	Comments
Gaps	3/16"	1/16"	OK	1/8"	1/16"	1/8"	1/16"	1/16"	GAP IS BETWEEN BASE PL & CONCRETE
Anchor length	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	
Protruding length	2 7/16"	2"	2 3/16"	1 3/4"	1 3/4"	2 1/4"	2 1/8"	2 1/4"	
Embedment	3 1/16"	3 1/2"	3 5/16"	3 3/4"	3 3/4"	3 1/4"	3 3/8"	3 1/4"	
Bolt grip	1 1/8"	1"	15/16"	1 1/16"	1"	1 1/16"	1"	1"	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	>12"	>12"	>12"	>12"	>12"	>12"	>12"	>12"	
Anchor spacing	1'-2"	2'-3 3/16"	2'-2 3/16"	1'-1 1/2"	1'-1 3/8"	1'-1 1/2"	1'-1 1/4"	1'-1 3/8"	
Anchor angularity	5°	OK	OK	OK	OK	OK	OK	OK	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: ALL GAPS ARE BETWEEN THE BASE PLATE & THE STRUCTURAL CONCRETE. ANGULARITY FOR ANCHOR R OCCURS ABOVE THE NUT, THE WASHER & NUT ARE FLUSH WITH THE BASE PLATE, ALL ANCHORS HAVE (1) FLAT & (1) LOCK WASHER.

GAPS DID NOT CLOSE DURING TIGHTNESS.

Verified by: Dims [signature] / Tightness [signature] 9-28-93 Date: 9-28-93
Qual./Cert. Inspector

Reviewed by: T. Omanson Date: 10-5-93
Construction ARE

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T. Omanson

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-BATT-AB   Dwg No.: 12-3289-9
Anchor type: EXPANSION NON-SHELL Dia: 3/8"   Dwg No.: 12-3476-18
Tightness established by: ☐ "Snug Fit" ☑ Torque
Torque Wrench No.: CPM 481   Cal. Due Date: 26 OCT 93
Tightness verified? ☑ Yes ☐ No T. Omahoney Construction ARE   Date: 9-24-93
Equipment base flexible? ☐ Yes ☑ No T. Omahoney Construction ARE   Date: 9-24-93

PHYSICAL CHARACTERISTICS

Bolt ID	A1	B1	C1	D1	E1	F1	G1	H1	Comments
Gaps	3/16"	1/16"	1/8"	3/16"	1/8"	1/8"	1/8"	3/16"	GAP IS BETWEEN BASE PL & CONCRETE
Anchor length	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	
Protruding length	2 3/8"	2 1/4"	2 1/16"	2 3/16"	2"	1 15/16"	1 13/16"	2 1/16"	
Embedment	3 1/8"	3 1/4"	3 7/16"	3 5/16"	3 1/2"	3 9/16"	3 11/16"	3 7/16"	
Bolt grip	1 3/16"	1 1/16"	1 1/8"	1 1/8"	1 11/16"	1 1/16"	1 1/16"	1 1/16"	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	>12"	>12"	>12"	>12"	>12"	>12"	>12"	>12"	
Anchor spacing	1'-4 3/4"	1'-4 1/4"	1'-4 1/2"	1'-4 1/2"	1'-4 1/2"	1'-4 1/4"	1'-4 1/2"	1'-4 1/4"	
Anchor angularity	OK	OK	OK	OK	OK	OK	OK	OK	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: ALL GAPS ARE BETWEEN THE BASE PLATE & THE STRUCTURAL CONCRETE. ANCHOR E1 HAS (9) FLAT WASHERS. ALL OTHERS HAVE (1) FLAT & (1) LOCK WASHER.

GAPS DID NOT CLOSE DURING TIGHTNESS.

Verified by: Dims [signature] 9-28-93 / Tightness [signature]   Date: 9-28-93
Qual./Cert. Inspector

Reviewed by: T. Omahoney   Date: 10-5-93
Construction ARE

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OCT 05 1993
T. Omahoney

ANCHOR INSPECTION DATA SHEET

Equipment No.: Z-BATT-AB Dwg No.: 12-3289-9

Anchor type: EXPANSION NON-SHELL Dia: 3/8" Dwg No.: 12-3476-18

Tightness established by: ☐ "Snug Fit" ☑ Torque

Torque Wrench No.: CPM 481 Cal. Due Date: 26 OCT 93

Tightness verified? ☑ Yes ☐ No T Omanson Date: 9-24-93
Construction ARE

Equipment base flexible? ☐ Yes ☑ No T Omanson Date: 9-24-93
Construction ARE

PHYSICAL CHARACTERISTICS

Bolt ID	I1	J1	K1	L1	M1	N1	P1	Q1	Comments
Gaps	1/8"	3/16"	3/16"	1/8"	1/16"	1/16"	3/16"	1/16"	GAP IS BETWEEN BASE PL & CONCRETE
Anchor length	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	
Protruding length	2 1/8"	2 1/8"	1 5/8"	1 7/8"	1 9/16"	1 13/16"	2 1/4"	2 1/16"	
Embedment	3 3/8"	3 3/8"	3 7/8"	3 5/8"	3 15/16"	3 11/16"	3 1/4"	3 7/16"	
Bolt grip	1 1/8"	1 1/8"	1"	1 1/8"	1 1/16"	1"	1 1/8"	1"	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	>12"	>12"	>12"	>12"	>12"	>12"	>12"	>12"	
Anchor spacing	1'-4 1/4"	2'-4 1/8"	2'-4 1/8"	2'-4 1/8"	2'-4 1/8"	2'-4 1/8"	2'-4 1/8"	1'-1 1/4"	
Anchor angularity	OK	OK	OK	OK	OK	OK	OK	OK	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: ALL GAPS ARE BETWEEN THE BASE PLATE & THE STRUCTURAL CONCRETE. ANCHOR Q1 IS MISSING LOCK WASHER, HAS (1) FLAT WASHER. ALL OTHER ANCHORS HAVE (1) LOCK & (1) FLAT WASHER.
GAPS DID NOT CLOSE DURING TIGHTNESS.

Verified by: Tightness [signature] 9-28-93 / Dims [signature] 9-28-93 Date: ____
Qual./Cert. Inspector

Reviewed by: T. Omanson Date: 10-5-93
Construction ARE

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
OCT 05 1993
T. Omanson

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-BATT-AB Dwg No.: 12-3289-9

Anchor type: EXPANSION NONSHELL Dia: 3/8" Dwg No.: 12-3476-18

Tightness established by: ☐ "Snug Fit" ☑ Torque

Torque Wrench No.: CPM 481 Cal. Due Date: 26 OCT 93

Tightness verified? ☑ Yes ☐ No T Omanion Construction ARE Date: 9-24-93

Equipment base flexible? ☐ Yes ☑ No T Omanion Construction ARE Date: 9-24-93

PHYSICAL CHARACTERISTICS

Bolt ID	R1	S1	T1	U1* (1/2" Dia.)	V1	W1	X1	Y1	Comments
Gaps	OK	$\frac{3}{16}$"	$\frac{1}{8}$"	$\frac{1}{16}$"	OK	OK	$\frac{1}{16}$"	$\frac{1}{16}$"	GAP IS BETWEEN BAS[E] PL & CONCR[ETE]
Anchor length	$5\frac{1}{2}$"	$5\frac{1}{2}$"	$5\frac{1}{2}$"	7"	$5\frac{1}{2}$"	$5\frac{1}{2}$"	$5\frac{1}{2}$"	$5\frac{1}{2}$"	
Protruding length	$1\frac{3}{4}$"	$1\frac{7}{8}$"	$1\frac{15}{16}$"	$2\frac{5}{8}$"	$1\frac{5}{8}$"	$1\frac{11}{16}$"	$2\frac{1}{8}$"	$2\frac{3}{8}$"	
Embedment	$3\frac{3}{4}$"	$3\frac{5}{8}$"	$3\frac{9}{16}$"	$4\frac{3}{8}$"	$3\frac{7}{8}$	$3\frac{13}{16}$"	$3\frac{3}{8}$"	$3\frac{1}{8}$"	
Bolt grip	1"	$1\frac{3}{16}$"	$1\frac{1}{16}$"	$\frac{7}{8}$"	$1\frac{1}{16}$"	$\frac{7}{8}$"	1"	$1\frac{1}{8}$"	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	>12"	>12"	>12"	>12"	>12"	>12"	>12"	>12"	
Anchor spacing	1'-$4\frac{1}{4}$"	1'-$1\frac{3}{4}$"	1'-$1\frac{1}{2}$"	1'-$1\frac{1}{2}$"	1'-$1\frac{1}{4}$"	1'-$1\frac{1}{4}$"	1'-$1\frac{3}{8}$"	1'-1"	
Anchor angularity	OK	OK	OK	OK	OK	OK	OK	OK	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: ALL GAPS ARE BETWEEN THE BASE PLATE & THE STRUCTURAL CONCRETE. *BOLT U1 BROKE DURING TIGHTNESS VERIFICATION, NO INDEPENDEN[T] MOVEMENT OBSERVED. NUT & STUD TURNED TOGETHER FROM INITIAL TORQU[E] APPLICATION & BROKE INSTANTLY. U1 WAS REPLACED WITH 1/2" Ø ANCHO[R] PER CONDITION REPORT 91-1048. ANCHOR U1 & W1 MISSING LOCK WASHER, HAS FLAT WASHER. ANCHOR R1, S1, T1, V1 HAVE (1) FLAT & (1) LOCK WASHER. ANCHOR X1 HAS (2) FLAT WASHERS & NO LOCK WASHER. ANCHOR Y1 HAS (1) LOC[K]

Verified by: Tightness Brian [signature] 9-28-93 Dims [signature] 9-28-93 Date: ______
Qual./Cert. Inspector

Reviewed by: T. Omanion Date: 10-5-93
Construction ARE

& (2) FLAT WASHERS. ANCHOR S1 & Y1 HAS CHIPPED & CRACKED COATINGS.

GAPS DID NOT CLOSE DURING TIGHTNESS.

ANCHOR U1 WAS TORQUED TO 150 IN/lb.

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 6/24/93 REQUEST NO. N/A

IDENTIFICATION

Unit TWO
Component 2-BATT-AB
Item Anchors
Material C/S
Other Squg

TECHNIQUE

Test Unit/ S/N KB USK-7S CQC-405
Freq./Diameter 5mhz / .250
Reference Standard QC-30
Couplant/Batch No. UlTragel #9088

TEST DATA/REMARKS

Anchor	Length	Anchor	Length	Anchor	Length	Anchor	Length
A	5½	U	5½	A1	5½"	U1	7"
B	↓	V	↓	B1	↓	V1	5½
C		W		C1		W1	↓
D		X		D1		X1	
E		Y	↓	E1		Y1	↓
F				F1			
G				G1			
H				H1			
I				I1			
J				J1			
K				K1			
L				L1			
M				M1			
N				N1			
P				P1			
Q				Q1			
R				R1			
S				S1			
T	↓			T1	↓		

PERFORMED BY: [signature] LEVEL: II DATE: 6-24-93

REVIEWED BY: Stephen R. Vargo LEVEL: II DATE: 6/25/93

FORM NO. 12 SHP 5050 NDE.008-1

SAFE SHUTDOWN EQUIPMENT LIST (SSELWP)

FUNCTION: DIESEL GENERATION

Equipment Class: 17 Train: 1

Equipment ID: 1-OME-150-AB Drawing Number: 1-12001 1-5151A 1-5151B

System: DIESEL GENERATOR CONTROL AND INSTRUMENTATION

Equip Description: AB EMERG DIESEL GENERATOR

Building: AUXILIARY Room: AB EMERG DIESEL GENERATOE ROOM Elevation: 587

Normal state: Desired state: Power Required: Sort: W,R Notes:

Supporting System Drawing Number:

Required Interconnections and Supporting Components:

...ty Related Status: NUCLEAR SR Min/Opt: MIN

ADDITIONAL INFORMATION

Alins Number: Power Train: B

Component Served: AB EMERG DIESEL GENERATOR

Manufacturer: GENERAL ELECTRIC CO Model:

Panel: 1-DGAB 1-DGABX

Elem Drawing: 1-98032 1-98051 1-98052 Wiring Drawing: 1-95301

Power Source: 1-T11A11 1-T11B4 1-TDAB-2

Walkdown: F Relay Only: Y

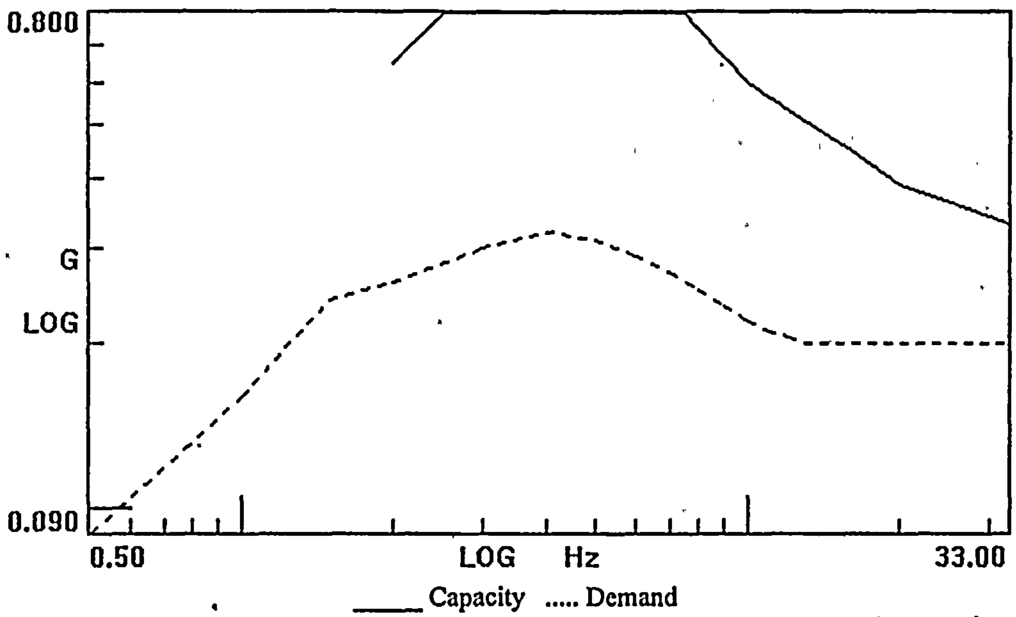
Component Type: ENG. GEN 3500KW,4KV
ISO Drawings:

Detailed Location: IN THE CENTER OF THE ROOM

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 4
ID : 1-OME-150-AB (Rev. 0)	Class : 17. Engine-Generators	
Description : AB EMERG DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE CENTER OF THE RM
Manufacturer, Model, Etc. : GENERAL ELECTRIC CO		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		587.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)		Yes
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 20.00)		Yes
4.	Capacity based on:	1.00 * Bounding Spectrum	
5.	Demand based on:	1.00 * Design Basis Ground Response Spectrum	



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0031\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N
Demand 2	C:\GIP\PROJ0031\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N

Does capacity exceed demand? Yes

CAVEATS - BOUNDING SPECTRUM

EG/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
EG/BS Caveat 2 - Driver and Driven Component on Rigid Skid.	Yes
EG/BS Caveat 3 - Base Vibration Isolation System Checked.	N/A
EG/BS Caveat 4 - Sufficient Slack and Flexibility of Attached Lines.	Yes
EG/BS Caveat 5 - Adequate Anchorage.	Yes
EG/BS Caveat 6 - Potential Chatter of Essential Relays Evaluated.	N/A
EG/BS Caveat 7 - No Other Concerns.	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 4
ID : 1-OME-150-AB (Rev. 0)	Class : 17. Engine-Generators	
Description : AB EMERG DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE CENTER OF THE RM
Manufacturer, Model, Etc. : GENERAL ELECTRIC CO		

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: George Gary Thomas (S&A) and Tom Huang (AEP) on 10/16/93.

Diesel Generator and driver not on same skid, however large contrete foundations originate from common floor, differential motion not a concern.

<table>
<tr><td colspan="2">DC Cook Unit 1
SCREENING EVALUATION WORK SHEET (SEWS)</td><td>GIP Rev 2, Corrected, 2/14/92
Status: Yes
Sheet 3 of 4</td></tr>
<tr><td>ID : 1-OME-150-AB (Rev. 0)</td><td colspan="2">Class : 17. Engine-Generators</td></tr>
<tr><td colspan="3">Description : AB EMERG DIESEL GENERATOR</td></tr>
<tr><td>Building : AUXILIARY</td><td>Floor El. : 587.00</td><td>Room, Row/Col : AB EDG RM, IN THE CENTER OF THE RM</td></tr>
<tr><td colspan="3">Manufacturer, Model, Etc. : GENERAL ELECTRIC CO</td></tr>
</table>

No interations. See AEP anchorage data for seismic qualification. Engine anchored by fourteen 2" or larger anchors. Generator anchored by eight 1" anchors. Generator shaft end anchored by four 1.75" anchors. the ANCHOR analysis gives a large safety margin (36) as shown by that done for 2-OME-150-CD.

Concern noted with regard to support of air manafold that supports aftercooler. Aftercooler supported by spring mounted column. This concern was tracked and reconciled with items 1-HE-47-ABS & ABN.

Zap shot Wk. 2, Team 2, Disk 2, Picture 20 & 21.

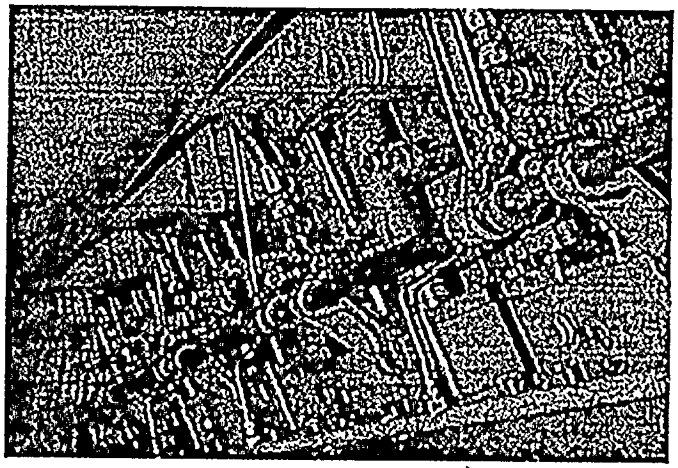
Evaluated by: George D. [illegible] Date: 11/20/95

[illegible] Chen [illegible] 11-29-95

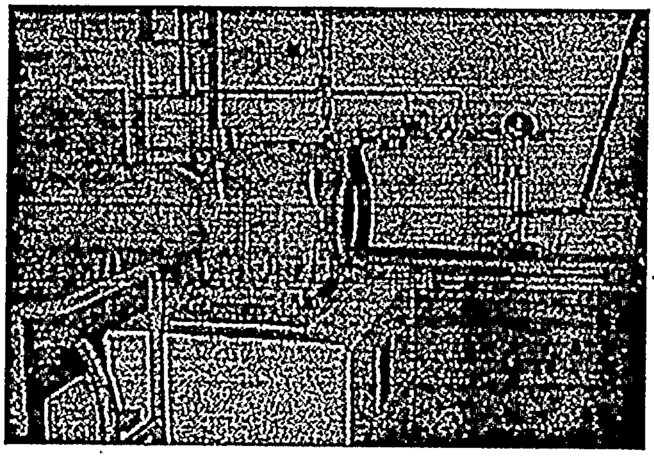
Attachment: Pictures

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 4
ID : 1-OME-150-AB (Rev. 0)	Class : 17. Engine-Generators	
Description : AB EMERG DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM, IN THE CENTER OF THE RM
Manufacturer, Model, Etc. : GENERAL ELECTRIC CO		

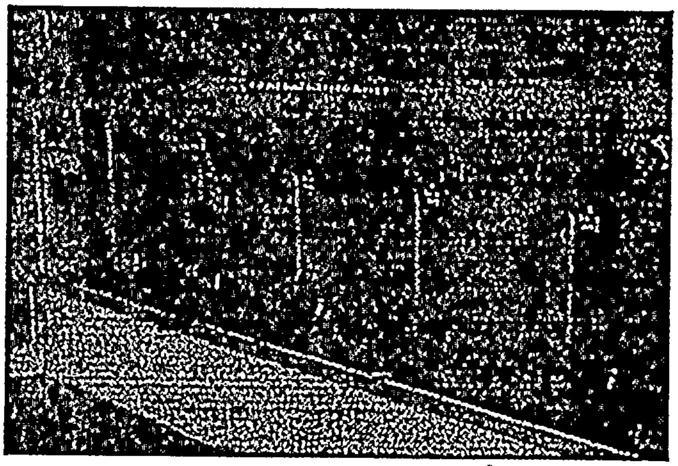
PICTURES



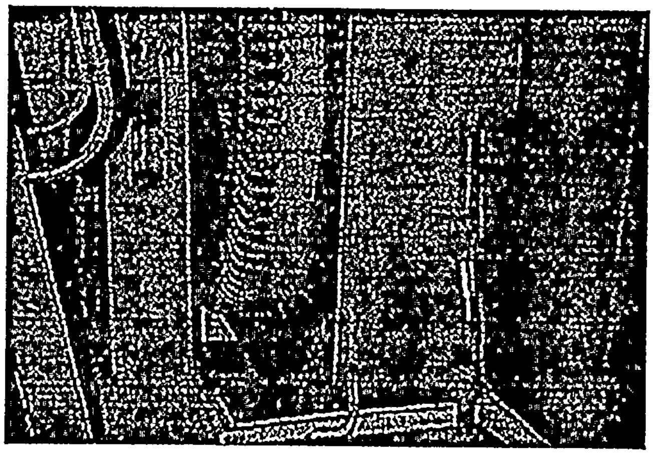
AB Emerg Diesel Generator 1-AB-150-AB



AB Emerg Diesel Generator, 1-OME-150-AB



AB Emerg. Diesel Generator 1-OME-150-AB



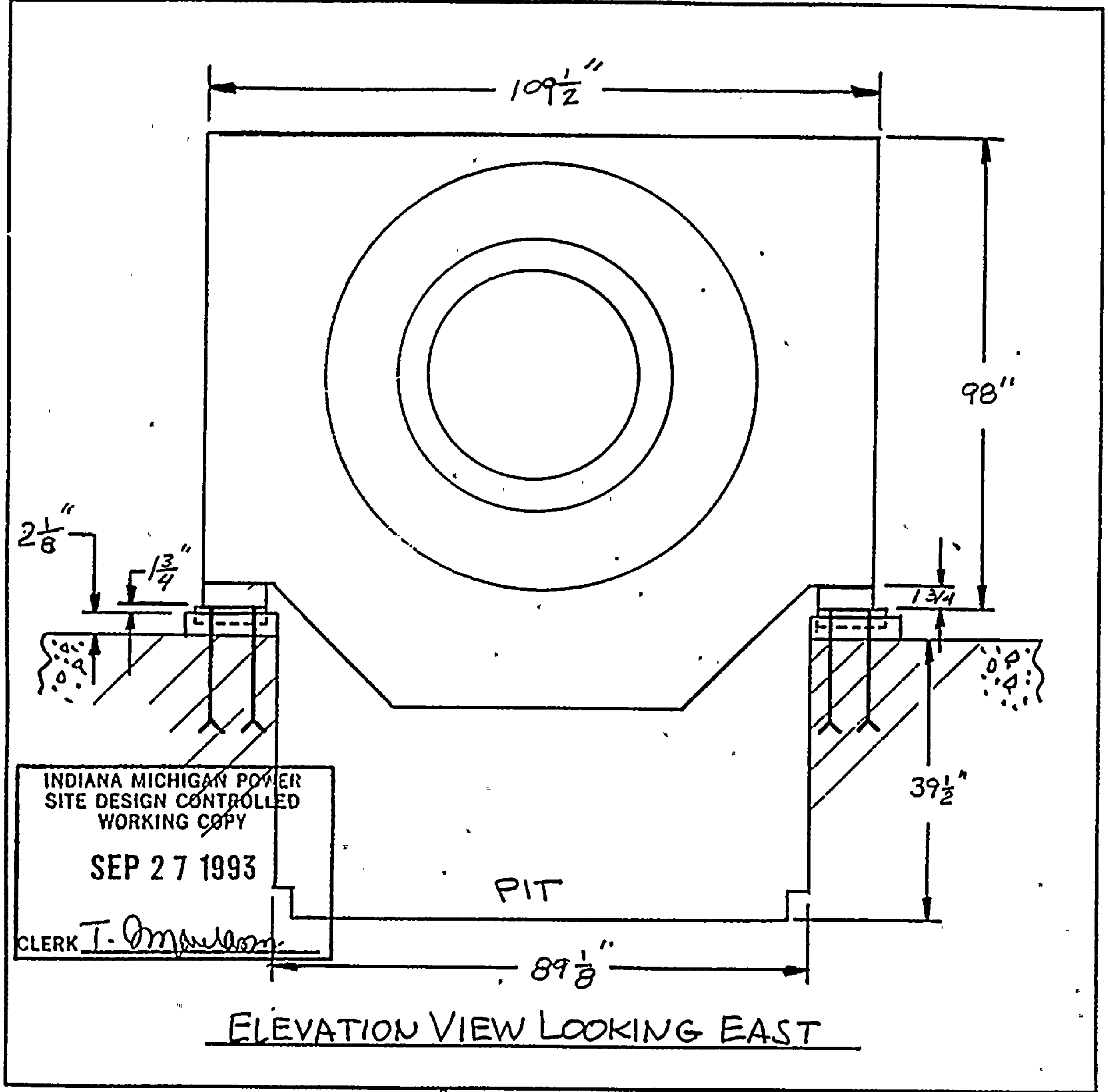
AB Emerg. Diesel Generator, 1-OME-150-AB

ANCHOR INSPECTION DATA SHEET

ONE	AUX	WEST END OF DIESEL ENGINE GENERATOR ROOM
Unit #	Bldg.	Location

12-3468-13	1-OME-150-AB
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: [signature] Date: 9-24-93

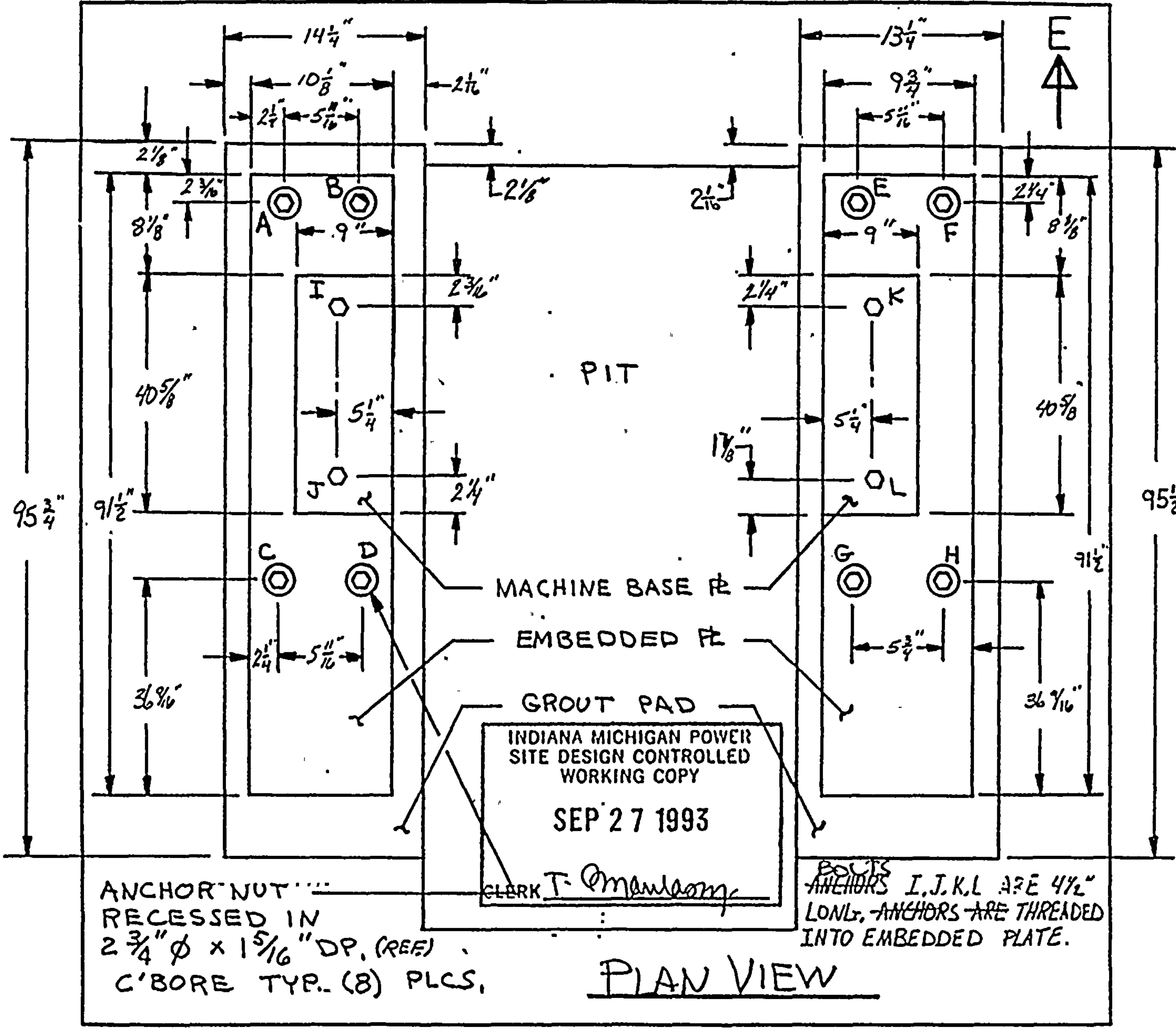
Verified by: [signature] Date: 9-24-93
Qual./Cert. Inspector

Reviewed by: T. Omanlann Date: 9-24-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

ONE	AUX	WEST END OF DIESEL ENGINE GENERATOR ROOM
Unit #	Bldg.	Location
12-3468-13	1-OME-150-AB	
Installation dwg. / Rev.	Equipment No.	

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 27 1993
CLERK T. Omanlaon

Drawn by:	[signature]	Date:	9-23-93
Verified by:	J. Jerry Morris Qual./Cert. Inspector	Date:	9-24-93
Reviewed by:	T. Omanlaon Construction Anchor Review Engineer	Date:	9-24-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-OME-150-AB Dwg No.: 12-3468-13

Anchor type: STUD Anchor TYPE 12 Dia: 1" DIA Dwg No.: 12-3073A-

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: -NA- Cal. Due Date: -NA-

Tightness verified? ☐ Yes ☒ No S. Thaveevar Construction ARE Date: 9-24-93

Equipment base flexible? ☐ Yes ☒ No S. Thaveevar Construction ARE Date: 9-24-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D	E	F	G	H	Comments
Gaps	"INA	CCESS	IBIE	NUT	RECE	SSED	INC	BORE."	"
Anchor length	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	
Protruding length	3½"	3½"	3½"	3¾"	3½"	3½"	3⅜"	3⅜"	
Embedment	5'-2½"	5'-2½"	5'-2½"	5'-2¼"	5'-2½"	5'-2½"	5'-2⅝	5'-2⅝	
Bolt grip	"INACCESSIBLE"								
Concrete condition	ok	ok	ok	ok	ok	CRACK IN GROUT	CRACK IN GROUT	CRACK IN GROUT	
Edge distance	9⅞"	4"	9¾"	4⅛"	3½"	9 5/16"	3"	9"	
Anchor spacing	5¾"	5¾"	5¾"	5¾"	5¾"	5¾"	5⅞"	5⅞"	
Anchor angularity	0°	0°	0°	0°	0°	0°	0°	0°	
Thread engagement	RECESSED ¼"	RECESSED ¼"	RECESSED ¼"	RECESSED ¼"	RECESSED ¼	RECESSED 3/16"	RECESSED ½	RECESSED ½"	

Comments:

Verified by: Jerry Morris Date: 9-24-93
Qual./Cert. Inspector

Reviewed by: T. Omanson Date: 9-27-93
Construction ARE

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 27 1993
CLERK T. Omanson

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A   REPORT DATE: 1/18/93   REQUEST NO. N/A

IDENTIFICATION

Unit ONE
Component 1-OME-150-AB
Item ANCHORS
Material C.S.
Other SQUG PROGRAM

TECHNIQUE

Test Unit/ S/N KB USK 7 / QC-405
Freq./Diameter 5MHZ / .250
Reference Standard QC-30 & 91-573
Couplant/Batch No. ULTRAGEL TG 9088

TEST DATA/REMARKS

ANCHOR	LENGTH	PL THICKNESS
A	*	2.375
B	*	
C	*	
D	*	
E	4.5"	
F	4.5"	
G	4.5"	
H	4.5"	
I	*	
J	*	
K	NOT OBTAINABLE **	
L	NOT OBTAINALE **	

*NOTE: A BACK REFLECTION INDICATING ANCHOR LENGTH WAS NOT OBTAINED DURING THIS EXAM. THIS WOULD BE INDICATIVE OF A J-BOLT TYPE ANCHOR.

**NOTE: NOT OBTAINABLE DUE TO THE ANCHOR / NUT THREAD ENGAGEMENT.

PERFORMED BY: Stephen R. Kago   LEVEL: II   DATE: 1/18/93

REVIEWED BY: [signature]   LEVEL: II   DATE: 1/18/93

FORM NO. 12 SHP 5050 NDE.008-1

Page 1 of 1
Revision 0

Equip Id: 2-OME-150-CD Train: 2 Equip Class: 17

Drawing No.: 2-12002, 2-5151C, 2-5151D

Function: DIESEL GENERATION

System: DIESEL GENERATION, CONTROL & INSTRUMENTATION

Equip Desc: CD EMERGENCY DIESEL GENERATOR

Building: AUXILIARY Room: CD EMERGENCY DIESEL GENERATOR ROOM

Elev: 587 Sort: S,R Notes:

Normal State: Desired State: Power Req'd:

Support System Drawing: 2-98033, 2-98051, 2-98052, 2-12002

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: A

Comp Served: CD EMERGENCY DIESEL GENERATOR

MFR: GENERAL ELECTRIC CO.

Model:

Panel: 2-SA, 2-DGCD 2-DGCDX

Elem. Drawing: 2-98033, 2-98051, 2-98052

Wiring Drawing: 2-95302

Power Source: 2-T21C3, 2-T21D8, 2-TDCD-2

Walkdown: F Relay Eval: Y

Comp Type: ENG. GEN-3500KW, 4KV

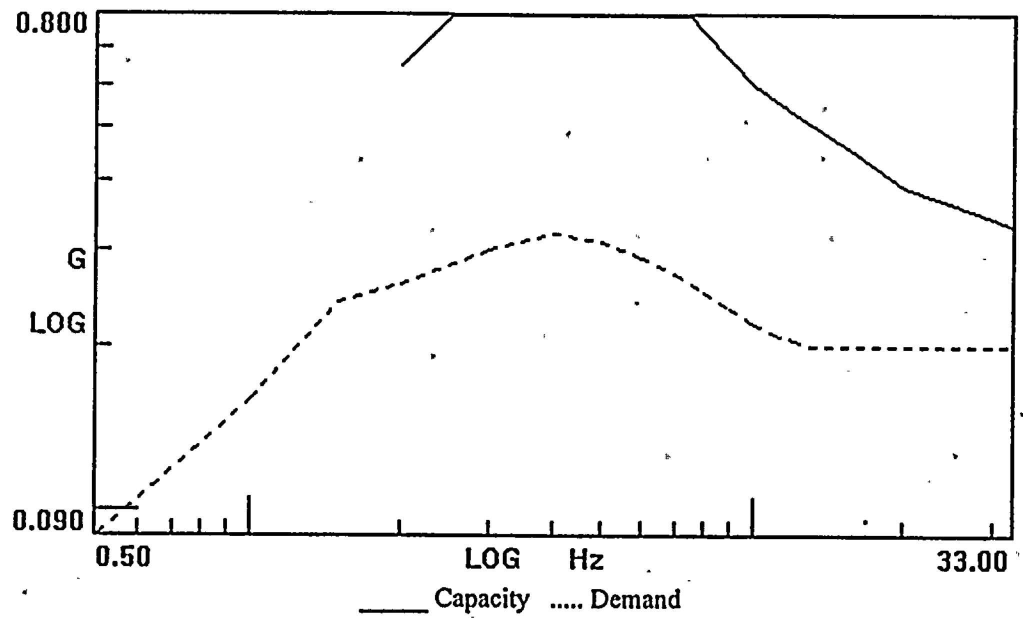
Iso Drawing:

Location: IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)			GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 14
ID : 2-OME-150-CD (Rev. 0)		Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR			
Building : AUXILIARY	Floor El. : 587.00		Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :			

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input	587.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)	Yes
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency =)	SRT
4.	Capacity based on:	1.00 * Bounding Spectrum
5.	Demand based on:	1.00 * Design Basis Ground Response Spectrum



	File	Record
Capacity	C:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	C:\GIP\PROJ0034\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N
Demand 2	C:\GIP\PROJ0034\spectra.des	BUILDING|Ground|ELEVATION|608|BROADEN|N

Does capacity exceed demand? Yes

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		

CAVEATS - BOUNDING SPECTRUM

EG/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
EG/BS Caveat 2 - Driver and Driven Component on Rigid Skid.	Yes
EG/BS Caveat 3 - Base Vibration Isolation System Checked.	N/A
EG/BS Caveat 4 - Sufficient Slack and Flexibility of Attached Lines.	Yes
EG/BS Caveat 5 - Adequate Anchorage.	Yes
EG/BS Caveat 6 - Potential Chatter of Essential Relays Evaluated.	N/A
EG/BS Caveat 7 - No Other Concerns.	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRTs are TR Satyan-Sharma, W. Djordjevic, J. Nieto, and R. Steele. -. 10/5/93

REF: 1. Anchorage Inspection Data Sheet, Anchorage Arrangement Sketches of generator anchorage, 9/8/93.
2. Report on Seismic Analysis of Equipment Supplied by Worthington Compressors Inc. for the D. C. Cook Nuclear Plant, Report EG-37017, 9/20/74 - Engine on Foundation calculation.
3..Dwgs 12-3241-12, 12-3468-13.
4. Anchor Bolt Schedule, Dwg 12-3073A-3.
5. General Arrangement Dwg W501812AT.

Anchorage:
See Reference # 2 for seismic qualification of Engine. Engine is anchored by 14 - 2" anchors.

Generator anchored by 8-1" CIP anchors. An edge distance reduction factor is taken for the 4 inside anchors (they are located approx. 3.7" from the pit's edge). Generator shaft end anchored by 4-1.75" CIP anchors (modeled as 1.375" anchors ANCHOR because this is the largest size anchor covered in the GIP). See ANCHOR analysis.

Photo: DG21-34&35, 36 and 37 (-34 of bolt, -35 from SW corner, -36 from NW corner, and -37 from NE corner).

Evaluated by: Date:

9/9/95

R Satyan Sharma 8/21/95

Attachment: Pictures
Attachment: ANCHOR Report

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
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Manufacturer, Model, Etc. :		

PICTURES

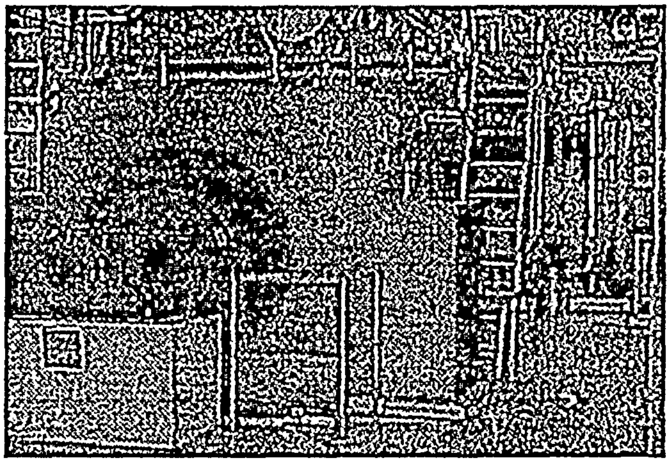


Figure 2: 2-OME-150-CD (Photo DG21.35)

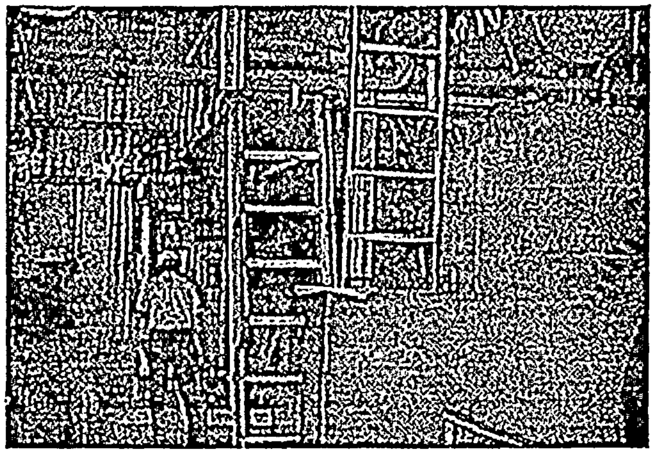


Figure 3: 2-OME-150-CD (Photo DG21.36)

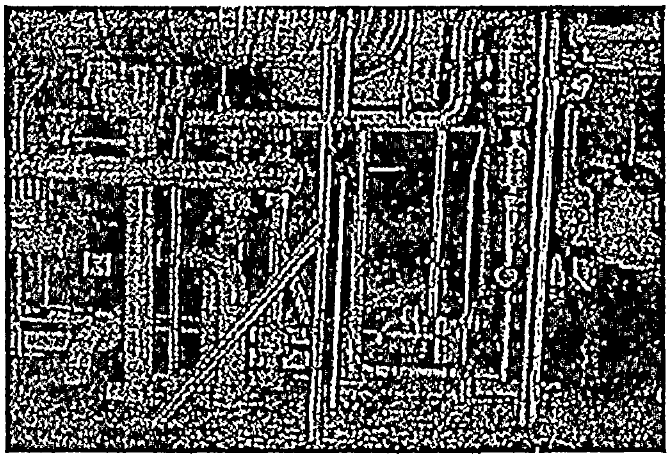


Figure 4: 2-OME-150-CD (Photo DG21.37)

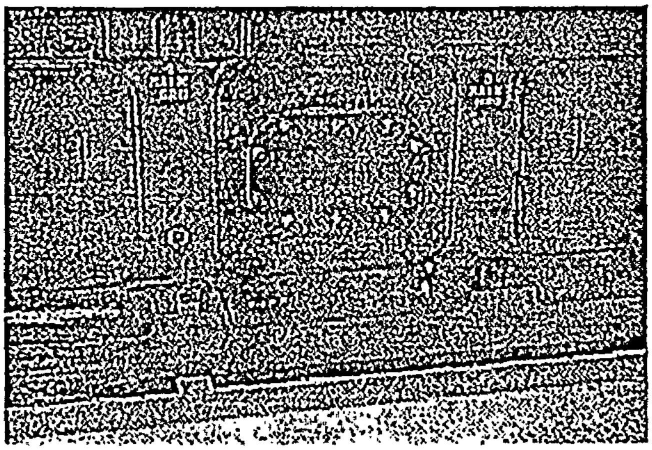


Figure1: 2-OME-150-CD (Photo DG21.34)

ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		

ANCHOR Report

Earthquake :

Response Spectrum : SSE

Frequency : GIP - Rigid

Percent Damping : GIP - 5.00

Spectral Values :

Direction.	Acceleration (g's)
North - South	0.38
East - West	0.38
Vertical	0.25

Angle (N-S Direction makes with the X Axis) : 0.00

Combination Criteria : SRSS

Weights :

Number of Weights : 1

No	Weight	X	Y	Z
1	10000.00	50.500	85.400	51.250

Forces :

Number of External Forces : 0

Moments :

Number of External Moments : 0

Allowables :

Anchor :

Number of Anchor types : 2

						Tension	Shear	

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		

				Ultimate	Ultimate	Inter	Inter	Saf
No.	Dia	Manufact	Product	Tension	Shear	Coeff	Coeff	Fact
1	1	Other	Cast In Place (A-307)	26690.00	13350.00	1.00	0.30	1.00
2	1-3/8	Other	Cast In Place (A-307)	50400.00	25250.00	1.00	0.30	1.00

Concrete :

Ultimate Stress : 3500.00 psi.

Reduction Factor : 0.85

Weld :

Allowable Stress : 30600 psi.

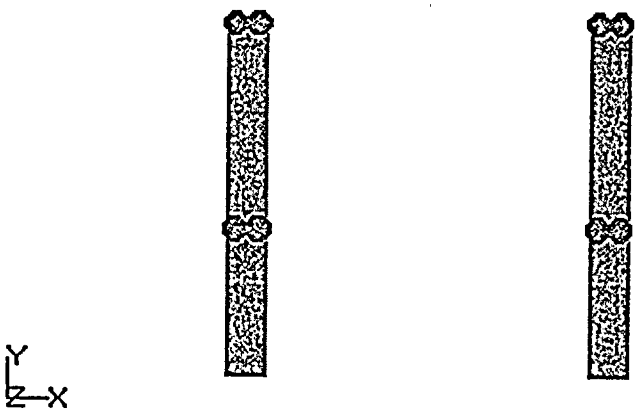
Surfaces :

Number of Surfaces : 2
Surface Orientation

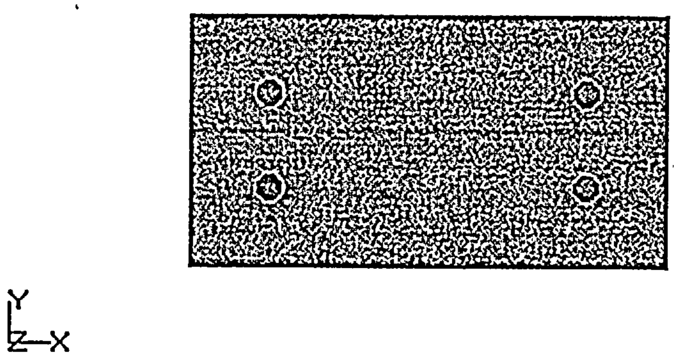
	Direction	Direction	Direction
	Comp	Comp	Comp
No	Nx	Ny	Nz
1	0.000	0.000	1.000
2	0.000	0.000	1.000

Anchor Pattern for Surface # 1

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 7 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		



Anchor Pattern for Surface # 2



Legend for Anchor Patterns

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 8 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		

Anchor Bolts :

Concrete Lines :

Concrete Points :

Weld Lines :

Geometry :

Anchor :

Number of Anchors : 12

No.	Anch Id	X Coord	Y Coord	Z Coord	Surf Id
1	1	98.700	76.750	0.000	1
2	1	93.200	76.750	0.000	1
3	1	93.200	129.250	0.000	1
4	1	98.700	129.250	0.000	1
5	1	2.300	129.250	0.000	1
6	1	8.060	129.250	0.000	1
7	1	8.060	76.750	0.000	1
8	1	2.300	76.750	0.000	1
9	2	30.750	10.000	8.500	2
10	2	30.750	22.000	8.500	2
11	2	70.250	10.000	8.500	2
12	2	70.250	22.000	8.500	2

Concrete Lines :

# of elements per line : 5

Number of Concrete Lines : 4

No	Start X-Coord	Start Y-Coord	Start Z-Coord	End X-Coord	End Y-Coord	End Z-Coord	Sf Id	Line Width
1	5.000	39.360	0.000	5.000	131.360	0.000	1	10.000
2	96.000	39.360	0.000	96.000	131.360	0.000	1	10.000
3	35.500	0.000	8.500	35.500	32.000	8.500	2	30.000

4	65.500	0.000	8.500	65.500	32.000	8.500	2	30.000

<u>Concrete Points :</u>

Number of Concrete Points : 0

<u>Weld Lines :</u>

# of elements per line : 5

Number of Weld Lines : 0

<u>Determination of Reduction Factors :</u>

Reduction Factor Input for Anchor # 1

Adequately Installed : Yes
Embedment Length : (61.38 in. Min Reqd. to achieve full capacity) :=10.00 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 8.75 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 2

Adequately Installed : Yes
Embedment Length : (61.38 in. Min Reqd. to achieve full capacity) :=10.00 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 3.70 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 3

Adequately Installed : Yes
Embedment Length : (61.38 in. Min Reqd. to achieve full capacity) :=10.00 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 3.70 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		

Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 4

Adequately Installed : Yes
Embedment Length : (61.38 in. Min Reqd. to achieve full capacity) :=10.00 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 8.75 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 5

Adequately Installed : Yes
Embedment Length : (61.38 in. Min Reqd. to achieve full capacity) :=10.00 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 8.75 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 6

Adequately Installed : Yes
Embedment Length : (61.38 in. Min Reqd. to achieve full capacity) :=10.00 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 3.70 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 7

Adequately Installed : Yes
Embedment Length : (61.38 in. Min Reqd. to achieve full capacity) :=10.00 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 3.70 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 11 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		

Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 8

Adequately Installed : Yes
Embedment Length : (61.38 in. Min Reqd. to achieve full capacity) :=10.00 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 8.75 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 9

Adequately Installed : Yes
Embedment Length : (54.50 in. Min Reqd. to achieve full capacity) :=13.75 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 8.75 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 10

Adequately Installed : Yes
Embedment Length : (54.50 in. Min Reqd. to achieve full capacity) :=13.75 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 8.75 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 11

Adequately Installed : Yes
Embedment Length : (54.50 in. Min Reqd. to achieve full capacity) :=13.75 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 8.75 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 12 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
Description : CD EMERGENCY DIESEL GENERATOR		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE CENTER OF THE ROOM, 10 FEET NORTH OF THE MAIN ENTRANCE DOOR
Manufacturer, Model, Etc. :		

Reduction Factor Input for Anchor # 12

Adequately Installed : Yes
Embedment Length : (54.50 in. Min Reqd. to achieve full capacity) :=13.75 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 8.75 in.
Crack Size : 0.000 in.
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factors Data Current : Yes

No	Anc Id	Pall/ Vall	Pallr/ Vallr	RT	RN	RL	RG	RS	RE	RF	RC	RR	RP	RB	RM
1	1	20671.79	N/A	1.00	1.00	1.00	1.00	0.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		13350.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1	0.00	N/A	1.00	1.00	1.00	1.00	0.77	*	1.00	1.00	1.00	1.00	1.00	1.00
		0.00	N/A	1.00	1.00	1.00	1.00	1.00	*	1.00	1.00	1.00	1.00	1.00	1.00
3	1	0.00	N/A	1.00	1.00	1.00	1.00	0.77	*	1.00	1.00	1.00	1.00	1.00	1.00
		0.00	N/A	1.00	1.00	1.00	1.00	1.00	*	1.00	1.00	1.00	1.00	1.00	1.00
4	1	20671.79	N/A	1.00	1.00	1.00	1.00	0.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		13350.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1	20907.90	N/A	1.00	1.00	1.00	1.00	0.78	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		13350.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1	0.00	N/A	1.00	1.00	1.00	1.00	0.78	*	1.00	1.00	1.00	1.00	1.00	1.00
		0.00	N/A	1.00	1.00	1.00	1.00	1.00	*	1.00	1.00	1.00	1.00	1.00	1.00
7	1	0.00	N/A	1.00	1.00	1.00	1.00	0.78	*	1.00	1.00	1.00	1.00	1.00	1.00
		0.00	N/A	1.00	1.00	1.00	1.00	1.00	*	1.00	1.00	1.00	1.00	1.00	1.00
8	1	20907.90	N/A	1.00	1.00	1.00	1.00	0.78	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		13350.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	2	39829.26	N/A	1.00	1.00	1.00	1.00	0.88	0.90	1.00	1.00	1.00	1.00	1.00	1.00
		13395.02	N/A	1.00	1.00	1.00	1.00	1.00	0.53	1.00	1.00	1.00	1.00	1.00	1.00
10	2	39829.26	N/A	1.00	1.00	1.00	1.00	0.88	0.90	1.00	1.00	1.00	1.00	1.00	1.00
		13395.02	N/A	1.00	1.00	1.00	1.00	1.00	0.53	1.00	1.00	1.00	1.00	1.00	1.00
11	2	39829.26	N/A	1.00	1.00	1.00	1.00	0.88	0.90	1.00	1.00	1.00	1.00	1.00	1.00
		13395.02	N/A	1.00	1.00	1.00	1.00	1.00	0.53	1.00	1.00	1.00	1.00	1.00	1.00
12	2	39829.26	N/A	1.00	1.00	1.00	1.00	0.88	0.90	1.00	1.00	1.00	1.00	1.00	1.00
		13395.02	N/A	1.00	1.00	1.00	1.00	1.00	0.53	1.00	1.00	1.00	1.00	1.00	1.00

Legend :

N/A	= Not Applicable
Pall	= Allowable Pull without Reduced Inspection
Vall	= Allowable Shear without Reduced Inspection
Pallr	= Allowable Pull with Reduced Inspection

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 13 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators	
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Manufacturer, Model, Etc. :		

Vallr	= Allowable Shear with Reduced Inspection
*	= Outlier
X	= Reduction Factor Not Used
RT	= Reduction Factor for Type of Anchorage
RN	= Reduction Factor for Installation Adequacy
RL	= Reduction Factor for Embedment
RG	= Reduction Factor for Gap at Anchors
RS	= Reduction Factor for Spacing
RE	= Reduction Factor for Edge Distance
RF	= Reduction Factor for Concrete Strength
RC	= Reduction Factor for Concrete Cracks
RR	= Reduction Factor for Essential Relays
RP	= Reduction Factor for Base Stiffness and Prying Action
RB	= Reduction Factor for Base Strength and Load Path
RM	= Reduction Factor for Embed. Steel and Pads

Analysis Results :

Analysis Performed : Yes

Type of Analysis : Regular

	Spectral Accelerations (G's)			
No	N-S	E-W	Vertical	Safety Factor
1	0.375	0.150	0.100	49.387
2	-0.375	-0.150	-0.100	66.437
3	-0.375	0.150	0.100	49.196
4	0.375	-0.150	-0.100	66.700
5	0.375	-0.150	0.100	36.848
6	-0.375	0.150	-0.100	79.872
7	0.375	0.150	-0.100	80.174
8	-0.375	-0.150	0.100	36.703
9	0.150	0.375	0.100	84.089
10	-0.150	-0.375	-0.100	84.919
11	0.150	-0.375	0.100	41.166
12	-0.150	0.375	-0.100	124.223
13	-0.150	0.375	0.100	84.082
14	0.150	-0.375	-0.100	85.254
15	0.150	0.375	-0.100	124.223
16	-0.150	-0.375	0.100	41.142
17	0.150	0.150	0.250	57.447

D.C. COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)			GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 14 of 14
ID : 2-OME-150-CD (Rev. 0)	Class : 17. Engine-Generators		
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Manufacturer, Model, Etc. :			

18	-0.150	-0.150	-0.250	2091.746
19	0.150	0.150	-0.250	735.385
20	-0.150	-0.150	0.250	37.892
21	-0.150	0.150	0.250	57.220
22	0.150	-0.150	-0.250	2091.804
23	0.150	-0.150	0.250	38.041
24	-0.150	0.150	-0.250	735.242

Minimum Safety Factor : 36.703

The Anchorage Capacity is 36.703 times greater than the Demand

REPORT ON SEISMIC ANALYSIS

OF EQUIPMENT SUPPLIED BY

WORTHINGTON COMPRESSORS INC.

FOR

THE D. C. COOK NUCLEAR PLANT

OF

AMERICAN ELECTRIC POWER

SERVICE CORPORATION

REPORT EG-37017, Edition C

September 20, 1974

CK 81A

CALCU.

SUBJECT ENGINE ON FOUNDATION

GROUP C-1

TYPE DRG. No.

Sheet 0 of 17 Shts.

CAL. BY RLB Ck By MFP

Date 4/2/74

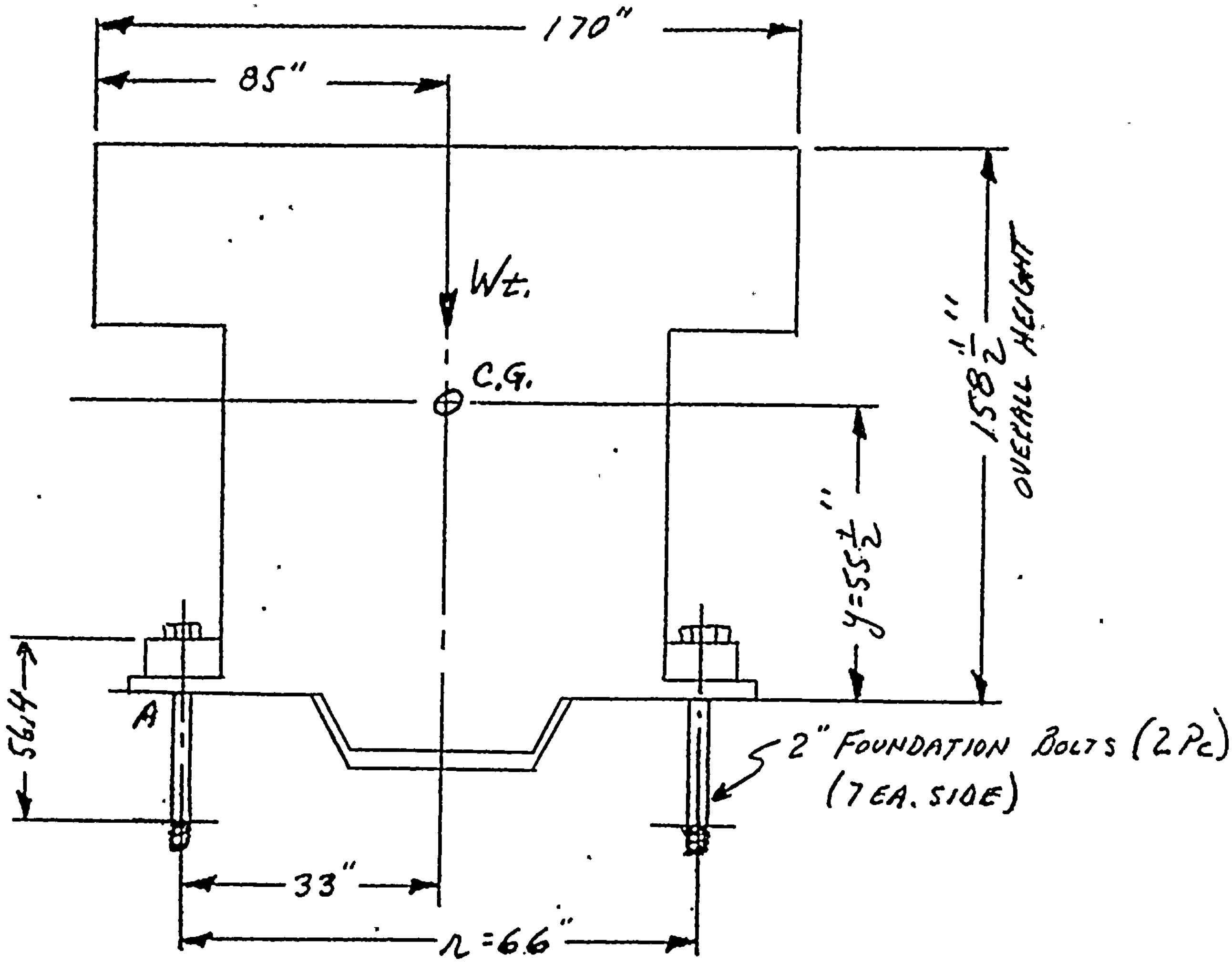
Page	Comment No.	DESCRIPTION
1	(1 A.1 &	Engine Sepecifications
2	1A.2)	Foundation Bolt Specifications
4		Engine Flange Specifications
5.		Foundation Bolts - Tension - Rocking, Operating, Tightening, Seismic, Stresses & F.S.
9		Foundation Bolts - Bending
14	1A.3	Foundation Bolts - Shear & Combined Stresses & F.S.
15	1A.4	Flange - Bending - Rocking, Torque, Stress & F. S.
17		Conclusions

WORTHINGTON CORPORATION

CK 81A

SUBJECT ENGINE ON FOUNDATION	CALCU.
TYPE ______ DRG. No. W-501812AM	GROUP C-1
CAL. BY RHB APP. ______	Sheet 1 of 17 Shts.
	Date 3/5/74

WORTHINGTON CORPORATION



ENGINE:

a) $Wt = 161,650^{\#}$ (PER WORTH. SK-4799A)

b) C.G. – AS SHOWN (PER WORTH. DATA)

c) OVERALL DIM. – AS SHOWN

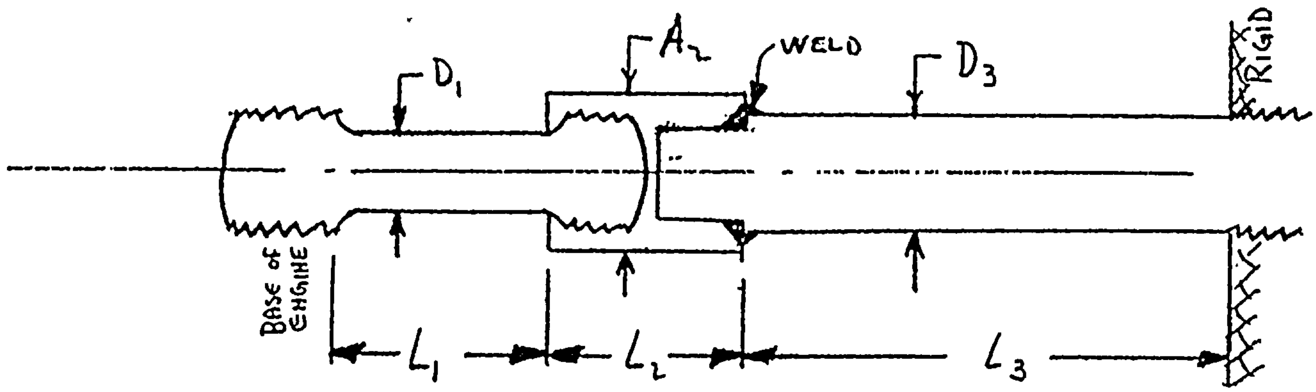
d) HORSEPOWER = 4900 (PER SPECS.)

e) R.P.M. = 514 (PER WORTH SK-4799A)

f) FOUNDATION BOLT STRESS AREA $= \frac{\pi d^2}{4} = \frac{\pi (1.815)^2}{4} = 2.587\ \text{in}^2/\text{BOLT}$
(AS PER SKETCH)

CK 81A

SUBJECT ENGINE ON FOUNDATION	CALCU.
TYPE ______ DRG. No. Y-500009HW	GROUP ICI-1
CAL. BY RKB APP. ______	Sheet 2 of 17 Shts.
	Date 3/5/74



FOUNDATION BOLTS (14) AS PER WORTH. #500009HW8

$L_1 = 8.41$ IN. $D_1 : 1.815$ IN $A_1 = 2.587$ IN^2

$L_2 = 6.0$ IN. $D_2 : 3.5''$ HEX. $A_2 = 10.609$ IN^2

$L_3 = 42.0$ IN. $D_3 : 2.25$ IN. $A_3 : 3.976$ IN^2

ELONGATION/Lb_f $= \delta = \dfrac{L}{AE}$

$$\delta_1 = \frac{8.41 \text{ IN.}}{(2.587 \text{ IN.}^2)(30\times10^6 \text{ PSI})} = .108\times10^{-6} \text{ IN}/Lb_f$$

$$\delta_2 = \frac{6.0 \text{ IN.}}{(10.609 \text{ IN}^2)(30\times10^6 \text{ PSI})} = .019\times10^{-6} \text{ IN.}/Lb_f$$

$$\delta_3 = \frac{42.0 \text{ IN}}{(3.976 \text{ IN}^2)(30\times10^6 \text{ PSI})} : .352\times10^{-6} \text{ IN.}/Lb_f$$

$$\delta_{TOTAL} : \delta_1 + \delta_2 + \delta_3 = .479\times10^{-6} \text{ IN}/Lb_f.$$

CONSIDER ROTATION ABOUT POINT "A" — ∴ 7 BOLTS IN TENSION:

$$\delta = \frac{.479\times10^{-6}}{7} = .064\times10^{-6} \text{ IN}/Lb_f.$$

ANGULAR DISPLACEMENT:

$$\phi = \frac{\delta}{r} = \frac{.064\times10^{-6}}{66} = 9.7\times10^{-10} \text{ RAD}/Lb_f.$$

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SUBJECT ENGINE ON FOUNDATION	CALCU. GROUP C-1
TYPE ______ DRG. No. W-501812AM	Sheet 3 of 12 Shts.
CAL. BY RLB APP. ______	Date 3/5/74

$M = FY = (1\ LBf)(55.5\ IN) = 55.5\ LBf\text{-}IN$

K_ϕ = SPRING CONSTANT $= \frac{M}{\phi} = \frac{55.5}{9.7\times10^{-10}} = 5.7\times10^{10}\ \frac{LBf\text{-}IN}{RAD}$

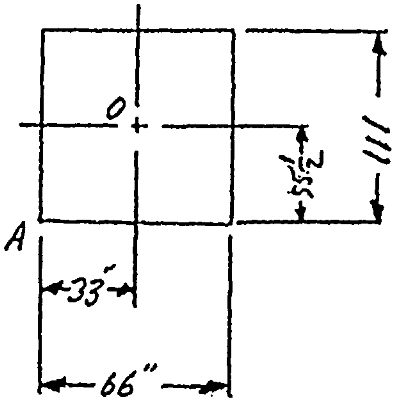
A_S = MIN. STRESS AREA OF FOUNDATION BOLTS $= 7\left(\frac{\pi(1.815)^2}{4}\right) = 18.104\ IN^2$

SUMMING MOMENTS ABOUT POINT "A" (CONSIDERING HORIZONTAL FORCE EQUAL TO WT OF ENGINE AT C.G.)

$Wt\,(y) = F(x)$

$F_H = \frac{W_t(y)}{x} = \frac{161{,}650\,(55.5)}{66} = 135{,}933^{\#}$

σ_t = TENSILE STRESS PER BOLT DUE TO ROCKING $= \frac{F_H}{A_S} = \frac{135933}{18.104} = 7508\ \frac{LBf}{IN^2}$



$\overline{AO} = \left\{(55.5)^2 + (33)^2\right\}^{1/2} = 64.2''$

$W_t = 161{,}650^{\#}$

$J_{M_{o\text{-}o}} = \frac{M}{12}(h^2+b^2) = \frac{161{,}650}{(12)(12)(32.2)}\left\{(66)^2 + (111)^2\right\} = 581360\ LBf\text{-}IN\text{-}SEC^2$

$J_{M_{A\text{-}A}} = J_{M_{o\text{-}o}} + M\left(\overline{AO}\right)^2 = 581360 + \frac{161{,}650}{(12)(32.2)}(64.2^2) = 2.32\times10^6$

$\omega_{cr} = \sqrt{\frac{K_\phi}{J_{M_{A\text{-}A}}}} = \sqrt{\frac{5.7\times10^{10}\ \frac{LBf\text{-}IN}{rad}}{2.32\times10^6}} = 157\ \frac{RAD}{SEC}$

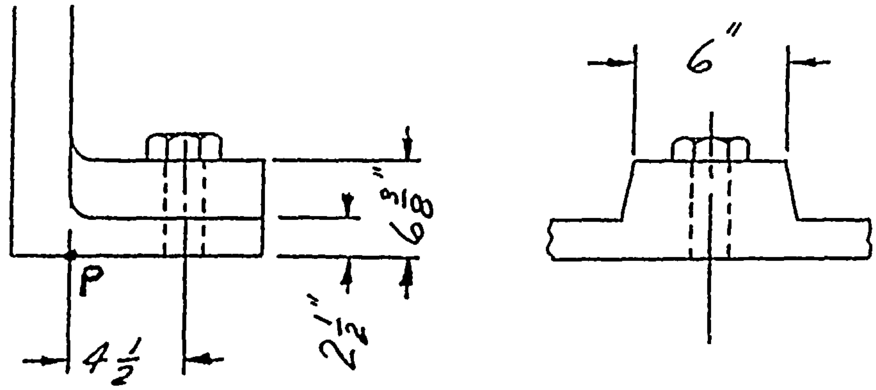
$T = \frac{1}{f_{cr}} = \frac{1}{\omega_{cr}/2\pi} = \frac{2\pi}{\omega_{cr}} = \frac{2\pi}{157} = .0400\ SEC$

CK 81A

SUBJECT ENGINE ON FOUNDATION		CALCU.
TYPE	DRG. No. W-510465M	GROUP C-1...
CAL. BY	APP.	Sheet 4 of 17 Shts.
		Date 3-6-74

WORTHINGTON CORPORATION

BASE FLANGE BENDING



$$I = \frac{bh^3}{12} = \frac{(6-2)(6.375)^3}{12} = 86.4 \ IN^4$$

$$\delta_{FLG} = \frac{WL^3}{3EI} = \frac{1(4.5)^3}{3(30\times10^6)(605)} = .00167\times10^{-6} \ IN/LB_f$$

$$\phi = \frac{\delta}{r} = \frac{.00167\times10^{-6}}{66} = .253\times10^{-10} \ RAD/LB_f$$

$$K_{\phi_{FLG}} = \frac{M}{\phi} = \frac{55.5}{.253\times10^{-10}} = 219.37\times10^{10} \ IN\text{-}LBF/RAD$$

SPRING CONST. IN SERIES WITH BOLTS:

$$K_\phi = \frac{1}{\frac{1}{K_{\phi_{FLG}}} + \frac{1}{K_{\phi_{BOLTS}}}} = \frac{1}{\frac{1}{219.37\times10^{10}} + \frac{1}{5.7\times10^{10}}}$$

$$K_\phi = 5.556\times10^{10} \ \frac{IN\text{-}LB_f}{rad}$$

$$\omega_{cr} = \sqrt{\frac{K_\phi}{JM_{A-A}}} = \sqrt{\frac{5.556\times10^{10}}{2.325\times10^6}} = 154.6 \ rad/sec$$

CK 81A

$$f_{cr} = \frac{\omega_{cr}}{2\pi} = \frac{154.6}{2\pi} = 24.6 \text{ C.P.S.}$$

$$T = .0405 \text{ sec.}$$

ENGINE ON FOUNDATION:

I. MODE OF FAILURE - ROCKING - FOUNDATION BOLTS ON ONE SIDE IN TENSION.

a) FROM RESPONSE SPECTRA CHART: ELEV: 587'
DES. BASIS EARTHQUAKE
.5% DAMPING
COOK AUX. BLDG

$T = .0405$ SEC. (PG. 5)

M: MAGNIFIER = .22

$\sigma_t = 7508$ PSI (PAGE 3)

$$\therefore \sigma_{T_{BOLTS_1}} = 7508(.22) = 1651.8 \ Lb_f/IN.^2$$

b). OPERATING STRESS - REACTION TO ENGINE TORQUE

$$T = \frac{63{,}000 \ HP}{N} = \frac{63{,}000(4900)}{514} = 600{,}000 \ Lb_f\text{-}IN$$

$$F: \frac{T}{l/2} = \frac{600{,}000}{33''} \doteq 18181.8 \ Lb_f$$

$$\sigma_{t_2} = \frac{F}{A} = \frac{18181.8}{18.104} = 1004.3 \ Lb_f/IN^2$$

(STRESS ON SMALLEST CROSS SECTION OF COMPOSITE FOUNDATION BOLT)

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CE 81A

WORTHINGTON CORPORATION

SUBJECT: ENGINE ON FOUNDATION		CALCU.
		GROUP: C-1
TYPE:	DRG. No. W-510465 M	Sheet 6 of 17 Shts.
CAL. BY: KAN	APP.	Date: 3/6/74

c) INITIAL TENSION IN BOLTS DUE TO TIGHTENING:

USING A TORQUE COEFFICIENT OF $C = 0.2$
(FROM "PREDICTING BOLT TENSIONS" - MANEY G.A.)
(FASTENERS DATA BOOK)

D = NOM. BOLT DIA = 2 IN.

T = INITIAL TORQUE = 2000 Lbs-FT. (WORTH. SPEC.)

$T = CDF$

$$F = \frac{T}{CD} = \frac{2000 \text{ Lb}_f \text{ ft } (12 \text{ in/ft})}{(0.2)(2 \text{ IN})} = 60{,}000 \text{ Lb}_f$$

$$\sigma_{t_3} = \frac{F}{A} = \frac{60{,}000 \text{ Lb}_f}{2.587 \text{ IN}^2} = 23{,}193 \text{ Lb}_f/\text{IN}^2$$

d) VERTICLE SEISMIC FORCE ON BOLTS:

$F = 161650 \text{ Lb}_f$

$$\delta = \frac{\delta_{TOTAL}}{14} = \frac{.479 \times 10^{-6}}{14} = .032 \times 10^{-6} \text{ IN}/\text{Lb}_f \quad \text{(SEE Pg 2)}$$

$$F = Kx, \quad K = F/x = \frac{1 \text{ Lb}_f}{\delta} = \frac{1}{.032 \times 10^{-6}} = 31.25 \times 10^{6} \frac{\text{Lb}_f}{\text{IN}}$$

$$\text{MASS} = \frac{W_t}{12(32.2)} = \frac{161650}{(12)(32.2)} = 408.2 \frac{\text{Lb}_f \text{ sec}^2}{\text{in}}$$

$$W_{cr} = \sqrt{\frac{K}{m}} = \sqrt{\frac{31.25 \times 10^{6}}{408}} = \sqrt{7.66 \times 10^{4}} = 277 \text{ rad/sec}$$

CK 81A

CALCU.

SUBJECT Engine On Foundation

GROUP ...

TYPE ___ DRG. No. W-51046SM

Sheet 7 of 17 Shts.

CAL. BY KHB APP. ___

Date 3/6/74

$$f_{cr} = \frac{W_{cr}}{2\pi} = .44 \text{ cps}$$

$$T = \frac{1}{f_{cr}} = .022 \text{ sec.}$$

From Response Spectra Chart Elev. 587' DBE

M = Magnifier = .20 .5% Damping

$A_s = 14(\text{Area/Bolt}) = 14(2.587) = 36.208 \text{ in}^2$

$$F = \frac{2}{3}(W_t) = \frac{2}{3}(161650) = 107766\#$$

$$\sigma_{t_4} = \frac{F}{A_s}(M) = \frac{107766(.2)}{36.208} = 595.3 \text{ Lbs/in}^2$$

e) Total Loads: (Tension On Bolts)

σ_{t_1}	Horizontal Seismic	=	1651.8 PSI
σ_{t_2}	Operating Stress	=	1004.3 PSI
σ_{t_4}	Verticle Seismic	=	595.3 PSI
	σ_t max	=	3251.4 PSI

f) Factor Of Safety:

Since There Are Three Different Materials Involved In The Foundation Bolts, A Proportional Relationship Will Be Set Up With Respect To Each Of The Different Materials & Different Cross Sections.

WORTHINGTON CORPORATION

CK #1A

SUBJECT: ENGINE ON FOUNDATION	CALCU.
TYPE ______ DRG. No. W-510465 M	GROUP C-1
CAL. BY RHB APP. ______	Sheet 8 of 17 Shts. Date 3/6/74

SINCE $F.S. = \frac{Y.S.}{\sigma_{MAX}}$ & USING THE SMALLEST CROSS SECTIONAL AREA AS A. REF.

$$F.S._1 = \frac{Y.S._1}{\sigma_1}$$

$$F.S._2 : \frac{Y.S._2}{\sigma_2} = \frac{YS_1}{\sigma_1}\left(\frac{YS_2}{\sigma_2} \times \frac{\sigma_1}{YS_1}\right) = \frac{YS_1}{\sigma_1}\left(\frac{YS_2\, A_2}{YS_1\, A_1}\right)$$

$$F.S._3 = \frac{YS_1}{\sigma_1}\left(\frac{YS_3\, A_3}{YS_1 A_1}\right)$$

FROM WORTHINGTON MATERIAL SPECIFICATIONS.

$Y.S._1 = 105{,}000$ PSI (WORTH S-6)

$Y.S._2 = 50{,}000$ PSI (WORTH S-1)

$Y.S._3 = 40{,}000$ PSI (WORTH S-2)

$$C_2 = \frac{YS_2 A_2}{YS_1 A_1} = \frac{(50{,}000)(10.609)}{(105{,}000)(2.587)} = 1.97$$

$$C_3 = \frac{YS_3 A_3}{YS_1 A_1} = \frac{(40{,}000)(3.976)}{(105{,}000)(2.587)} = .59$$

$$F.S._1 = \frac{YS_1}{\sigma_1} = \frac{105{,}000}{3251.4 \text{ (P.7)}} = 32.3$$

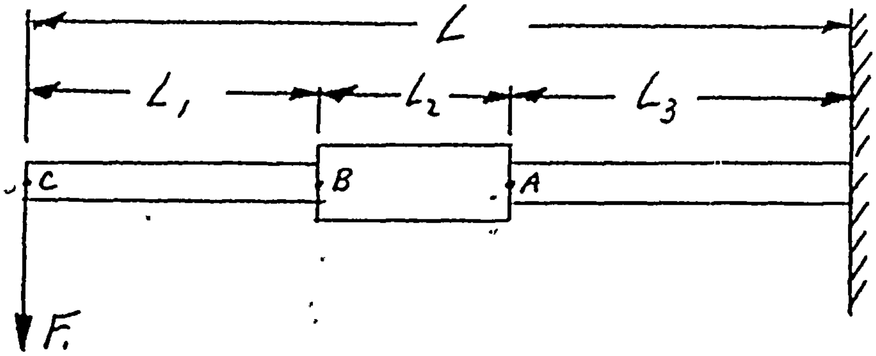
$F.S._2 = F.S._1(C_2) = 63.6$

$F.S._3 = F.S._1(C_3) = 19.1$

WORTHINGTON CORPORATION

CK 81A

SUBJECT: ENGINE ON FOUNDATION		CALCU. GROUP
TYPE	DRG. No. Y-500009HW	Sheet 9 of 12 Shts.
CAL. BY RAB	APP.	Date 3/7/74



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II MODE OF FAILURE - BENDING - FOUNDATION BOLTS DUE TO HORIZONTAL SEISMIC LOAD

$L_1 = 8.41$ IN $\quad L = 56.41$ IN. $\quad a = L_1$

$L_2 = 6.0$ IN $\quad b = L_1 + L_2$

$L_3 = 42.0$ IN

$$I_1 = \frac{\pi D_1^4}{64} = .049 D_1^4 = .049(1.815)^4 = 0.532 \text{ IN}^4$$

$$I_2 = .06 d_2^4 = .06(3.5)^4 = 9.004 \text{ IN}^4$$

$$I_3 = .049 D_3^4 = .049(2.25)^4 = 1.256 \text{ IN}^4$$

$$Z_1 = \frac{I}{y} = .098 D_1^3 = .098(1.815)^3 = .586 \text{ IN.}^3$$

$$Z_2 = .104 D_2^3 = .104(3.5)^3 = 4.459 \text{ IN.}^3$$

$$Z_3 = .098 D_3^3 = .098(2.25)^3 = 1.116 \text{ IN.}^3$$

$$F = \frac{W_t}{\text{No. BOLTS}} = \frac{161{,}650}{14} = 11546^{\#}$$

CE 81A

SUBJECT ENGINE ON FOUNDATION	CALCU. GROUP C-1
TYPE ... DRG. No. Y-500009HW	Sheet 10 of 17 Shts.
CAL. BY RB APP.	Date 3/7/74

a) USING THEORY EXPLAINED IN "MECHANICS OF DEFORMABLE SOLIDS" by I. SHANES (p. 267): (VARIABLE CROSS-SECTION)

① $$\frac{d^2Y}{dx^2} = \frac{1}{EI}\left[-x\,P[u(x)]\right]$$

② $$\frac{1}{I} = \frac{1}{I_1}[u(x)] - \frac{1}{I_1}[u(x-a)] + \frac{1}{I_2}[u(x-a)]$$

$$-\frac{1}{I_2}[u(x-b)] + \frac{1}{I_3}[u(x-b)]$$

BY SUBSTITUTING ② INTO ①; ADDING & SUBTRACTING THE FOLLOWING:

$$\frac{Pa}{I_1}[u(x-a)]$$

$$\frac{Pa}{I_2}[u(x-a)]$$

$$\frac{Pb}{I_2}[u(x-b)]$$

$$\frac{Pb}{I_3}[u(x-b)]$$

& COLLECTING ALL TERMS COMMON:

③ $$\frac{d^2Y}{dx^2} = \frac{1}{E}\left\{\frac{-Px}{I_1}[u(x)] + \left[\frac{1}{I_1} - \frac{1}{I_2}\right]\left[P(x-a) + Pa\right][u(x-a)]\right.$$

$$\left. + \left[\frac{1}{I_2} - \frac{1}{I_3}\right]\left[P(x-b) + Pb\right][u(x-b)]\right\}$$

WORTHINGTON CORPORATION

CK 81A

CALCU.

SUBJECT ENGINE ON FOUNDATION

GROUP ..C-1

TYPE

DRG. No. Y-500009HW

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CAL. BY [illegible]

APP.

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INTEGRATING TWICE:

④ $$\frac{dY}{dx} = \frac{1}{E}\left\{\frac{-Px^2}{2I_1}[u(x)] + \left[\frac{1}{I_1} - \frac{1}{I_2}\right]\left[\frac{P(x-a)^2}{2} + Pa(x-a)\right][u(x-a)] + \left[\frac{1}{I_2} - \frac{1}{I_3}\right]\left[\frac{P(x-b)^2}{2} + Pb(x-b)\right][u(x-b)]\right\} + C_3$$

⑤ $$Y = \frac{1}{E}\left\{\frac{-Px^3}{6I_1}[u(x)] + \left[\frac{1}{I_1} - \frac{1}{I_2}\right]\left[\frac{P(x-a)^3}{6} + \frac{Pa(x-a)^2}{2}\right][u(x-a)] + \left[\frac{1}{I_2} - \frac{1}{I_3}\right]\left[\frac{P(x-b)^3}{6} + \frac{Pb(x-b)^2}{2}\right][u(x-b)]\right\} + C_3x + C_4$$

at $x = L^-$ $\frac{dY}{dx} = 0$ & $Y = 0$

∴ SOLVING FOR C_3 & C_4

$C_3 = +.4846$

$C_4 = -18.23$

TO FIND MAX DEFLECTION: $x = 0$

$Y = C_4 = -18.23$ IN.

$K = \frac{E}{Y} = \frac{11546}{18.23} = 633.4$ Lbs/IN. [SPRING CONSTANT IN BENDING]

$MASS = \frac{11546}{(12)(32.2)} = 29.88 \frac{Lbs - sec^2}{IN}$

CK 81A

SUBJECT ENGINE ON FOUNDATION:	CALCU.
TYPE DRG. No. Y-500009HW	GROUP C-1
CAL. BY RAB APP.	Sheet 12 of 17 Shts.
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$$\omega_{cr} = \sqrt{K/m} = \sqrt{\frac{633.4}{29.88}} = 4.604$$

$$f_{cr} = \frac{\omega_{cr}}{2\pi} = 0.733 \text{ cps}$$

$$T = \frac{1}{f_{cr}} = 1.36 \text{ sec}$$

b) FROM RESPONSE SPECTRA CHART

ELEV = 587' COOK AUX BLDG.

.5% DAMPING

D.B.E

MAGNIFIER = 0.14

$$F_H = F(\text{MAG}) = \overset{(P.9)}{11546}(.14) = 1616 \text{ Lb}_f$$

c) FRICTIONAL FORCE BETWEEN ENGINE & FOUNDATION:

N = NORMAL FORCE = (W_E) + (FORCE DUE TO TIGHTENING BOLTS) − (VERTICAL SEISMIC FORCE)

= 161,650 + (14)(60,000) − (595.3) = 1001055 Lb$_f$

μ = COEF. OF FRICTION = 0.4 [STEEL VS C.I]

$F = \mu N$

= (0.4)(1001055) = 400422 Lb$_f$

WORTHINGTON CORPORATION

CE 01A

SUBJECT Engine On Foundation

TYPE

DRG. No. Y-500009HW

CAL. BY RWB

APP.

CALCU.

GROUP C-1

Sheet 13 of 17 Shts.

Date 4/2/74

d) $F_{FRICTION} > F_{HORIZ\ SEIS} \rightarrow 400422 > 1616$

$$F.S. = \frac{400422}{1616} = 248$$

∴ No Foundation Bolt Bending Will Occur Due To The Frictional Force Resisting Any Horizontal Movement.

This Fact Also Hinders Any Shear In The Foundation Bolts Due To Horizontal Seismic Loads.

WORTHINGTON CORPORATION

III MODE OF FAILURE - SHEAR IN FOUNDATION BOLTS DUE TO HORIZONTAL SEISMIC LOADING.

$$F_{HS} = (H_{AG})(W_T) = (.145)(161650) = 23439 \text{ lbf}$$

FROM P 12:

$$F_{FRICTION} = 400422$$

$$F_{FRICT} > F_{HS} : 400422 > 23439$$

So THE FRICTION BETWEEN THE FOUNDATION & THE ENGINE BASE ALLOW NO SHEAR FORCES TO BE TRANSMITTED TO THE FOUNDATION BOLTS.

IV FOUNDATION BOLT INITIAL TENSION: [Y.S. FROM P. 6]

WORTH SPEC → BULLETIN # 4314 E1 - 15G STATES:

TORQUE = 2450-2550 FT-LBf

FROM "DESIGN OF MACHINE ELEMENTS" by FAIRES P.159

$T = CDF$ $C = .2$ $D = 2''$

$$F = \frac{T}{CD} = \frac{(2500)(12)}{(.2)(2)} = 75000 \text{ lbf}$$

a) UPPER SECTION: THD. $A_s = 2.95 \text{ in}^2$

SHANK $A_s = 2.6 \text{ in}^2$

$$\sigma = \frac{75000}{2.6} = 28829 \text{ lbf/in}^2 \quad \left[\tau = \frac{\sigma}{2} = 14414.5 \frac{\text{lbf}}{\text{in}^2}\right]$$

b) LOWER SECTION: THD $A_s = 3.76 \text{ in}^2$

SHANK $A_s = 3.976 \text{ in}^2$

$$\sigma = \frac{75000}{3.76} = 19947 \text{ lbf/in}^2 \quad \left[\tau = 9973 \frac{\text{lbf}}{\text{in}^2}\right]$$

c) $F.S._\sigma$ (UPPER): $\frac{105000}{28829} = \underline{3.6}$; $F.S._\tau = \frac{(.6)(105000)}{14414.5} = \underline{4.4}$

d) $F.S._\sigma$ (LOWER) $= \frac{40000}{19947} = \underline{2.0}$; $F.S._\tau = \frac{(.6)(40000)}{9973} = \underline{2.4}$

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CK 81A

SUBJECT ENGINE ON FOUNDATION	CALCU.
TYPE DRG. No. W-510465 M	GROUP C-1
CAL. BY [illegible] APP.	Sheet 15 of 17 Shts.
	Date 3/8/74

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V MODE OF FAILURE - ROCKING - FLANGE BENDING

FROM PG. 5 : $T = .0405$ sec.

FROM RESPONSE SPECTRA CHART: ELEV = 587'
DBE
.5% DAMPING.
COOK AUX BLDG.

MAGNIFIER = 0.22

$I = 86.4 \text{ IN}^4$ (PG. 4)

$C = 3.19$ IN (PG. 4)

$L = 4.5$ IN (PAGE 4)

a) FROM ROCKING;

$$F = \frac{F_H}{7}(\text{MAGNIFIER}) = \frac{\overset{(P.3)}{135933}(.22)}{7} = 4272 \ Lb_f$$

$$M = F(L) = (4272)(4.5) = 19224 \ Lb_f\text{-IN.}$$

$$\sigma_t = \frac{Mc}{I} = \frac{(19224)(3.19)}{86.4} = 710 \ Lb_f/IN^2$$

b) OPERATING STRESS - REACTION TO ENGINE TORQUE.

$F = 18181.8 \ Lb_f$ (PAGE 5)

$$M = \frac{F}{7}(L) = \frac{18181.8}{7}(4.5) = 11688 \ Lb_f\text{-IN.}$$

$$\sigma_t = \frac{Mc}{I} = \frac{(11688)(3.19)}{86.4} = 432 \ Lb_f/IN^2$$

c) REFERING TO THE FIGURE ON PAGE 4 (C-1), SINCE WE ARE CONSIDERING FLANGE BENDING, IE, FLANGE IN TENSION AT THE POINT "P," THE FORCES

CONTRIBUTING ARE:

1) ROCKING FROM HORIZONTAL SEISMIC LOADS
2) ENGINE TORQUE.

THE INITIAL BOLT TIGHTENING LOADS ARE COMPRESSIVE AND ONLY CONTRIBUTE IN CAUSING A STRESS CONCENTRATION.

FROM "DESIGN OF MACHINE ELEMENTS" - FAIRES

$d/h = \frac{2}{6} = .33$

$K_t = 2.34$ (THIS IS OVERLY CONSERVATIVE DUE TO THE DIRECTION OF LOADING)

d) STRESS ON FLANGE: (BENDING)

$$\sigma_t = K_t \left[\sigma_{ROCKING} + \sigma_{OPERATING} \right]$$

$$= 2.34 \left[710 + 432 \right]$$

$$= 2672 \ Lbs/IN^2$$

e) SAFETY FACTOR: Y.S. = 30,000 Lbs/IN^2 [WORTH. SPEC C-1]

$$F.S. = \frac{Y.S.}{\sigma_t} = \frac{30,000}{2672} = 11.23$$

WORTHINGTON CORPORATION

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SUBJECT ENGINE ON FOUNDATION -	CALCU. GROUP C-1
TYPE	DRG. No.	Sheet 17 of 17 Shts.
CAL. BY RLB APP.	Date 6/11/74

CONCLUSIONS:

I FOUNDATION BOLT: $F.S._{\tau}$ = 2.4 (P.14) ; $F.S._{\sigma}$ = 2.0 (P.14

THIS SAFETY FACTOR IS DUE TO THE PRELOAD ON THE FOUNDATION BOLT AND OCCURS ON THE LOWER PART OF THE 3-PIECE BOLT. FRICTION BETWEEN THE ENGINE AND FOUNDATION ALLOW NO SHEAR OR BENDING IN THE BOLTS, SO THE PRETENSION, BEING CONSIDERABLY GREATER THAN TENSILE LOADS CAUSED BY ENGINE ROCKING, IS THE GOVERNING FACTOR.

II ENGINE MOUNTING FLANGES: F.S. = 11.23 (P.16)

III FREQUENCIES:

A) ENGINE ROCKING: F_{cr} = 24.6 CPS (P.5)

THID IS VERY CONSERVATIVE BECAUSE IT IS BASED ON FOUNDATION BOLT ELONGATION AND THE PRETENSION SHOULD ALLOW NONE.

B) VERTICAL: F_{cr} = 44 CPS (P.7)

WORTHINGTON CORPORATION

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 2-OME-150-CD Class 17

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ___ (If yes, check items that apply.)

Anchor Type	**Remarks**
Anchor Diameter ✓	
Anchor Spacing ✓	
Anchor Number	Concrete crack noted was reviewed/accepted as insignificant.
Anchor Embedment	
Anchor Edge Distance ✓	
Anchor Gap	Worthington report will be reviewed by S&A.
Anchor Thread Engagement	RK
Anchor Grip	
Anchor Angularity	
Concrete Crack	

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:
NONE

Actions Taken:

Prepared By T. Omanarony Date 9-8-93

ANCHOR INSPECTION DATA SHEET

TWO · Unit #

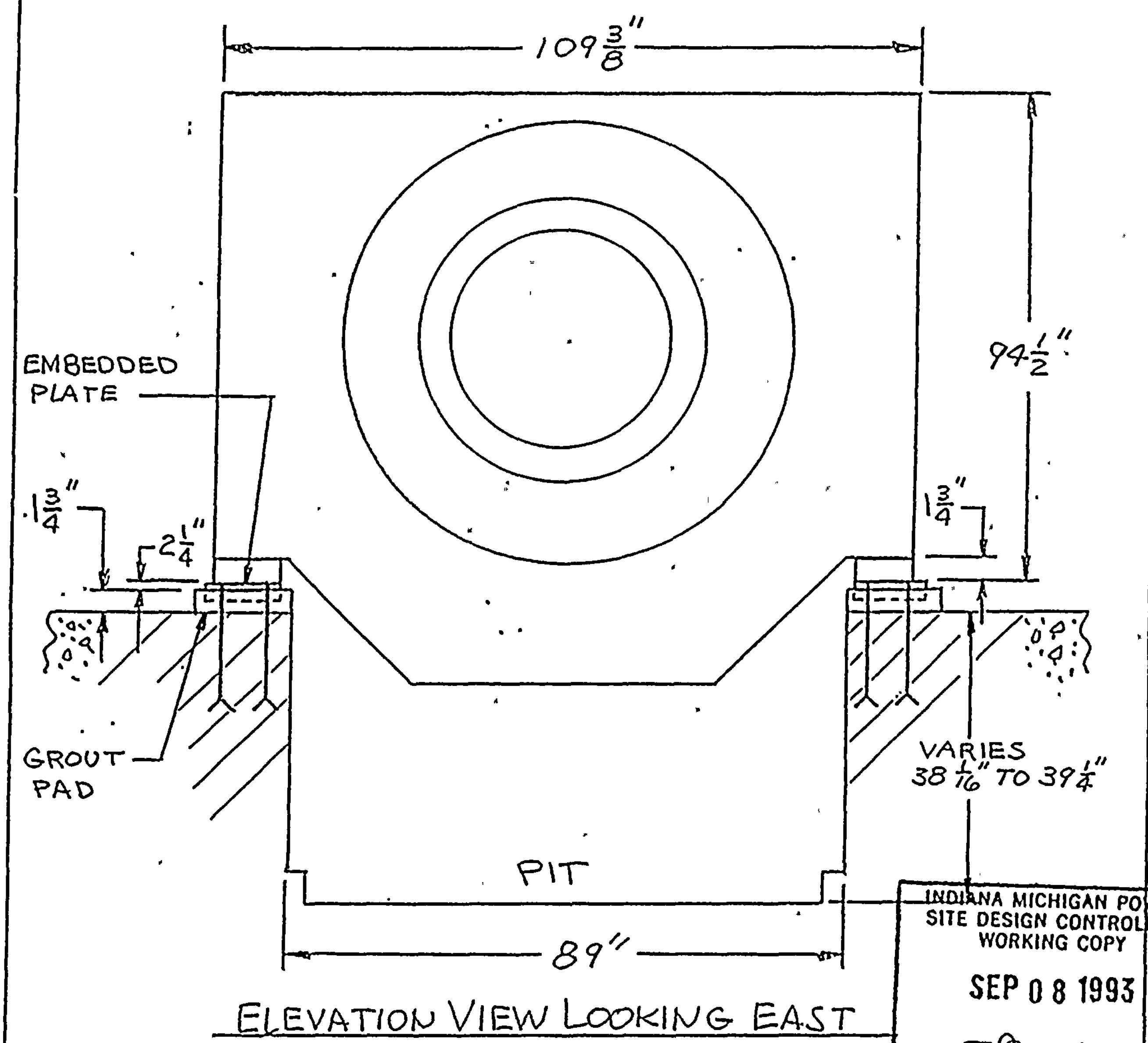
AUX Bldg.

WEST END OF DIESEL ENGINE CD GENERATOR ROOM Location

12-3468-13 Installation dwg. / Rev.

2-OME-150-CD Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 08 1993
CLERK T. Manarary

Drawn by: Garry Malick Date: 9/3/93

Verified by: [signature] Date: 9-7-93
Qual./Cert. Inspector

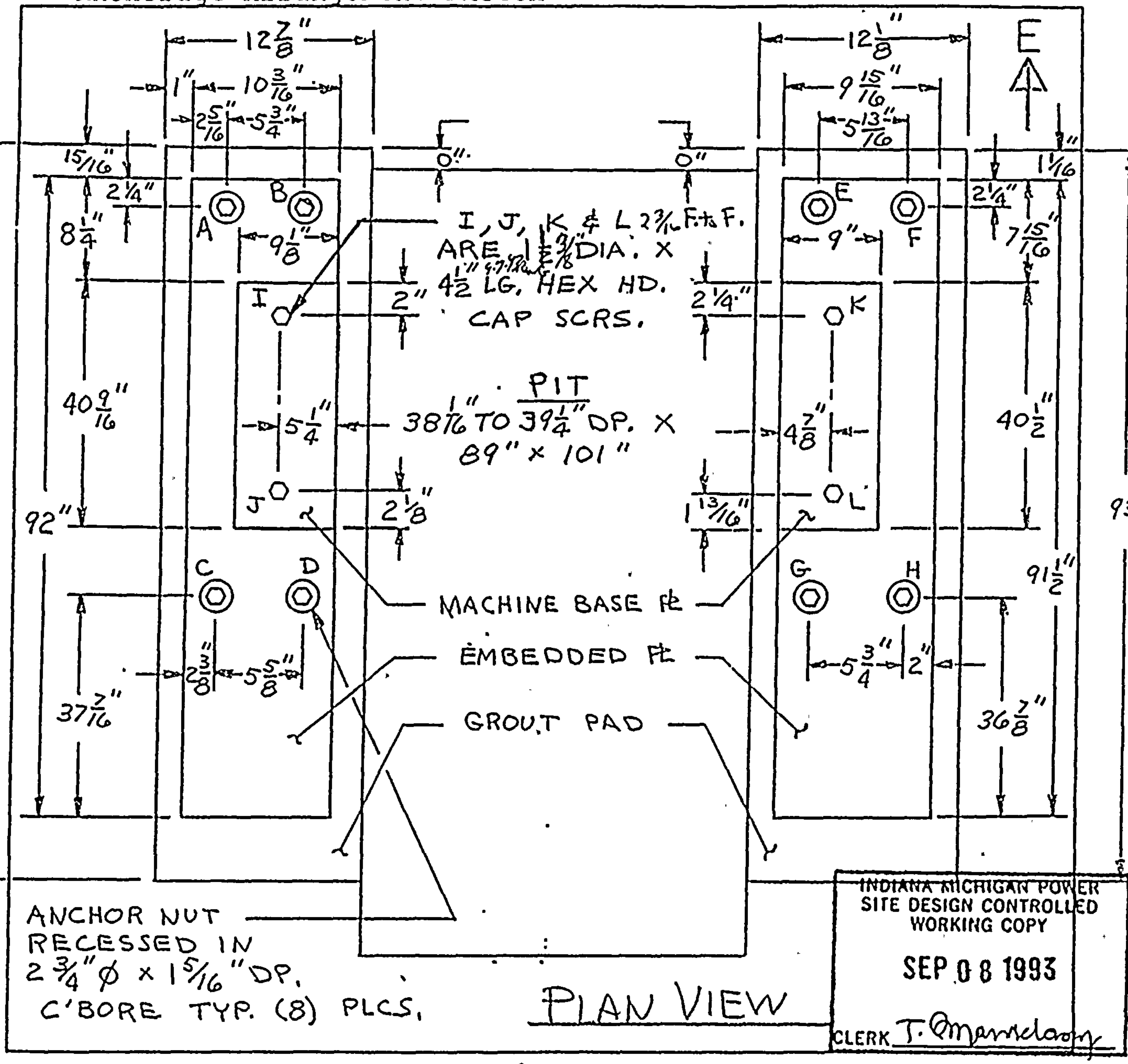
Reviewed by: T. Manarary Date: 9-8-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

TWO	AUX	WEST END OF DIESEL ENGINE CD GENERATOR ROOM
Unit #	Bldg.	Location

12-3468-13	2-OME-150-CD
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
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SEP 08 1993
CLERK T. Mannelaozy

Drawn by:	Garry Malick	Date:	9/3/93
Verified by:	[signature] Qual./Cert. Inspector	Date:	9-7-93
Reviewed by:	T. Mannelaozy Construction Anchor Review Engineer	Date:	9-8-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-OME-150-CD Dwg No.: 12-3468-13
Anchor type: STUD ANCHOR TYPE 12 Dia: 1" Dwg No.: 12-3073A-3
Tightness established by: ☐ "Snug Fit" ☐ Torque
Torque Wrench No.: NA Cal. Due Date:
Tightness verified? ☐ Yes ☒ No T. Omanderson Construction ARE Date: 9-3-93
Equipment base flexible? ☐ Yes ☒ No T. Omanderson Construction ARE Date: 9-3-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D	E	F	G	H	Comments
Gaps	INDET	ERMIN	ABLE	- NU	TS RE	CESSE	D IN	A C'B	ORE
Anchor length	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	PER DWG. #12-3073A-
Protruding length	4 5/16"	4 7/16"	4 5/8"	4 7/16"	4"	4 7/16"	4 1/8"	4 13/16"	
Embedment	5'-1 11/16"	5'-1 9/16"	5'-1 3/8"	5'-1 9/16"	5'-2"	5'-1 9/16"	5'-1 7/8'	5'-1 3/16"	
Bolt grip	2 5/8"	2 11/16"	2 15/16"	2 15/16"	2 5/16"	2 5/16"	2 9/16"	2 9/16"	
Concrete condition	*	OK	*	OK	*	*	OK	OK	
Edge distance	9 3/8"	3 3/4"	9 3/8"	3 5/8"	3 1/4"	9 1/8"	3 1/2"	9 1/4"	
Anchor spacing	5 3/4"	5 3/4"	5 5/8"	5 5/8"	5 13/16"	5 13/16"	5 3/4"	5 3/4"	
Anchor angularity	0°	0°	0°	0°	0°	0°	0°	0°	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: * A CRACK IN FLOOR COATING 18" AWAY.
NO WASHERS PRESENT.

Verified by: CWhalan Date: 9-2-93
Qual./Cert. Inspector

Reviewed by: T. Omanderson Date: 9-8-93
Construction ARE

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 08 1993
CLERK T. Omanderson

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 8/30/93 REQUEST NO. N/A

IDENTIFICATION

Unit: Two
Component: 2-OME-150-CD
Item: Anchors
Material: C/S
Other: Squg

TECHNIQUE

Test Unit/ S/N: KB USK-7S CQC-405
Freq./Diameter: 5 mhz / .250
Reference Standard: QC-30
Couplant/Batch No.: Ultragel II 9088

TEST DATA/REMARKS

Anchors: A, B, C, D, E, F, G, H –
A Back Reflection indicating Anchor Bolt Length was not obtained During this Exam. This would Be Indicative of a J-Bolt Type Anchor

Anchor	Length
I	4 1/2"
J	4 1/2"
K	4 1/2"
L	4 1/2"

PERFORMED BY: [signature] LEVEL: II DATE: 8-30-93
REVIEWED BY: [signature] LEVEL: II DATE: 8/30/93

Database: K:SSEL2C.DBF

Equip Id: 2-A11   Train: NA   Equip Class: 20

Drawing No.: NONE

Function:

System: EQUIPMENT CONTROL AND INDICATION STATIONS

Equip Desc: AUXILIARY RELAY PANEL A11

Building: AUXILIARY   Room: CONTROL ROOM

Elev: 633   Sort: S,_   Notes:

Normal State: Desired State: Power Req'd:

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR   Min/Opt: MIN

Alias No: Power Train:

Comp Served:

MFR:

Model:

Panel:

Elem. Drawing:

Wiring Drawing: 2-92071

Power Source:

Walkdown: F   Relay Eval: N

Comp Type: INSTRUMENT/RELAY RACK

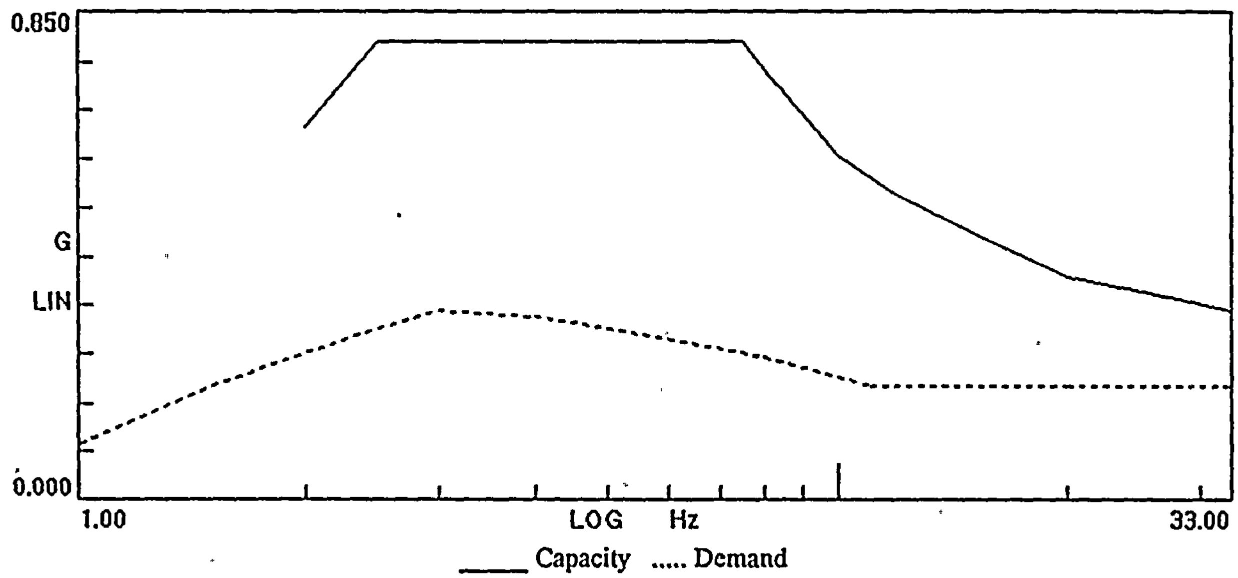
Iso Drawing:

Location: IN THE NORTHEAST CORNER OF THE ROOM

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 8
ID: 2-A11 (Rev. 0)	Class : 20. Instrumentation and Control Panels and Cabinets	
Description : AUXILIARY RELAY PANEL A11		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col :.CONTROL ROOM - IN THE NORTHEAST CORNER OF THE ROOM
Manufacturer, Model, Etc.:		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		633.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)		Yes
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 11.00)		Yes
4.	Capacity based on:	1.00 * Bounding Spectrum	
5.	Demand based on:	1.00 * Design Basis Ground Response Spectrum	



	File	Record
Capacity	H:\GIP\GIP\spectra.des	Label|Bounding Spectrum
Demand 1	H:\GIP\PROJ0059\spectra.des	BUILDING|Ground Spectrum|ELEVATION||BROADEN|
Demand 2	H:\GIP\PROJ0059\spectra.des	BUILDING|Ground Spectrum|ELEVATION||BROADEN|

Does capacity exceed demand? Yes

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 8
ID: 2-A11 (Rev. 0)	Class : 20. Instrumentation and Control Panels and Cabinets	
Description : AUXILIARY RELAY PANEL A11		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : CONTROL ROOM - IN THE NORTHEAST CORNER OF THE ROOM
Manufacturer, Model, Etc.:		

CAVEATS - BOUNDING SPECTRUM

I&C/BS Caveat 1 - Earthquake Experience Equipment Class.	Yes
I&C/BS Caveat 2 - Computers and Programmable Controllers Evaluated Separately.	N/A
I&C/BS Caveat 3 - Strip Chart Recorders Evaluated.	N/A
I&C/BS Caveat 4 - Structural Adequate.	Yes
I&C/BS Caveat 5 - Adjacent Cabinets or Panels Bolted Together.	Yes
I&C/BS Caveat 6 - Drawers or Equipment on Slides Restrained.	N/A
I&C/BS Caveat 7 - Doors Secured.	Yes
I&C/BS Caveat 8 - Sufficient Slack and Flexibility of Attached Lines.	Yes
I&C/BS Caveat 9 - Adequate Anchorage.	Yes
I&C/BS Caveat 10 - Potential Chatter of Essential Relays Evaluated.	Yes
I&C/BS Caveat 11 - No Other Concerns.	Yes

Is the intent of all the caveats met for Bounding Spectrum? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	N/A
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	Yes
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	Yes
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 8
ID: 2-A11 (Rev. 0)	Class : 20. Instrumentation and Control Panels and Cabinets	
Description : AUXILIARY RELAY PANEL A11		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : CONTROL ROOM - IN THE NORTHEAST CORNER OF THE ROOM
Manufacturer, Model, Etc.:		

<u>IS EQUIPMENT SEISMICALLY ADEQUATE?</u> <u>Yes</u>

<u>COMMENTS</u>

Date: 11/1/93
SRT: Satyan Sharma (AEP), Paul Krugh (AEP), Steve Anagnostis (S&A), Randy Steele (AEP - Relay Engineer)

References:
1. Anchorage Package
2. AEPSC USI A-46 Project Report No MT2, Rev 0, "Summary Report of Fundamental Frequencies Determined by In-Situ Transfer Function Modal Testing at Cook Nuclear Plant", Aug 1994.
3. Drawing No 12-3388-3

A11 - 15 form an 10"-2" long x 8' tall x 2' deep control panel. The panel is constructed of welded steel plate, angles, and channels. The panel is welded along the front to embedded steel at 4 points, and along the back at two points. A11 and A13 contain essential relays.

Based on modal test data of similar panels in the control room (Ref 2), the SRT estimates the lower bound fundamental frequency at 11 Hz.

The overhead control room ceiling and raceways have been evaluated as part of the raceway walkdown and judged acceptable - see the control room PASS form for details.

There is a door at the far end of the A6-A15 bank that is commonly left open. The door could strike the panel, but the SRT judges the impact is far enough away from the essential relays not to be significant.

There is a ladder secured against the wall in front of the panel - it is secured so it will not strike the panel - judged acceptable.

There is a fire extinguisher hung on the end of A6 that will bang against the cabinet. The SRT judges that it will not affect the essential relays in A11 and A13.

Anchorage:

1. The anchorage package shows details for 1 of the four front edge weldments - the others are similar.
2. The back edge weldments were not detailed - the SRT added these details to the anchorage package.
3. The SRT conservatively estimates the weight at 300 lbs/ lineal foot.
4. The strength of the weldments is equivalent to at least a 1.5" x 1/8" fillet weld (4 kips per GIP Table C.6-1). The embedded steel is a 5/16" steel plate anchored with a 1/2" x 4" Nelson stud every 12" (4.4 kips per GIP Table C.3-1 including a .65 knockdown for embedment length). The weldment controls. The attached ANCHOR analysis shows a margin of 3.3.

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 8
ID: 2-A11 (Rev. 0)	Class : 20. Instrumentation and Control Panels and Cabinets	
Description : AUXILIARY RELAY PANEL A11		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : CONTROL ROOM - IN THE NORTHEAST CORNER OF THE ROOM
Manufacturer, Model, Etc.:		

Evaluated by: [signature] Date: 8/21/95

R Satyan Sharma 8/30/95

Attachment: ANCHOR Report

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 8
ID: 2-A11 (Rev. 0)	Class : 20. Instrumentation and Control Panels and Cabinets	
Description : AUXILIARY RELAY PANEL A11		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : CONTROL ROOM - IN THE NORTHEAST CORNER OF THE ROOM
Manufacturer, Model, Etc.:		

ANCHOR Report

Earthquake :
Response Spectrum : Instructure Realistic
Frequency : User - 11.00
Percent Damping : User - 5.00

Spectral Values :

Direction	Acceleration (g's)
North - South	0.314
East - West	0.314
Vertical	0.183

Angle (N-S Direction makes with the X Axis) : 0.00
Combination Criteria : SRSS

Weights :
Number of Weights : 1

No	Weight	X	Y	Z
1	3000.00	60.000	0.000	50.000

Forces :
Number of External Forces : 0

Moments :
Number of External Moments : 0

Allowables :
Anchor :
Number of Anchor types : 1

No.	Dia	Manufact	Product	Ultimate Tension	Ultimate Shear	Tension Inter Coeff	Shear Inter Coeff	Saf Fact
1	3/8	Hilti	Kwik-Bolt (N)	1460.00	1420.00	1.00	0.30	1.00

Concrete :
Ultimate Stress : 3500.00 psi.
Reduction Factor : 0.85

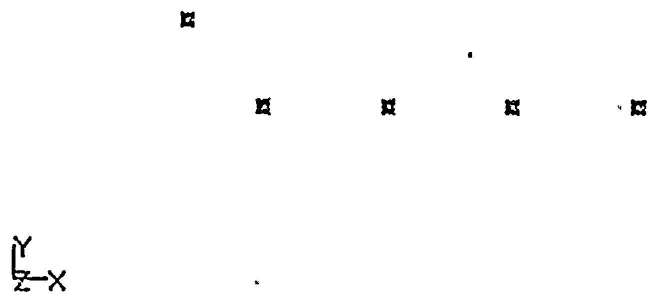
Weld :
Allowable Stress : 30600 psi.

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 8
ID: 2-A11 (Rev. 0)	Class : 20. Instrumentation and Control Panels and Cabinets	
Description : AUXILIARY RELAY PANEL A11		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : CONTROL ROOM - IN THE NORTHEAST CORNER OF THE ROOM
Manufacturer, Model, Etc.:		

Surfaces :
Number of Surfaces : 1
Surface Orientation

	Direction	Direction	Direction
	Comp	Comp	Comp
No	Nx	Ny	Nz
1	0.000	0.000	1.000

Anchor Pattern for Surface # 1



Legend for Anchor Patterns

Anchor Bolts :

Concrete Lines :

Concrete Points :

Weld Lines :

Geometry :
Anchor :
Number of Anchors : 0

Concrete Lines :
# of elements per line : 1

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 7 of 8
ID: 2-A11 (Rev. 0)	Class : 20. Instrumentation and Control Panels and Cabinets	
Description : AUXILIARY RELAY PANEL A11		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : CONTROL ROOM - IN THE NORTHEAST CORNER OF THE ROOM
Manufacturer, Model, Etc.:		

Number of Concrete Lines : 0

Concrete Points :
Number of Concrete Points : 6

	X	Y	Z	Surf	Conc-Pt
No.	Coord	Coord	Coord	Id	Area
1	19.000	2.000	0.000	1	9.000
2	47.000	2.000	0.000	1	9.000
3	75.000	2.000	0.000	1	9.000
4	103.000	2.000	0.000	1	9.000
5	2.000	22.000	0.000	1	9.000
6	118.000	22.000	0.000	1	9.000

Weld Lines :
# of elements per line : 1
Number of Weld Lines : 6

	Start	Start	Start	End	End	End	Sf	Line
No	X-Coord	Y-Coord	Z-Coord	X-Coord	Y-Coord	Z-Coord	Id	Width
1	19.000	2.000	0.000	20.500	2.000	0.000	1	0.125
2	47.000	2.000	0.000	48.500	2.000	0.000	1	0.125
3	75.000	2.000	0.000	76.500	2.000	0.000	1	0.125
4	103.000	2.000	0.000	104.500	2.000	0.000	1	0.125
5	2.000	22.000	0.000	3.500	22.000	0.000	1	0.125
6	118.000	22.000	0.000	119.500	22.000	0.000	1	0.125

Determination of Reduction Factors :

Reduction Factors Data Current : Yes

Analysis Results :
Analysis Performed : Yes

Type of Analysis : Regular

	Spectral Accelerations (G's)			
No	N-S	E-W	Vertical	Safety Factor
1	0.314	0.125	0.073	13.973
2	-0.314	-0.125	-0.073	8.111
3	-0.314	0.125	0.073	13.973
4	0.314	-0.125	-0.073	8.111
5	0.314	-0.125	0.073	8.500
6	-0.314	0.125	-0.073	18.535
7	0.314	0.125	-0.073	18.535
8	-0.314	-0.125	0.073	8.500

D. C. Cook Unit 2 Screening Evaluation Worksheet (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 8 of 8
ID: 2-A11 (Rev. 0)	Class : 20. Instrumentation and Control Panels and Cabinets	
Description : AUXILIARY RELAY PANEL A11		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : CONTROL ROOM - IN THE NORTHEAST CORNER OF THE ROOM
Manufacturer, Model, Etc.:		

9	0.125	0.314	0.073	7.505
10	-0.125	-0.314	-0.073	3.290
11	0.125	-0.314	0.073	3.352
12	-0.125	0.314	-0.073	8.921
13	-0.125	0.314	0.073	7.505
14	0.125	-0.314	-0.073	3.290
15	0.125	0.314	-0.073	8.921
16	-0.125	-0.314	0.073	3.352
17	0.125	0.125	0.183	12.626
18	-0.125	-0.125	-0.183	7.842
19	0.125	0.125	-0.183	37.028
20	-0.125	-0.125	0.183	8.816
21	-0.125	0.125	0.183	12.626
22	0.125	-0.125	-0.183	7.842
23	0.125	-0.125	0.183	8.816
24	-0.125	0.125	-0.183	36.553

Minimum Safety Factor : 3.290

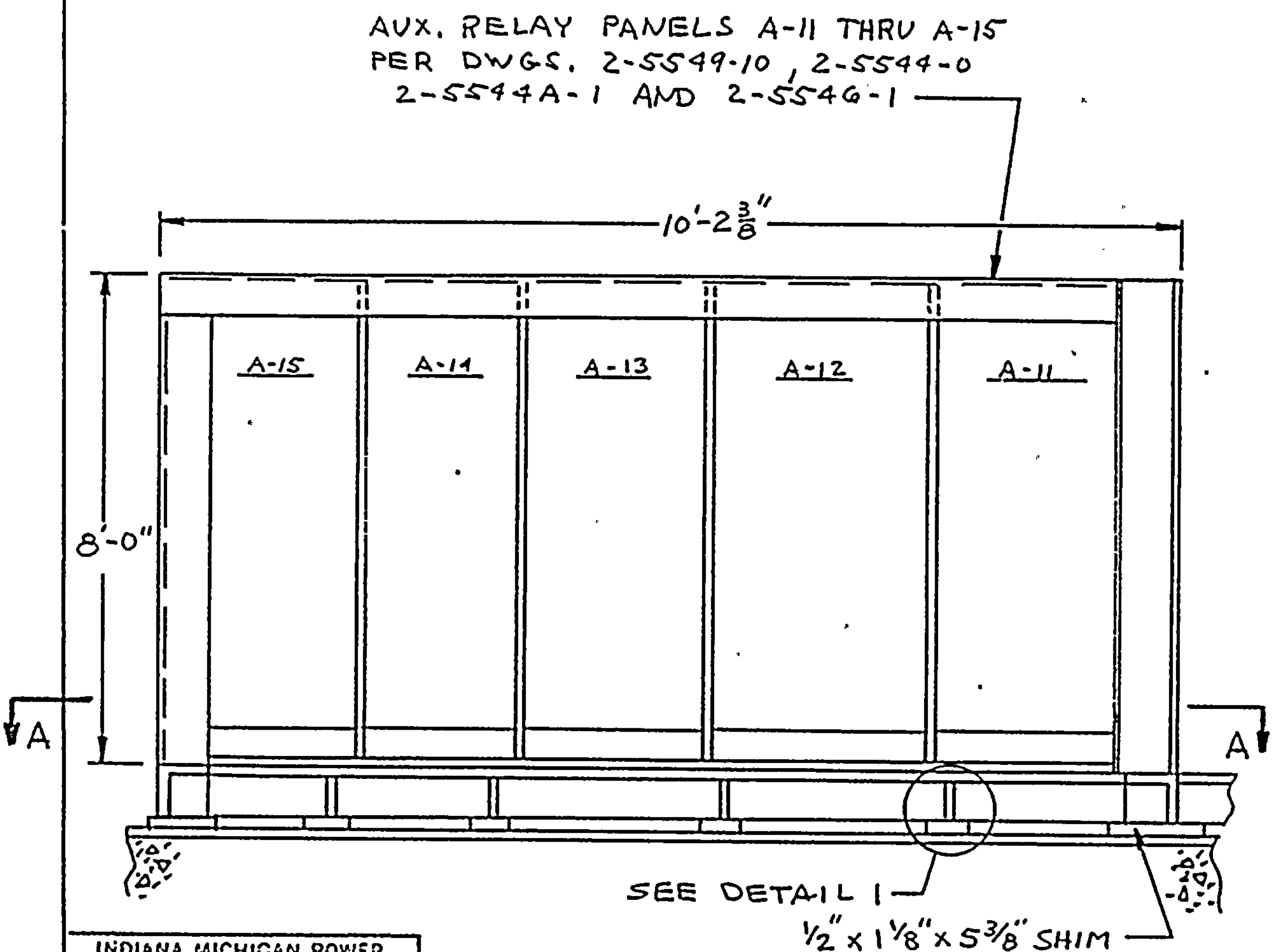
The anchorage can withstand 3.290 times greater seismic demand

ANCHOR INSPECTION DATA SHEET

TWO	AUX 633'	NORTHEAST CORNER OF THE ROOM
Unit #	Bldg.	Location

2-5549-10	2-A11 AND 2-A13
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



ELEV. VIEW LKG. EAST

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 21 1993
CLERK T. Omanorsy

Drawn by: Garry Malick Date: 9/17/93

Verified by: R Whaham Date: 9·20·93
Qual./Cert. Inspector

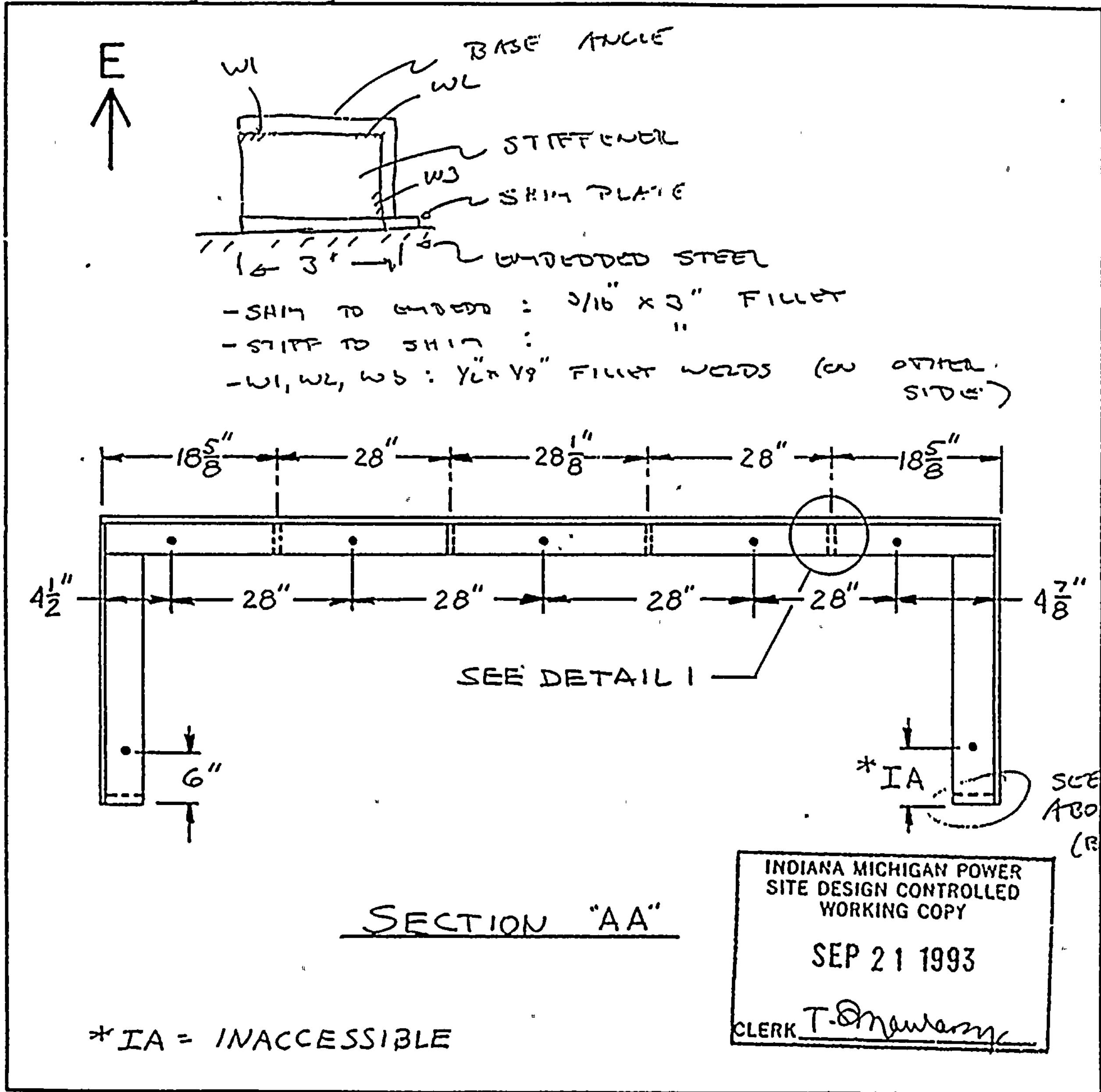
Reviewed by: T. Omanorsy Date: 9-21-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Unit #	Bldg.	Location
TWO	AUX 633'	NORTHEAST CORNER OF THE ROOM

Installation dwg. / Rev.	Equipment No.
2-5549-10	2-A11 AND 2-A13

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 21 1993
CLERK T. Mandarino

Drawn by: Gary McLish Date: 9/17/93

Verified by: [signature] Date: 9-20-93
Qual./Cert. Inspector

Reviewed by: T. Mandarino Date: 9-21-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-A11 AND 2-A13 Dwg No.: 2-5549-10

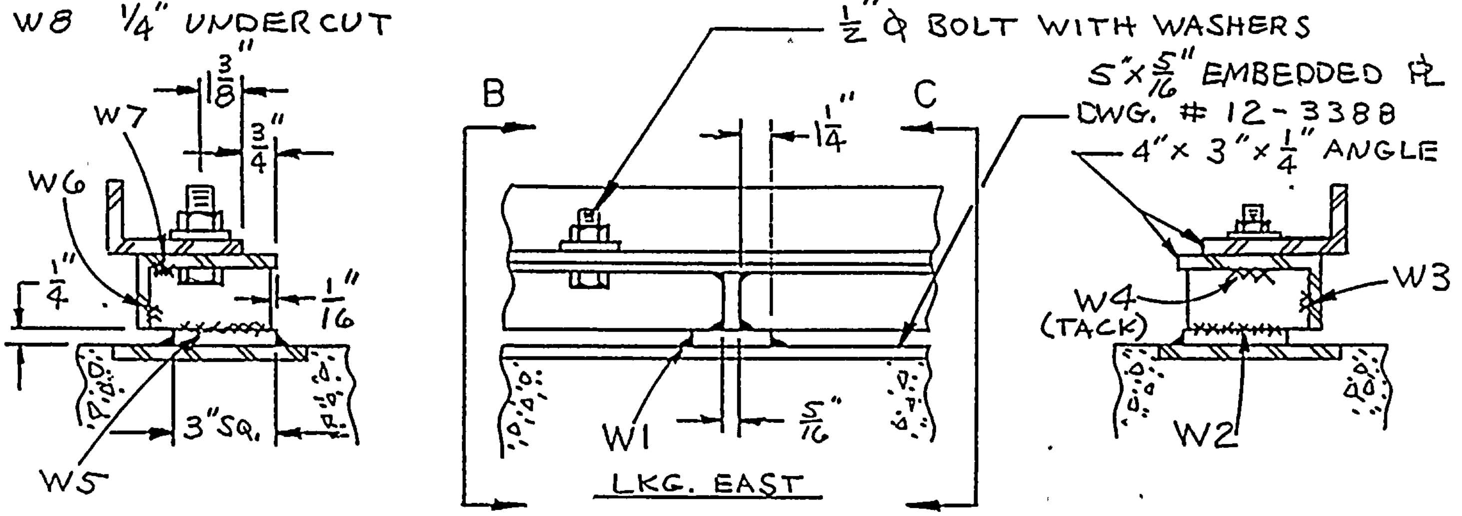
Embedded Steel Dwg. No.: 12-3388

PHYSICAL CHARACTERISTICS

Weld ID	W1	W2	W3	W4	W5	W6	W7	
Type	1	1	1	TACK	1	1	1	
Size	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	
Length	9"	3"	3/4"	3/4"	3"	3/4"	1/2"	
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

W1 IS WELDED ON FOUR SIDES.
W2 1/8" UNDERCUT
W3 1/8" UNDERCUT
W4 1/4" UNDERCUT
W5 1/4" UNDERCUT
W6 1/4" UNDERCUT
W8 1/4" UNDERCUT



SECTION "BB" DETAIL 1 SECTION "CC"

Equipment base flexible: ☐ Yes ☒ No T. [signature] Construction Are Date: 9-17-93

Reviewed by: T. [signature] Construction Anchor Review Engineer Date: 9-21-93

Verified by: [signature] Qual./Cert. Inpsector Date: 9-20-93

INDIANA MICHIGAN POWER
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WORKING COPY
SEP 21 1993
T. [signature]

ATTACHMENT 3 TO AEP:NRC:1040E

SAMPLE SEWS, ANCHORAGE CALCULATIONS, AND
ANCHORAGE INSPECTION DOCUMENTATION
FOR TANKS & HEAT EXCHANGERS EVALUATED
FOR USI A-46 THAT ARE NOT COVERED BY THE
PROCEDURES IN SECTION 7 OF THE GIP
RAI ITEM 5

This attachment includes sample SEWS, anchorage calculations and anchorage inspection documentation for a cross section of class 0 and 21 tanks and heat exchangers that are not covered by the procedures in Section 7 of the GIP. The samples selected are designated with an * in Table 2 and 3 of this RAI. The following examples are included:

Class	ID
0	1-QT-113-AB1
21	1-HE-13
21	1-HE-18E
21	1-HE-34-NE
21	1-TK-11
21	1-TK-37
21	12-TK-47-AB
21	2-HE-11
21	2-HE-38E
21	2-QT-134-CD
21	2-TK-76N

Equip ID: 1-QT-113-AB1 Train: 1 Equip Class:0

Drawing No.: 1-5151A

Function: EMERG DIESEL

System: DIESEL LUBE OIL

Equip Desc: AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1

Building: AUXILIARY Room: AB EMERG DIESEL LUBE OIL PIT

Elev: 579 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: LUBE OIL STRAINER 1

MFR: NUGENT

Model: 1554-4L3B

Panel:

Elem. Drawing: N/A

Wiring Drawing: N/A

Power Source: N/A

Walkdown: A Relay Eval : N

Comp Type: STRAINER

Iso Drawing:

Location:

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		587.00
2.	Elevation of seismic input below about 40' from grade (grade = 608.00)		N/A
3.	Equipment has fundamental frequency above about 8 Hz (est. frequency = 8.00)		N/A
4.	Capacity based on:	Judgment	
5.	Demand based on:	1.00 * Realistic Mean-Centered Floor Response Spectra	

	File	Record
Capacity		
Demand 1	C:\GIP\PROJ0031\spectra.des	BUILDING|Auxiliary|ELEVATION|587|BROADEN|N
Demand 2	C:\GIP\PROJ0031\spectra.des	BUILDING|Auxiliary|ELEVATION|587|BROADEN|N

Does capacity exceed demand? Yes

ANCHORAGE

1. The sizes and locations of anchors have been determined.	Yes
2. Appropriate equipment characteristics have been determined (mass, CG, natural freq., damping, center of rotation).	Yes
3. The type of anchorage is covered by the GIP.	Yes
4. The adequacy of the anchorage installation has been evaluated (weld quality and length, nuts and washers, expansion anchor tightness, etc.)	Yes
5. Factors affecting anchorage capacity or margin of safety have been considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking.	Yes
6. For bolted anchorages, any gaps under the base are less than 1/4 .	Yes
7. Factors affecting essential relays have been considered: gaps under the base, capacity reduction for expansion anchors.	N/A
8. The base has adequate stiffness and the effect of prying action on anchors has been considered.	Yes
9. The strength of the equipment base and the load path to the CG is adequate.	Yes
10. The adequacy of embedded steel, grout pads or large concrete pads have been evaluated.	Yes
11. The anchorage capacity exceeds the demand.	Yes

Are anchorage requirements met? Yes

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

INTERACTION EFFECTS

1. Soft targets are free from impact by nearby equipment or structures.	Yes
2. If the equipment contains sensitive relays, it is free from all impact by nearby equipment or structures.	N/A
3. Attached lines have adequate flexibility.	Yes
4. Overhead equipment or distribution systems are not likely to collapse.	Yes
5. No other adverse concerns were found.	Yes

Is equipment free of interaction effects? Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Tom Huang (AEP) and George Gary Thomas (S&A) on 10/6/93

REF: 1. Anchor Inspection Data Sheets: Anchorage Arrangement Sketches and Physical Characteristics Data Sheet, Certified 6/16/92 for both 1-QT-113-AB1 and 1-QT-113-AB2.
2. Dwg # 10-089
3. Worthington Co. Full Flow Oil Lube Strainer Calculation, 8/26/74.

MFG: NUGENT, WM W&Co - 1554-4-L3B-DN-100

Seismic Capacity vs Demand: The Bounding Spectrum does not apply for Class 0 items. This component is seismically rugged based on SRT judgement and inspection, and anchor analysis.

Anchorage:
Supported on 4 angle legs. Each leg is anchored by one 1/2" J-bolt anchor. The ANCHOR analysis was performed for 1-QT-113-AB1 and 1-QT-113-AB2 together, since they are connected by a relatively rigid piping segment.

Frequency was judged to be greater than 8 Hz.

The total weight is 1730#, with the CG located at an approx. mid-height = 33" (Ref. 2).

The minimum embedment of the 1/2" J-bolts for 1-QT-113-AB1 and 1-QT-113-AB2 is 9.125" and was used for the embedment reduction factor for the J-bolts.

The SRT also judged the bolts may be subject to prying. therefore a very conservative .5 reduction factor was applied for prying.

ANCHOR analysis includes nozzle loads as specified in Ref. 3, Sheet 15. Conservatively assume that the inlet and outlet nozzle loads are distributed between the two strainers, 1-QT-113-AB1 and AB2, because of the way they are joined (see Ref. 2). Therefore the nozzle loads modeled in the ANCHOR analysis are the absolute values of

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

the larger of the two loads specified in Ref. 3, Sheet 15. The way the loads are defined in Ref. 3, they correspond to the x,y,z coordinate system as follows: c=x, a=y, and b=z.

The ANCHOR analysis even with the highest nozzle loads and anchorage reduction factors, shows a high margin of safety (2.5).

Zap Shot, Wk 1, Tm 2, Disk 1, Picture 45

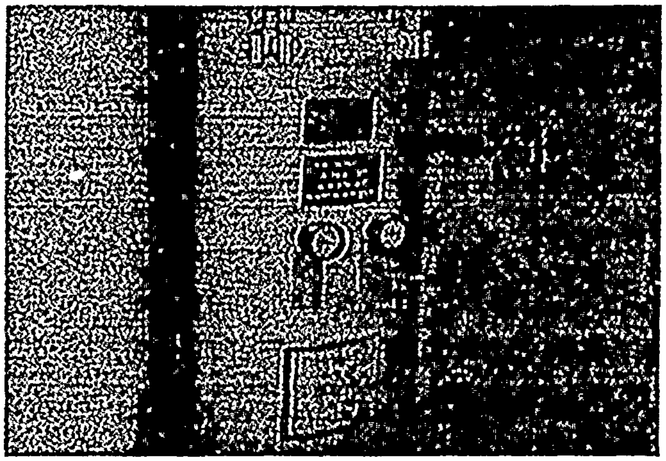
Evaluated by: George D. Diaz — Date: 11/21/95

N Clee Huang — 12-8-95

Attachment: Pictures
Attachment: ANCHOR Report

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

PICTURES



AB Emerg Diesel Full Flow Lube Oil Strainer 1, 1-QT-113-AB!

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

ANCHOR Report

Earthquake :
Response Spectrum : Instructure Realistic
Frequency : User - 8.00
Percent Damping : User - 5.00

Spectral Values :

Direction	Acceleration (g's)
North - South	0.32
East - West	0.32
Vertical	0.17

Angle (N-S Direction makes with the X Axis) : 0.00
Combination Criteria : SRSS

Weights :
Number of Weights : 2

No	Weight	X	Y	Z
1	1730.00	22.875	0.000	33.000
2	1730.00	-22.875	1.000	33.000

Forces :
Number of External Forces : 2

No	Fx	Fy	Fz	X	Y	Z
1	1.23E+002	1.23E+002	7.03E+002	0.000	12.000	24.000
2	3.31E+002	4.02E+002	6.24E+002	0.000	-12.000	24.000

Moments :
Number of External Moments : 2

No	Mx	My	Mz
1	8.64E+003	-1.86E+004	6.86E+003
2	3.98E+003	-8.52E+002	2.54E+003

Allowables :
Anchor :
Number of Anchor types : 1

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

No.	Dia	Manufact	Product	Ultimate Tension	Ultimate Shear	Tension Inter Coeff	Shear Inter Coeff	Saf Fact
1	1/2	Other	J-Bolt (90 deg)	6660.00	3330.00	1.00	0.30	1.00

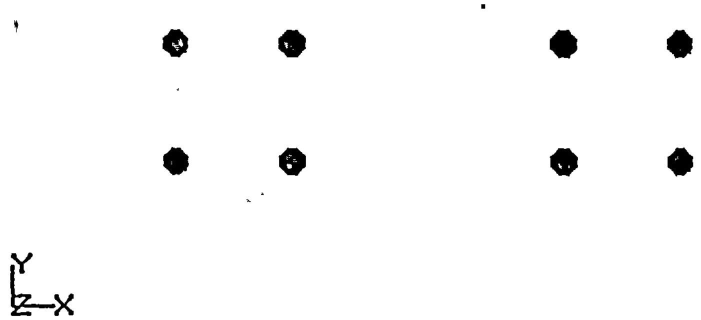
Concrete :
Ultimate Stress : 3500.00 psi.
Reduction Factor : 0.85

Weld :
Allowable Stress : 30600 psi.

Surfaces :
Number of Surfaces : 1
Surface Orientation

No	Direction Comp Nx	Direction Comp Ny	Direction Comp Nz
1	0.000	0.000	1.000

Anchor Pattern for Surface # 1



Legend for Anchor Patterns

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 7 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

Anchor Bolts :

Concrete Lines :

Concrete Points :

Weld Lines :

Geometry :

Anchor :

Number of Anchors : 8

No.	Anch Id	X Coord	Y Coord	Z Coord	Surf Id
1	1	-30.719	-7.250	0.000	1
2	1	-16.531	-7.250	0.000	1
3	1	-30.719	7.250	0.000	1
4	1	-16.531	7.250	0.000	1
5	1	30.719	-7.250	0.000	1
6	1	16.531	-7.250	0.000	1
7	1	30.719	7.250	0.000	1
8	1	16.531	7.250	0.000	1

Concrete Lines :

# of elements per line : 4

Number of Concrete Lines : 0

Concrete Points :

Number of Concrete Points : 8

No.	X Coord	Y Coord	Z Coord	Surf Id	Conc-Pt Area
1	-30.719	-7.250	0.000	1	4.000
2	-16.531	-7.250	0.000	1	4.000
3	-30.719	7.250	0.000	1	4.000
4	-16.531	7.250	0.000	1	4.000
5	30.719	-7.250	0.000	1	4.000
6	16.531	-7.250	0.000	1	4.000
7	30.719	7.250	0.000	1	4.000
8	16.531	7.250	0.000	1	4.000

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 8 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

Weld Lines :
# of elements per line : 4
Number of Weld Lines : 0

Determination of Reduction Factors :
Reduction Factor Input for Anchor # 1

Adequately Installed : Yes
Embedment Length : (27.25 in. Min Reqd. to achieve full capacity) := 9.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.000 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 2

Adequately Installed : Yes
Embedment Length : (27.25 in. Min Reqd. to achieve full capacity) := 9.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.000 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 3

Adequately Installed : Yes
Embedment Length : (27.25 in. Min Reqd. to achieve full capacity) := 9.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.000 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 4

Adequately Installed : Yes
Embedment Length : (27.25 in. Min Reqd. to achieve full capacity) := 9.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.000 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 9 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 5

Adequately Installed : Yes
Embedment Length : (27.25 in. Min Reqd. to achieve full capacity) := 9.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.000 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 6

Adequately Installed : Yes
Embedment Length : (27.25 in. Min Reqd. to achieve full capacity) := 9.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.000 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 7

Adequately Installed : Yes
Embedment Length : (27.25 in. Min Reqd. to achieve full capacity) := 9.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.000 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 8

Adequately Installed : Yes
Embedment Length : (27.25 in. Min Reqd. to achieve full capacity) := 9.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 4.38 in.
Crack Size : 0.000 in. - Cracks traverses thru Installation
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)	GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 10 of 11

ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER, 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

Reduction Factors Data Current : Yes

No	Anc Id	Pall/ Vall	Pallr/ Vallr	RT	RN	RL	RG	RS	RE	RF	RC	RR	RP	RB	RM
1	1	1398.60	N/A	1.00	1.00	0.42	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
		3330.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1	1398.60	N/A	1.00	1.00	0.42	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
		3330.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	1	1398.60	N/A	1.00	1.00	0.42	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
		3330.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1	1398.60	N/A	1.00	1.00	0.42	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
		3330.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1	1398.60	N/A	1.00	1.00	0.42	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
		3330.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1	1398.60	N/A	1.00	1.00	0.42	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
		3330.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1	1398.60	N/A	1.00	1.00	0.42	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
		3330.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1	1398.60	N/A	1.00	1.00	0.42	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
		3330.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Legend :

N/A	= Not Applicable
Pall	= Allowable Pull without Reduced Inspection
Vall	= Allowable Shear without Reduced Inspection
Pallr	= Allowable Pull with Reduced Inspection
Vallr	= Allowable Shear with Reduced Inspection
*	= Outlier
X	= Reduction Factor Not Used
RT	= Reduction Factor for Type of Anchorage
RN	= Reduction Factor for Installation Adequacy
RL	= Reduction Factor for Embedment
RG	= Reduction Factor for Gap at Anchors
RS	= Reduction Factor for Spacing
RE	= Reduction Factor for Edge Distance
RF	= Reduction Factor for Concrete Strength
RC	= Reduction Factor for Concrete Cracks
RR	= Reduction Factor for Essential Relays
RP	= Reduction Factor for Base Stiffness and Prying Action
RB	= Reduction Factor for Base Strength and Load Path
RM	= Reduction Factor for Embed. Steel and Pads

Analysis Results :

Analysis Performed : Yes

Type of Analysis : Regular

	Spectral Accelerations (G's)	

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 11 of 11
ID : 1-QT-113-AB1 (Rev. 0)	Class : 0. Other	
Description : AB EMERG DIESEL FULL FLOW LUBE OIL STRAINER 1		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : AB EDG LUBE OIL PIT,
Manufacturer, Model, Etc. : NUGENT 1554-4L3B		

No	N-S	E-W	Vertical	Safety Factor
1	0.325	0.130	0.067	5.843
2	-0.325	-0.130	-0.067	7.456
3	-0.325	0.130	0.067	5.843
4	0.325	-0.130	-0.067	7.456
5	0.325	-0.130	0.067	5.853
6	-0.325	0.130	-0.067	7.213
7	0.325	0.130	-0.067	7.213
8	-0.325	-0.130	0.067	5.853
9	0.130	0.325	0.067	2.478
10	-0.130	-0.325	-0.067	2.756
11	0.130	-0.325	0.067	2.503
12	-0.130	0.325	-0.067	2.695
13	-0.130	0.325	0.067	2.478
14	0.130	-0.325	-0.067	2.756
15	0.130	0.325	-0.067	2.695
16	-0.130	-0.325	0.067	2.503
17	0.130	0.130	0.167	5.114
18	-0.130	-0.130	-0.167	9.385
19	0.130	0.130	-0.167	8.752
20	-0.130	-0.130	0.167	5.040
21	-0.130	0.130	0.167	5.114
22	0.130	-0.130	-0.167	9.385
23	0.130	-0.130	0.167	5.040
24	-0.130	0.130	-0.167	8.752

Minimum Safety Factor : 2.478

The Anchorage Capacity is 2.478 times greater than the Demand

CE 81A

CALCU.

SUBJECT FULL FLOW L.O. STRAINER

GROUP C-10

TYPE DRG. No.

Sheet 0 of Shts.

CAL. BY A.L.M. CK. APP. D.O.

Date 9/13/74

WORTHINGTON CORPORATION

Calculations

SUBJECT: Full Flow Lube Oil Strainer

JOB NUMBER P2519.01
FILE NUMBER C-10
SHEET 1 OF
BY A L Mc E DATE 22/5/
APP DATE

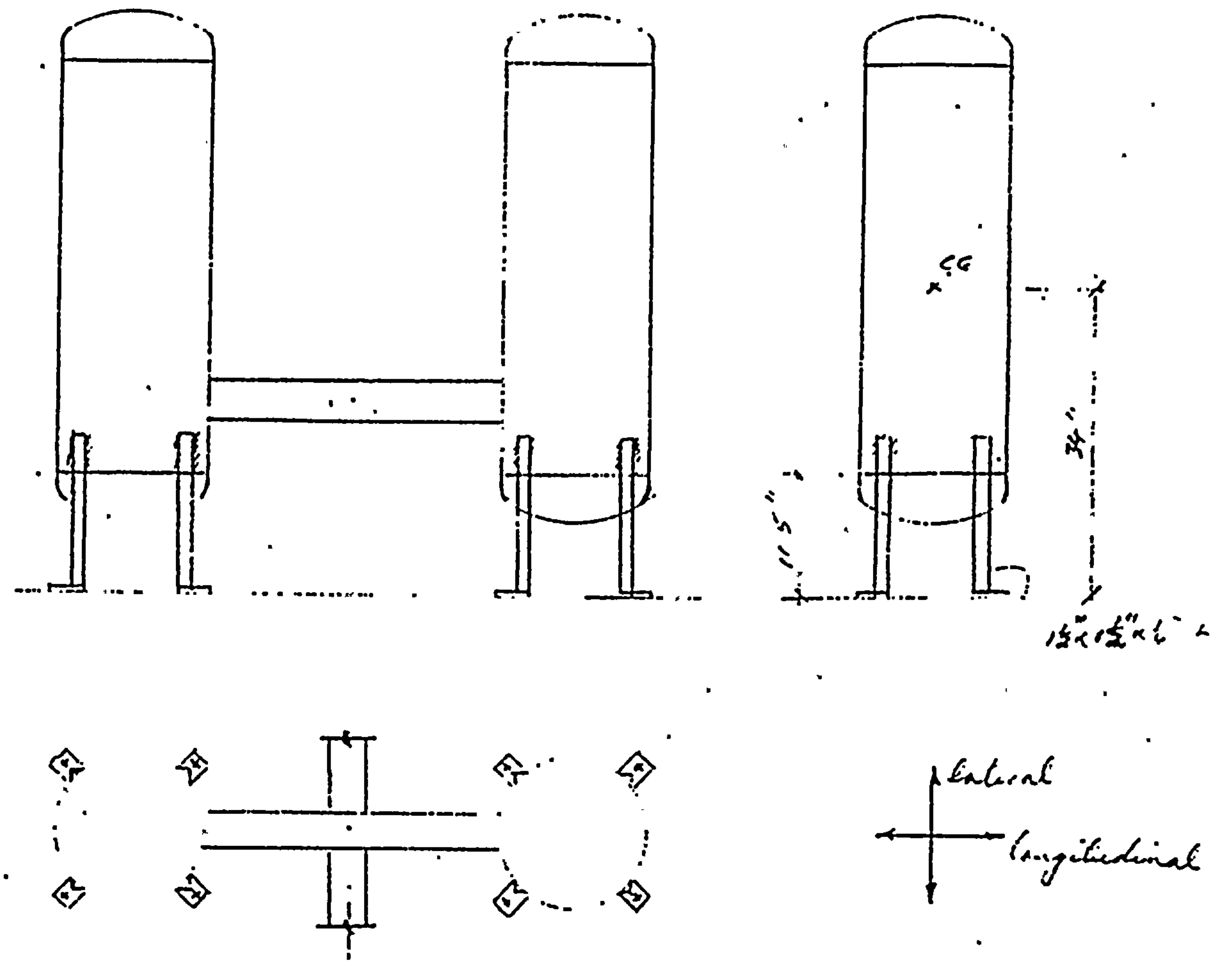


Fig 1

FORM NO. REV. 1

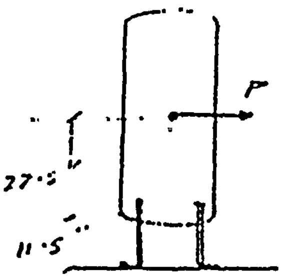
Calculations

SUBJECT:

JOB NUMBER P2519.01
FILE NUMBER C-10
SHEET 2 OF
BY ACM DATE 22/8/74
APP DATE

The pipe system connecting the two tanks provides increased stiffness against longitudinal motion as compared with lateral motion. The frequency of vibration in the longitudinal direction will consequently be greater resulting in lesser seismic stresses in the present instance. Hence motion in the lateral direction will be considered critical.

A preliminary analysis showed that the frequency of vibration was greater than 33 Hz (the value that leads to max. response). Therefore any assumptions which tend to decrease the calculated value of the frequency to a value not less than 33 Hz will be conservative.



Consider a force P applied at the assumed c.g. of the tank system. (c.g. assumed 34" above base which is conservative.)

Supporting legs are assumed fixed to the tank and pinned to the base plates. Allowance will be made for the base plates lifting off the foundation.

The deflection and slope at the c.g. is made up of the following components

(i) Bending of the tank
(ii) axial deformation of the legs
(iii) Bending deformation of the legs
(iv) uplift of the leg base plates

FORM NO. REV. 1

ACRES **Calculations** SUBJECT:	JOB NUMBER P2519.01
	FILE NUMBER C-10
	SHEET 3 OF
	BY A.C.M DATE 22/2/74
	APP DATE

Section properties

(i) Tank

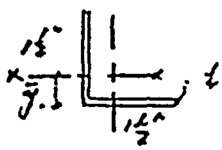
$I = \frac{\pi}{64}(16^4 - 15.625^4) = 291 \text{ in}^4$ — Vendors information, tank full

$M = \frac{1}{2}$ mass of 2 tanks + valve $= \frac{1}{2}\left(\frac{1730}{g}\right) = \frac{865}{g}$

∴ J_M = mass moment of inertia $= M\left[\frac{L^2}{12} + \frac{d^2}{16}\right] = \frac{865}{g}\left[\frac{57^2}{12} + \frac{16^2}{16}\right]$

$= 306 \times \frac{865}{g}$

(ii) Legs



$\frac{3}{2} \times \frac{1}{4} = \frac{3}{8} \times \frac{3}{4} = \frac{9}{32} \times \frac{3}{4} = \frac{27}{128} \to \frac{9}{128}$

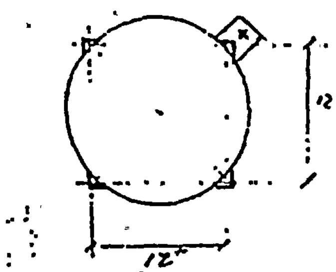
$\frac{5}{4} \times \frac{1}{4} = \frac{5}{16} \times \frac{1}{8} = \frac{5}{128} \times \frac{1}{4} = \frac{5}{1024} + \frac{5}{3 \times 1024}$

$\frac{11}{16} \quad \frac{41}{128} \quad \frac{296.6}{1024}$

$A\bar{y}^2 = -\frac{41}{128} \times \frac{41}{88}$

$A = .6875 \text{ in}^2$ ∴ $I_L = .1385 \text{ in}^4$

$\bar{y} = \frac{41}{128} \cdot \frac{16}{11} = .466''$



12" ~ actually 12.06" between centroids of legs but call it 12" for easy calculation

$I_{group} = 4(.1385 + .6875 \times 6^2) = 99.6 \text{ in}^4$

Calculations	JOB NUMBER P2519.01
SUBJECT: NORTHINGTON LUBE OIL STRAINER	FILE NUMBER
	SHEET 3a OF
	BY L. Newton DATE Sept 1984
	APP DATE

GOING TO P3 OF ALM'' CALCULATIONS

SECTION PROPERTIES.

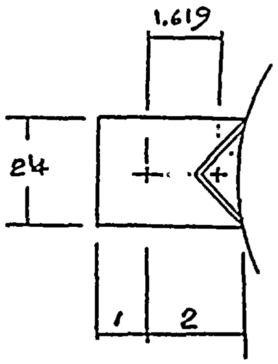
(i) TANK $I = 291 \text{ in}^4$ $J_M = 3067\ 865$ 9

(ii) LEGS $A = .6875$ $I = .1365$

$I_{group} = 99.6 \text{ in}^4$

(iii) BASEPLATES $I_{bp} = \frac{1}{12} \times 2.25 \times .5^3 = \underline{.02344 \text{ in}^4}$

= WAS .357 (was .00293)



The base plate is taken $\frac{1}{2}$" thick.

FORM NO. 162 REV. 1

ACRES	**Calculations** SUBJECT: WORTHINGTON LUBE OIL STRAINER	JOB NUMBER P2519.01 FILE NUMBER ____ SHEET 4 OF ____ BY L. Nauta DATE Sept 11/79 APP ____ DATE ____

NATURAL FREQUENCY OF TANK

DEFLECTION

$$\Delta = \frac{P}{E}\Big[\frac{22.5^3}{3\times291}$$ TANK

$$+ \frac{1}{99.6}\left(\frac{11.5^3}{3} + 11.5^2\times22.5 + 11.5\times22.5^2\right)$$ LEGS AXIAL

$$+ \frac{1}{.1385\times4}\times\frac{11.5^3}{3}$$ LEGS BENDING

$$+ \frac{34}{2\times12}\times\frac{1.619^3}{3\times.02344}\times\frac{34}{12}\Big]$$ BASE UPLIFT

$$= \frac{P}{E}\left[13.1 + 93.4 + 916 + 242\right]$$

$$\Delta = \frac{P}{E}\ 1264$$

SLOPE:

$$\theta = \frac{P}{E}\Big[\frac{22.5^2}{2\times291}$$ TANK

$$+ \frac{1}{99.6}\left(\frac{11.5^2}{2} + 11.5\times22.5\right)$$ LEGS AXIAL

$$+ \frac{34}{2\times12}\times\frac{1.619^3}{3\times.02344}\times\frac{1}{12}\Big]$$ BASE UPLIFT

$$= \frac{P}{E}\left[.87 + 3.26 + 7.12\right]$$

$$= \frac{P}{E}\times11.25$$

POTENTIAL ENERGY OF DEFORMATION $= \frac{1}{2}\frac{P^2}{E}\times1264$

KINETIC ENERGY OF MASSES $= \frac{1}{2}\omega^2\left\{\frac{W}{g}\frac{P^2}{E^2}\times1264^2 + 306\frac{W}{g}\times\frac{P^2}{E^2}\times11.25^2\right\}$

$$\omega^2 = \frac{gE}{W}\ \frac{1264}{(1264^2 + 306\times11.25^2)} = \frac{386\times30\times10^6}{865}\times\frac{1}{1294.6}$$

$$\omega^2 = 10340$$

$$\omega = 101.7$$

$$f = 16.2\ Hz$$

FORM NO. 152 REV. 1

Calculations

SUBJECT:

JOB NUMBER P2519.07
FILE NUMBER C-10
SHEET 5 OF
BY ALM DATE 22/6/79
APP DATE

from response spectra curve : Cook Diesel Generator Building , floor el 609 . design basis earthquake

acceleration = 0.3g for 1/2% damping

Horiz. seismic force on whole tank system = $1730 \times 0.3 = 519$ #

Overturning moment at base $= \left(519 \times 34 + 206 \times 519 \times \frac{15.23}{1400}\right)\frac{1}{12}$

$\qquad\qquad M_H \qquad M_B$

$= 1471 + 144 = 1615$ #ft

Vertical seismic force $= \frac{2}{3} \times 519 = 346$ #

<u>Individual leg forces</u> seismic force in lateral direction

Longitudinal direction. 0

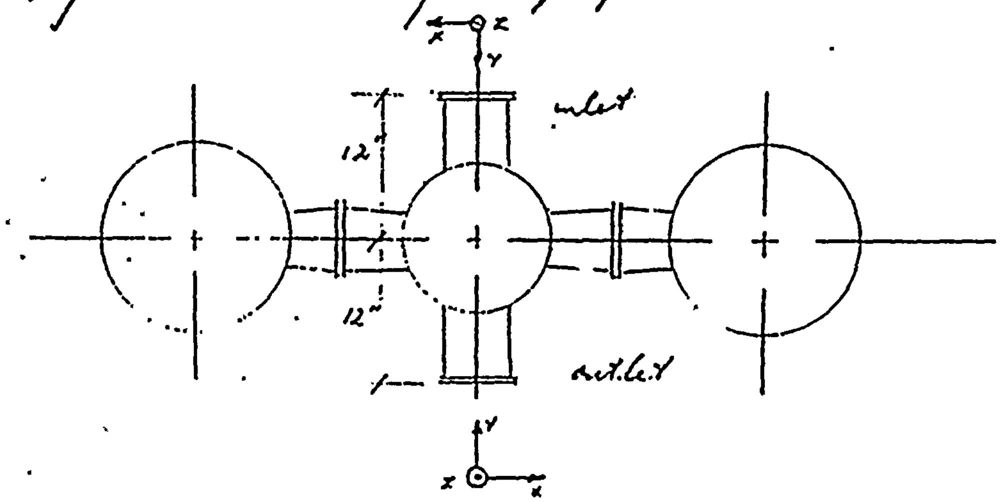
Lateral direction. $\pm \frac{519}{8} = \pm 65$ #

vertical direction $\pm\left(\frac{346}{8} + \frac{1615}{4 \times 11}\right) = \pm 447$ #

Calculations	JOB NUMBER 92519.01
SUBJECT:	FILE NUMBER C-10
	SHEET 6 OF
	BY ALM DATE 24/9/74
	APP DATE

Nozzle Loads.

These values extracted from data supplied by EDS as of 14/8/74



	Inlet +	Inlet −	Outlet +	Outlet −	
F_x	123	376	331	25	#
F_y	123	129	402	13	#
F_z	410	703	0	624	#
M_x	441	720	210	352	# ft
M_y	527	1547	770	71	# ft
M_z	572	262	212	2	# ft

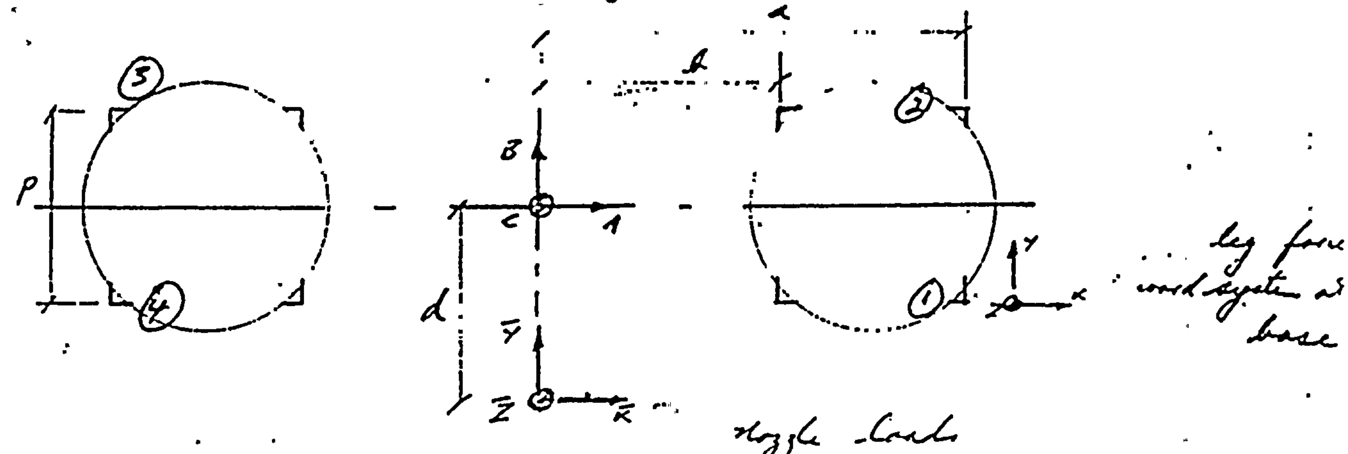
FORM NO REV. 1

ACRES **Calculations**

SUBJECT:

JOB NUMBER P2519-01
FILE NUMBER C-10
SHEET 7 OF
BY ALH DATE 24/8/?
APP DATE

Leg forces due to nozzle loads



$a = 2.47'$ $\quad$ h = ht of nozzle above base $= 23\frac{15}{16}"$ $= 2'$ say

$b = 1.47'$ $\quad$ $\bar{l}$ = ht of legs $= 11.5" = .96'$

$p = 1'$

$d = 1'$

When calculating leg forces due to nozzle loads, the nozzle loads are first transferred to the system of axes ABC.

$F_A = F_{\bar{x}}$

$F_B = F_{\bar{y}}$

$F_C = F_{\bar{z}}$

$M_A = M_{\bar{x}} - F_{\bar{z}}\, d$

$M_B = M_{\bar{y}}$

$M_C = M_{\bar{z}} + F_{\bar{x}}\, d$

Similar expressions may be written for the other nozzle loads.

The leg forces arising due to moments about the A, B + C axes are considered to be in proportion to their distance from the origin of ABC (this is the conventional bending assumption). This causes the largest forces to occur in the

FORM NO. 162 REV. 1

Calculations

SUBJECT:

JOB NUMBER F2519.01
FILE NUMBER C-10
SHEET 9 OF
BY ALM DATE 24/12/74
APP DATE

legs marked ① . ② . ③ & ④ and only these legs will be examined for critical stresses. The assumption that leg forces are proportional to distances from the origin is conservative since any flexibility in the pipe system between the tanks will tend to even out the forces amongst the legs.

For moment about the z axis it is assumed that the pipe has no torsional stiffness. This is a conservative assumption as any stiffness in the pipe will tend to reduce the critical force in the legs.

Forces at leg ①

x · direc $\quad -\frac{F_x}{8} - \frac{1}{U}\left(M_z + F_x . d\right) = -F_x\left(\frac{1}{8} + \frac{d}{U}\right) - \frac{M_z}{U}$

y · direc $\quad -\frac{F_y}{8} - \frac{1}{V}\left(M_z + F_x d\right) = -\frac{F_y}{8} - \frac{F_x d}{V} - \frac{M_z}{V}$

z · direc $\quad +\frac{F_x h}{S} - \frac{F_z d}{T} - \frac{F_y h}{4p} - \frac{F_z}{8} - \frac{F_z d}{4p}$

$$+ \frac{M_x}{4p} + \frac{M_y}{S} - \frac{M_z}{T}$$

where $\frac{1}{U} = \frac{p}{8(a^2+b^2+p_2^2)} = .0143 \ ft^{-1} \qquad d = 1'$

$\frac{1}{V} = \frac{a}{4(a^2+b^2+p_2^2)} = .0705 \ ft^{-1}$

$\frac{1}{S} = \frac{a}{4(a^2+b^2)} = .07475 \ ft^{-1}$

$\frac{1}{T} = \frac{a}{2(a^2+b^2+p_2^2)} \ \frac{I}{p} = .1353 \ ft^{-1}$

The forces in legs ②, ③, ④ are made up of similar terms but with different signs.

The following table indicates the leg forces due to the applied nozzle loads.

FORM REV. 1

AGRES

Calculations

SUBJECT: NORTHINGTON

FORCES AT BASE OF LEGS

JOB NUMBER P0619.01
FILE NUMBER
SHEET 9A OF
BY L. Norton DATE Sept 1/94
APP DATE

LEG No 1

	x DIRECTION				Y DIRECTION				Z DIRECTION			
LOADED AT	INLET		OUTLET		INLET		OUTLET		INLET		OUTLET	
	+	-	+	-	+	-	+	-	+	-	+	-
F_A	13.6	-41.6	-46.1	3.5	-8.7	26.5	-23.4	1.8	-35.0	107.0	4.7	-0.3
F_B					15.4	-16.1	-54.3	1.6	39.8	-32.2	-100.5	3.2
F_C									51.2	-87.9	0.0	234.0
H_A									-110.2	180.0	52.5	-83.0
H_B									-39.4	115.5	57.5	-5.3
M_C	-8.2	3.7	-3.0	0.0	-40.3	18.5	-14.9	0.1	-77.5	35.4	-28.6	0.3

STRESS COMBINATIONS

	x	Y	Z
MAX x	-98.9 (max)	-118.5	-452.9
MAX Y	-42.7	-153.7 (max)	-594.9
MAX Z	-84.0	38.7	+872.1 (max)

FORM NO. 152 REV. 1

Calculations	JOB NUMBER P2519.01
SUBJECT: WORTHINGTON	FILE NUMBER
	SHEET 9B OF
	BY L. Norton DATE
STRESS AT BASE OF LEGS	APP DATE

LEG 1

Stress for values giving max. X :-

forces in u & v direction are :-

$$u = \frac{x+y}{\sqrt{2}} \qquad v = \frac{y-x}{\sqrt{2}} \qquad \text{(SEE SHEET 10)}$$

$x = -98.9 \qquad y = -118.5 \overset{\text{SEISMIC}}{-65} = -183.6 \qquad z = -452.9 - 447 = -899.9$

$\Rightarrow \; u = -199.7 \qquad v = -59.8$

$\therefore \; \sigma = -199.7 \times 11.5 \times 4.94 - 59.8 \times 11.5 \times 6.5 - \frac{899.9}{6875}$ (SEE SHEET 10)

$= -11.34 - 4.47 - 1.3$

$\underline{\sigma = -17.12 \text{ KSI}}$ (TENSION)

Stress for values giving max Y :-

$x = -42.7 \quad y = -153.7 - 65 = -218.7 \quad z = -514.9 - 447 = -1042$

$u = -185 \;\; \& \;\; v = -124.5$

$\sigma = -185 \times 11.5 \times 4.94 - 124.5 \times 11.5 \times 6.5 - \frac{1042}{6875}$

$= -10.5 - 9.3 - 1.5$

$\sigma = -\underline{21.3} \text{ KSI}$ (TENSION)

Similarly it may be shown that for legs 2, 3 + 4 the values that maximize Y-directional forces will give the greatest stress

FORM NO. 152 REV. 1

AGRES	**Calculations**	JOB NUMBER P2519.01
	SUBJECT: WORTHINGTON	FILE NUMBER
		SHEET 9C OF
		BY L. Nuton DATE Sept 4/
	FORCES AT BASE OF LEGS	APP DATE

LEG No 2

	X				Y				Z			
	INLET		OUTLET		INLET		OUTLET		INLET		OUTLET	
	+	−	+	−	+	−	+	−	+	−	+	−
F_A	17.2	-52.4	-36.7	2.7	-8.7	26.5	-23.4	1.8	-1.8	5.4	94.3	-7.1
F_B					15.4	-16.1	-50.3	1.6	-30.8	32.8	100.5	-3.2
F_C									-150.8	263.7	0.0	-78.0
M_A									110.2	-180.0	-52.5	83.0
M_B									-39.4	115.5	37.5	-5.3
M_C	8.2	-3.7	3.0	0.0	-40.3	18.5	-14.9	0.1	77.5	-35.4	28.6	-0.3

STRESS COMBINATIONS

	X	Y	Z
MAX X	-92.8 (max)	-44.7	806.6
MAX Y	-8.4	-153.7 (max)	941.2
MAX Z	-77.9	-118.5	948.4 (max)

FORM NO. 152 REV. 1

Calculations

AGRES

SUBJECT: WORTHINGTON

FORCES AT BASE OF LEGS

JOB NUMBER P2519.01
FILE NUMBER
SHEET 9D OF
BY L. Norton DATE Sept 11/84
APP DATE

LEG No 3

	X				Y				Z			
	INLET		OUTLET		INLET		OUTLET		INLET		OUTLET	
	+	−	+	−	+	−	+	−	+	−	+	−
F_A	17.2	-52.4	-36.7	2.7	8.7	-26.5	23.4	-1.8	1.8	-5.4	-94.3	7.1
F_B					15.4	-16.1	-50.3	1.6	-30.8	32.2	100.5	-3.2
F_C									-153.8	263.7	0.0	-78.7
M_A									110.2	-180.0	-52.5	83.0
M_B									39.4	-115.5	-57.5	5.3
M_C	8.2	-3.7	3.0	0	40.3	-18.5	14.9	-0.1	-77.5	35.4	-28.6	0.3

STRESS COMBINATIONS:

	X	Y	Z
MAX X	-92.8 (max)	-88.1	570.3
MAX Y	-53.4	-113.3 (max)	671.7
MAX Z	-77.9	+69.2	-877.1 (max)

FORM NO. 152 REV. 1

ACRES

Calculations

SUBJECT: WORTHINGTON

FORCES AT BASE OF LEGS

JOB NUMBER P2519.01
FILE NUMBER
SHEET 9E OF
BY L. Newton DATE [illegible]
APP DATE

LEG No 4

	X				Y				Z			
	INLET		OUTLET		INLET		OUTLET		INLET		OUTLET	
	+	−	+	−	+	−	+	−	+	−	+	−
F_A	13.6	-41.6	-46.1	3.5	8.7	-26.5	23.4	-1.8	35.0	-107.0	-4.7	0.3
F_B					15.4	-16.1	-50.3	1.6	30.8	-32.2	-100.5	3.2
F_C									51.2	-87.9	0.0	234.0
M_A									-110.2	180.0	52.5	-83.0
M_B									39.4	-115.8	-57.5	5.3
M_C	-8.2	3.7	-3.0	0.0	40.3	-18.5	14.9	-0.1	77.5	-35.4	28.6	-0.3

STRESS COMBINATIONS

	X	Y	Z
MAX X	-98.9 (max)	+69.1	+590.8
MAX Y	-34.4	-113.3 (max)	-729.2
MAX Z	+5.9	+79.1	+737.8 (max)

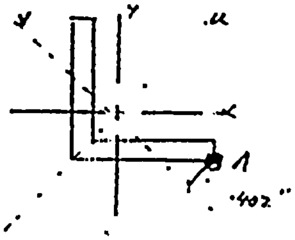
FORM NO. 152 REV. 1

Calculations

SUBJECT:

JOB NUMBER P2519.01
FILE NUMBER C-10
SHEET 10 OF
BY A.L.M DATE 24/ /74
APP DATE / /

To decide which combination cause the greatest stresses in the legs it should be noted that the loads in x & y directions are the most important since they cause bending of the legs. (bending stresses are approximately 90% of total in critical case). Maximum stresses occur at the junction of the legs and tanks ie. 11.5" above the base.



$I_x = I_y = .1385 \text{ in}^4 \qquad A = .6875 \text{ in}^2$

$I_{xy} = \frac{3}{2} \times \frac{1}{4} \times \frac{3}{4} \times \frac{7}{8} + \frac{5}{4} \times \frac{1}{4} \times \frac{7}{8} \times \frac{1}{8} - \frac{11}{16} \times \frac{61}{88} \times \frac{41}{88}$

$= .0694 - .146$

$= -.0766 \text{ in}^4$

$I_{uu} = .1385 + .0766 = .2151 \text{ in}^4$

$I_{vv} = .1385 - .0766 = .0619 \text{ in}^4$

at pt A $\qquad \frac{1}{S_{uu}} = \frac{1.5}{\sqrt{2} \times .2151} = 4.94 \text{ in}^4$

$\frac{1}{S_{vv}} = \frac{.402}{.0619} = 6.50 \text{ in}^4$

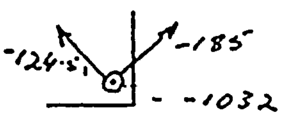
(u and v are at 45° to x & y)

a) For leg ① forces in u & v directions are

$u = \frac{x+y}{\sqrt{2}} \qquad v = \frac{y-x}{\sqrt{2}}$

$x = -42.7 \qquad y = -153.7 - 65 = -218.7 \text{ \#}$ seismic $\qquad z = -594.9 - 43.$ seismic $= -1032 \text{ \#}$

$\therefore u = -\frac{261.4}{\sqrt{2}} = -185 \text{ \#} \qquad v = \frac{-176.0}{\sqrt{2}} = -124.5 \text{ \#}$



at base of leg

Max stress at pt 11.5" above base

bending stresses, axial stress

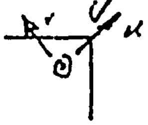
$\sigma = -185 \times 11.5 \times 4.94 - 124.5 \times 11.5 \times 6.50 - \frac{1032}{0.6875}$

Calculations	JOB NUMBER P2519-01
SUBJECT:	FILE NUMBER C-10
	SHEET 11 OF
	BY Acal DATE 24/8/74
	APP DATE

$= -10{,}500 - 9300 - 1500$

$= 21{,}300$ #/in² tension

b) For leg (2)



$x = -8.4$ # $y = -153.7 - 65 = -218.7$ #

$z = 961.2 + 437 = 1398$ #

$u = -\frac{227.1}{\sqrt{2}} = -161.0$ # $v = -\frac{210.3}{\sqrt{2}} = 149$ #

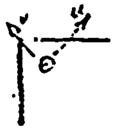
$\sigma = (161 \times 6.50 + 149 \times 4.94)\,11.5 + \frac{1398}{.6875}$

$= (1045 + 736)\,11.5 + 2030$

$= 20400 + 2030 = 22430$ #/in² compression

c) For leg (3)

$x = -92.8$ # $y = -88.1 - 65.0 = -153.1$ #



$u = 174.0$ # $v = 42.6$ #

will give lesser stresses than for leg (1)

d) For leg (4)

$x = -43.7$ $y = 104.3 + 65.0 = 169.3$

$u = 99.9$ # $v = 150.5$ #

will give lesser stresses than for leg (2)

∴ max longitudinal stress is in leg no. (2)

$\tau = 0$ when $\sigma = 22430$ #/in² max since at edge of angle

$F.S._2 = \frac{36000}{22430} = 1.61 > 1.6$ ∴ OK

mill steel

$\tau_{max\ at\ A} = \frac{VA\bar{y}}{It} = V\,\frac{t \times 1\frac{3}{8} \times (1\frac{3}{8} \times \frac{1}{2\sqrt{2}})}{\frac{3}{4} \times .2151} = 3.1V$

Calculations

SUBJECT:

JOB NUMBER P2512.01
FILE NUMBER
SHEET 12 OF
BY L. Nesten DATE Sept [illegible]
APP DATE

max values of u + v for all 4 legs

$\tau_{MAX} = (185 + 150.5) \times 3.1 = 1020$ lb/in²

Bending stress is min where τ is max.

$\therefore \; FS_{\tau} = \frac{.6 \times 36,000}{1020} = 21.2 > 1.6$ OK

Holding Down Bolt

Combine max uplift with max shear in x & y direction (conservative)

tension = 1374 lb

$\text{shear} = \left[98.9^2 + (1537 \div 65)^2 \right]^{\frac{1}{2}}$

x direction y direction

= 240 lb

FORM NO. 152 REV. 1

Tensile stress = $\frac{1364}{.142}$ = 9600 #/in²

1/2" bolt area

Shear stress = $\frac{240}{.142}$ = 1640 #/in²

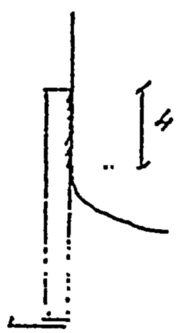
$\tau_{max} = \left[1640^2 + \left(\frac{9600}{2}\right)^2\right]^{\frac{1}{2}} = 5089$ #/in²

$\sigma_{max} = \frac{9600}{2} + 5089 = 9889$ #/in²

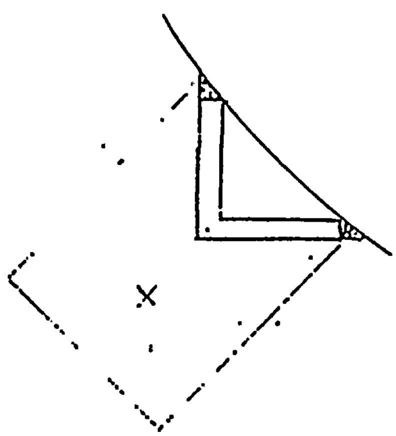
$F.S._{\tau} = \frac{.6 \times 36000}{5089} = \underline{\underline{4.24}} > 1.6$ OK

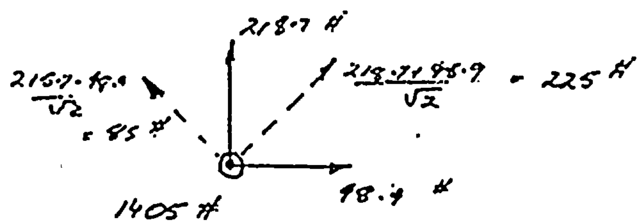
$F.S._{\sigma} = \frac{36000}{9889} = \underline{\underline{3.64}} > 1.6$ ∴ OK

Weld of Leg to Tank



4" weld to each leg of angle





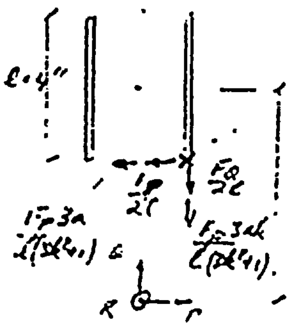
max forces at base of leg

0 0 0 1 0 2 4 0

Calculations

SUBJECT:

JOB NUMBER P2519.01
FILE NUMBER C-10
SHEET 14 OF
BY Aeg DATE 24/8/[illegible]
APP DATE



$kl = 2.12"$ $k = .153$

$\frac{F_R}{2l} + \frac{F_R\,3a}{l}$

$\mathcal{A}l = 13.5"$

$a = 3.375$

See "Design of Welded Structures" by O.W. Blodgett for stress formulae

$F_p = 85^{\#}$

$F_R = 225^{\#}$

$F_Q = 1405^{\#}$

max stress in weld

$$= \left[\left\{ \frac{F_p}{l} \left(\frac{3a}{3k^2+1} + \frac{1}{2} \right) \right\}^2 + \left\{ \frac{F_R}{l} \left(3a + \frac{1}{2} \right) \right\}^2 + \left\{ \frac{F_Q}{2l} + \frac{F_p}{l} \frac{3ak}{3k^2+1} \right\}^2 \right]^{\frac{1}{2}}$$

$3k^2+1 = 1.843$. $\frac{3a}{3k^2+1} = \frac{10.125}{1.843} = 5.50$, $\frac{3ka}{3k^2+1} = 2.91$

$$f = \frac{1405}{4} \left[\{.065 \times 4.0\}^2 + \{.16 \times 10.625\}^2 + \{.5 + .065 \times 2.91\}^2 \right]^{\frac{1}{2}}$$

$$= 351 \left[.065 + 2.890 + .474 \right]^{\frac{1}{2}} = 351 \times 1.85$$

$$= 650 \ \#/in$$

with E60 xx electrodes allowable shear/unit length, 1/16" weld size = 1000 #/in (from AISC handbook)
(see note below)

∴ Assuming only 1/8" weld

$$F.S. = \frac{2 \times 1000}{650} = 3.08 > 1.6 \quad \therefore OK.$$

[AISC actually gives 600 #/in as a working stress condition. This implies a F.S. of 1.67 at least & therefore the allowable load was taken as $600 \times 1.67 = 1000$ #/in]

FORM NO. 152 REV. 1

Calculations	JOB NUMBER P251201
SUBJECT:	FILE NUMBER
	SHEET 14A OF
	BY [illegible] DATE Sept 14/74
	APP DATE

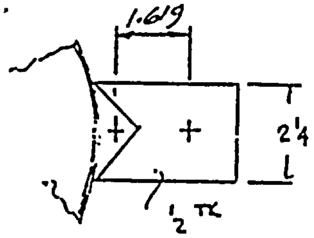
BASE PLATE (Flange Part)

Max uplift will occur at leg No. 3 (max. combination of forces in 2 directions with neg. sign)

UPLIFT = − 877.1 from sheet 9.D

North Seismic

With Seismic Force = 877 + 447 = 1324



$M_{MAX} = 1.324^{K} \times 1.619$
$= 2.144$ in·K

$\sigma = \dfrac{2.144 \text{ in}\cdot K}{\frac{1}{6} \times 2.25 \times .5^2} = 22.87$ KSI

$FS = \dfrac{36{,}000}{22.87} = 1.57 > 1.1$ DBE OK.

DBE, according to [illegible], must meet a F.S. of 1.1, whereas OBE must meet a F.S. of 1.6.

Checking baseplate for OBE & FS of 1.6:−

combination − 0.5 Eq

Total Force = $877 + \dfrac{447}{2} = 1100$

$M_{MAX} = 1.10 \times 1.619 = 1.782$ −K

$\sigma = \dfrac{1.782}{\frac{1}{6} \times 2.25 \times .5^2} = 19.00$ KSI

$F.S. = \dfrac{36.0}{19.0} = 1.89 > 1.6$ OK OBE

CE 81A

WORTHINGTON CORPORATION

SUBJECT Full Flow Lube Oil Strainer

TYPE ________ DRG. No. 10-089

CAL. BY RLB APP. ________

CALCU. GROUP C-10

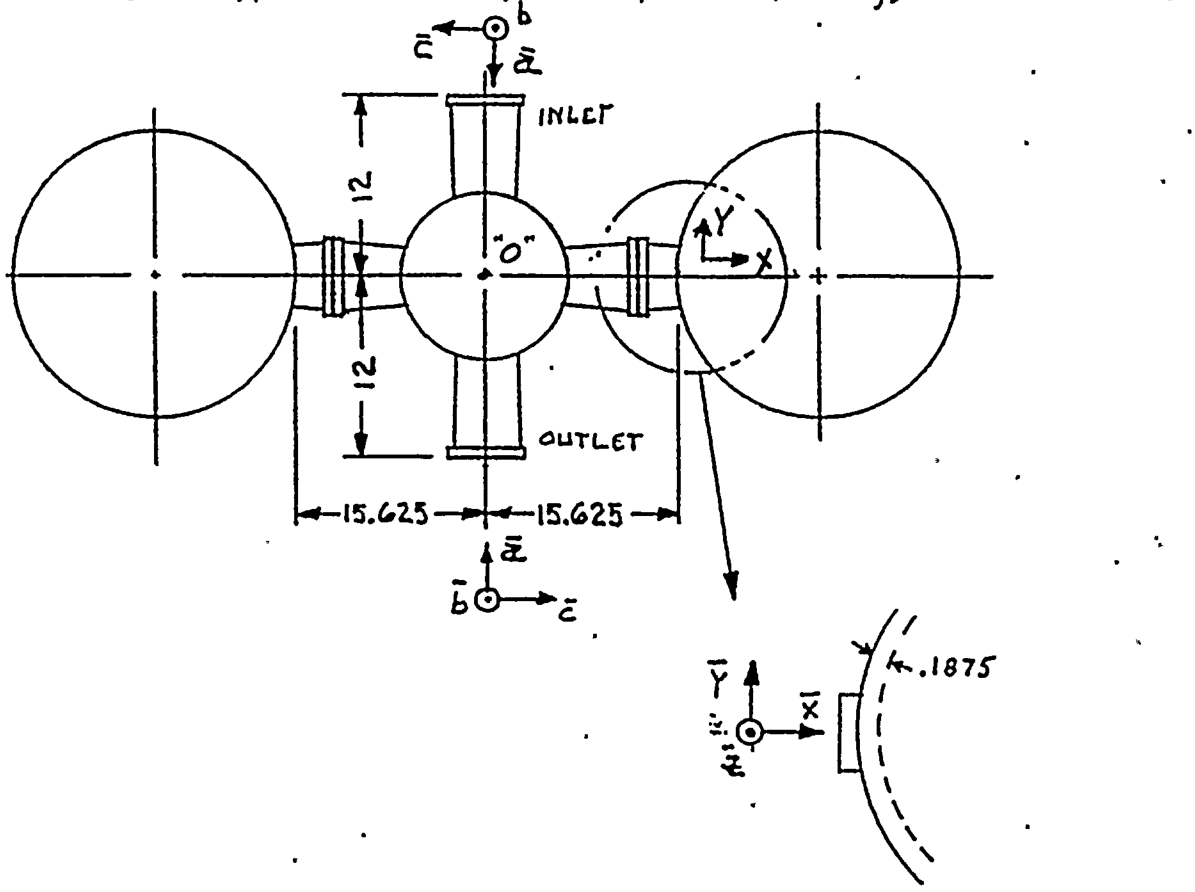
Sheet 15 of ____ Shts.

Date 8/26/74

Local Shell Stresses:

I Nozzle Loads: (as per EDS 8/14/74)

	INLET:		OUTLET:	
Fa	+123 Lbf	-129 Lbf	+402 Lbf	-13 Lbf
Fb	+410 Lbf	-703 Lbf	+0 Lbf	-624 Lbf
Fc	+123 Lbf	-376 Lbf	+331 Lbf	-25 Lbf
Ma	+527(12) in-Lbf	-1547(12) in-Lbf	+770(12) in-Lbf	-71(12) in-Lbf
Mb	+572(12) in-Lbf	-262(12) in-Lbf	+212(12) in-Lbf	-2(12) in-Lbf
Mc	+441(12) in-Lbf	-720(12) in-Lbf	+210(12) in-Lbf	-332(12) in-Lbf



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SUBJECT: Full Flow Lube Oil Strainer	CALCU.
TYPE:	GROUP: C-10
DRG. No.: 10-089	Sheet 16 of ___ Shts.
CAL. BY: R.L.B	Date: 8/26/74
APP.:	

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II TRANSFER OF LOADS FROM INLET & OUTLET NOZZLES TO TANK SHELL NOZZLES: (SKETCH P.15)

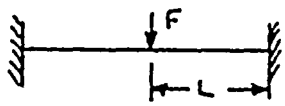
ASSUME ONLY ONE NOZZLE PER TANK SEES THE LOADS FROM THE INLET & OUTLET NOZZLES!

A] From Fa:

1] Fa^+_{IN}, Fa^-_{OUT}:

a) $F_{Y_1}^- = \dfrac{Fa^+_{IN} + Fa^-_{OUT}}{\#\ NOZZLES} = \dfrac{123+13}{2} = 68\ Lb_f$

b) $M_{Z_1}^+$:



SINCE $\sigma = \dfrac{W(2L)}{8Z} = \dfrac{M}{Z}$

$M_Z^+ = \dfrac{W(2L)}{8} = \dfrac{(Fa^+_{IN} + Fa^-_{OUT})(2)(15.625)}{8}$

$= \dfrac{(123+13)(2)(15.625)}{8} = 531.25\ IN-Lb_f$

2] Fa^-_{IN}, Fa^+_{OUT}:

a) $F_{y_1}^+ = \dfrac{Fa^-_{IN} + Fa^+_{OUT}}{\#\ NOZZLES} = \dfrac{129+402}{2} = 265.5\ Lb_f$

b) $M_{Z_1}^- = \dfrac{(Fa^-_{IN} + Fa^+_{OUT})(2)(15.625)}{8} = \dfrac{(129+402)(2)(15.625)}{8}$

$= 2074.2\ IN-Lb_f$

B] From Fb:

1] Fb^+_{IN}, Fb^+_{OUT}:

a) $F_{Z_1}^+ = \dfrac{Fb^+_{IN} + Fb^+_{OUT}}{\#\ NOZZLES} = \dfrac{410+0}{2} = 205\ Lb_f$

b) $M_{Y_1}^+ = \dfrac{(Fb^+_{IN} + Fb^+_{OUT})(2)(15.625)}{8} = \dfrac{(410+0)(2)(15.625)}{8}$

$= 1601.6\ IN-Lb_f$

c) $M_{X_1}^+ = \dfrac{12(Fb^+_{IN} - Fb^-_{OUT})}{\#\ NOZZLES} = \dfrac{12(410+0)}{2} = 2460\ IN-Lb_f$

③

SUBJECT: FULL FLOW LUBE OIL STRAINER

TYPE ____ DRG. No. 10-089

CAL. BY R.L.B. APP. ____

CALCU.

GROUP C-10

Sheet 17 of ____ Shts.

Date 8/26/74

2] Fb^-_{IN}, Fb^-_{OUT} :

a) $Fz^-_1 = \dfrac{Fb^-_{IN} + Fb^-_{OUT}}{\#\ NOZZLES} = \dfrac{703+624}{2} = 663.5\ Lb_f$

b) $M^-_{Y_1} = \dfrac{(Fb^-_{IN} + Fb^-_{OUT})(2)(15.625)}{8} = \dfrac{(703+624)(2)(15.625)}{8}$

$= 5183.6\ IN\text{-}Lb_f$

c) $M^-_{X_1} = \dfrac{(Fb^-_{IN} - Fb^-_{OUT})(12)}{\#\ NOZZLES} = \dfrac{(703-624)(12)}{2} = 474\ IN\text{-}Lb_f$

3] Fb^+_{IN}, Fb^-_{OUT} :

a) $Fz^-_2 = \dfrac{(Fb^-_{OUT} - Fb^+_{IN})}{\#NOZZLES} = \dfrac{624-410}{2} = 107\ Lb_f$

b) $M^-_{Y_2} = \dfrac{(Fb^-_{OUT} - Fb^+_{IN})(2)(15.625)}{8} = \dfrac{(624-410)(2)(15.625)}{8}$

$= 835.9\ IN\text{-}Lb_f$

c) $M^+_{X_2} = \dfrac{(Fb^-_{OUT} + Fb^+_{IN})(12)}{\#\ NOZZLES} = \dfrac{(624+410)(12)}{2} = 6204\ IN\text{-}Lb_f$

4] Fb^-_{IN}, Fb^+_{OUT} :

a) $Fz^-_3 = \dfrac{Fb^-_{IN} - Fb^+_{OUT}}{\#\ NOZZLES} = \dfrac{703-0}{2} = 351.5\ Lb_f$

b) $M^-_{Y_3} = \dfrac{(Fb^-_{IN} - Fb^+_{OUT})(2)(15.625)}{8} = \dfrac{(703-0)(2)(15.625)}{8}$

$= 2746.1\ IN\text{-}Lb_f$

c) $M^-_{X_2} = \dfrac{(Fb^-_{IN} + Fb^+_{OUT})(12)}{\#\ NOZZLES} = \dfrac{(703+0)(12)}{2} = 4218\ IN\text{-}Lb_f$

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CE 01A

					CALCU.
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CAL. BY	RLB	APP.		Date	8/27/74

c) FROM Fc:

1] $Fc_{IN}^{+}, Fc_{OUT}^{+}$:

a) $Fx_1^{+}: \dfrac{Fc_{OUT}^{+} - Fc_{IN}^{+}}{\#\text{ NOZZLES}} = \dfrac{331-123}{2} = 104 \text{ Lb}_f$

b) FROM ROARK, CASE 27, P. 113:

$Fy_2^{+} = R = 6\dfrac{M}{L^3}(aL - a^2) \qquad L = 2a \qquad a = 15.625$

$= \dfrac{.75(12)(Fc_{IN}^{+} + Fc_{OUT}^{+})}{15.625} = \dfrac{.75(12)(331+123)}{15.625} = 261.5 \text{ Lb}_f$

c) $M_{z_2}^{-} = \dfrac{M}{L^2}(2La - 3a^2) = M/4$

$= \dfrac{12(Fc_{IN}^{+} + Fc_{OUT}^{+})}{4} = \dfrac{12(331+123)}{4} = 1362 \text{ IN-Lb}_f$

2] $Fc_{IN}^{-}, Fc_{OUT}^{-}$:

a) $Fx_2^{+} = \dfrac{Fc_{IN}^{-} - Fc_{OUT}^{-}}{\#\text{ NOZZLES}} = \dfrac{376-25}{2} = 175.5 \text{ Lb}_f$

b) $Fy_2^{-} = R = \dfrac{.75(12)(Fc_{IN}^{-} + Fc_{OUT}^{-})}{15.625} = \dfrac{(.75)(12)(376+25)}{15.625} = 231 \text{ Lb}_f$

c) $M_{z_2}^{+} = \dfrac{12(Fc_{IN}^{-} + Fc_{OUT}^{-})}{4} = \dfrac{(12)(376+25)}{4} = 1203 \text{ IN-Lb}_f$

3] $Fc_{IN}^{+}, Fc_{OUT}^{-}$:

a) $Fx_1^{-} = \dfrac{Fc_{IN}^{+} + Fc_{OUT}^{-}}{\#\text{ NOZZLES}} = \dfrac{123+25}{2} = 74 \text{ Lb}_f$

b) $Fy_3^{+} = \dfrac{.75(12)(Fc_{IN}^{+} - Fc_{OUT}^{-})}{15.625} = \dfrac{(.75)(12)(123-25)}{15.625} = 56.5 \text{ Lb}_f$

c) $M_{z_3}^{-} = \dfrac{12(Fc_{IN}^{+} - Fc_{OUT}^{-})}{4} = \dfrac{12(123-25)}{4} = 294 \text{ IN-Lb}_f$

4] $Fc_{IN}^{-}, Fc_{OUT}^{+}$:

a) $Fx_3^{+} = \dfrac{Fc_{IN}^{-} + Fc_{OUT}^{+}}{\#\text{ NOZZLES}} = \dfrac{376+331}{2} = 353.5 \text{ Lb}_f$

b) $Fy_3^{-} = \dfrac{(Fc_{IN}^{-} - Fc_{OUT}^{+})(12)(.75)}{15.625} = \dfrac{(376-331)(12)(.75)}{15.625} = 26 \text{ Lb}_f$

c) $M_{z_3}^{+} = \dfrac{12(Fc_{IN}^{-} - Fc_{OUT}^{+})}{4} = \dfrac{12(376-331)}{4} = 135 \text{ IN-Lb}_f$

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CALCU.

SUBJECT Full Flow Lube Oil Strainer

GROUP C-10

TYPE ____ DRG. No. 10-089

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D] From Ma:

1] $Ma^{+}_{IN}, Ma^{-}_{OUT}$: FROM ROARK, CASE 37, P. 113

a) $F^{+}_{Z_2} = R = 6\frac{M}{\ell^3}(a\ell - a^2) \qquad \ell = 2a$

$= .75\frac{M}{a} = .75\frac{(Ma^{+}_{IN} + Ma^{-}_{OUT})}{15.625}$

$= .75\frac{(12)(527+71)}{15.625} = 344$ Lbf

b) $M^{+}_{Y_2} = \frac{M}{\ell^2}(2\ell a - 3a^2) = \frac{M}{4}$

$= \frac{Ma^{+}_{IN} + Ma^{-}_{OUT}}{4} = \frac{12(527+71)}{4} = 1794$ IN-Lbf

2] $Ma^{-}_{IN}, Ma^{+}_{OUT}$:

a) $F^{-}_{Z_4} = .75\frac{Ma^{-}_{IN} + Ma^{+}_{OUT}}{15.625} = .75\frac{(12)(1547+770)}{15.625} = 1335$ Lbf

b) $M^{+}_{Y_4} = \frac{Ma^{-}_{IN} + Ma^{+}_{OUT}}{4} = \frac{12(1547+770)}{4} = 6951$ IN-Lbf

3] $Ma^{+}_{IN}, Ma^{+}_{OUT}$:

a) $F^{-}_{Z_5} = .75\frac{Ma^{+}_{OUT} - Ma^{+}_{IN}}{15.625} = \frac{.75(12)(770-527)}{15.625} = 140$ Lbf

b) $M^{-}_{Y_5} = \frac{Ma_{OUT} - Ma_{IN}}{4} = \frac{12(770-527)}{4} = 729$ IN-Lbf

4] $Ma^{-}_{IN}, Ma^{-}_{OUT}$:

a) $F^{-}_{Z_6} = (.75)\frac{Ma^{-}_{IN} - Ma^{-}_{OUT}}{15.625} = \frac{.75(12)(1547-71)}{15.625} = 850$ Lbf

b) $M^{-}_{Y_6} = \frac{Ma^{-}_{IN} - Ma^{-}_{OUT}}{4} = \frac{12(1547-71)}{4} = 4428$ IN-Lbf

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SUBJECT Full Flow Lube Oil Strainer	CALCU.
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E] From Mb: translate Mb to "0":

1] Mb_{IN}^+, Mb_{OUT}^+:

a) $Fx_4^+ = \dfrac{Mb_{IN}^+ + Mb_{OUT}^+}{12(2)} = \dfrac{(572-212)(12)}{12(2)} = 180$ Lbf

b) From Roark, Case 37, P.113:

$Fy_4^+ = R = 6\dfrac{(M)}{L^3}(aL - a^2)$ $\quad L = 2a$

$= .75\dfrac{M}{a} = .75\dfrac{(572+212)(12)}{15.625} = 451.6$ Lbf

c) From Roark, Case 37, P.113:

$M_{Z_4}^- = \dfrac{M_0}{l^2}(2la - 3a^2) = \dfrac{M}{4}$

$= \dfrac{Mb_{IN}^+ + Mb_{OUT}^+}{4} = \dfrac{(572+212)(12)}{4} = 2352$ IN-Lbf

2] Mb_{IN}^-, Mb_{OUT}^-

a) $Fx_2^- = \dfrac{Mb_{IN}^- - Mb_{OUT}^-}{12(2)} = \dfrac{(12)(262-12)}{12(2)} = 125$ Lbf

b) $Fy_4^- = \dfrac{.75(Mb_{IN}^- + Mb_{OUT}^-)}{15.625} = \dfrac{.75(262+12)(12)}{15.625} = 157.8$ Lbf

c) $M_{Z_4}^+ = \dfrac{(Mb_{IN}^- + Mb_{OUT}^-)}{4} = \dfrac{(262+12)(12)}{4} = 822$ IN-Lbf

3] Mb_{IN}^+, Mb_{OUT}^-:

a) $Fx_5^+ = \dfrac{Mb_{IN}^+ + Mb_{OUT}^-}{12(2)} = \dfrac{12(572+12)}{12(2)} = 292$ Lbf

b) $Fy_5^+ = .75\dfrac{(Mb_{IN}^+ - Mb_{OUT}^-)}{15.625} = \dfrac{.75(12)(572-12)}{15.625} = 322.6$ Lbf

c) $M_{Z_5}^- = \dfrac{Mb_{IN}^+ - Mb_{OUT}^-}{4} = \dfrac{12(572-12)}{4} = 1680$ IN-Lbf

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SUBJECT Full Flow Lube Oil Strainer
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4] Mb^-_{IN}, Mb^+_{OUT} :

a) $Fx^-_3 = \frac{Mb^-_{IN} + Mb^+_{OUT}}{2(12)} = \frac{(262+12)(12)}{(2)(12)} = 137$ Lbf

b) $Fy^-_5 = \frac{(.75)(12)(Mb^-_{IN} - Mb^+_{OUT})}{15.625} = \frac{(.75)(12)(262-12)}{15.625} = 144$ Lbf

c) $M^+_{z_5} = \frac{Mb^-_{IN} - Mb^+_{OUT}}{4} = \frac{(12)(262-12)}{4} = 750$ IN-Lbf

F] From Mc: translate to "O".

1] Mc^+_{IN}, Mc^+_{OUT} :

a) $Fz^+_3 = \frac{Mc^+_{IN} + Mc^+_{OUT}}{2(12)} = \frac{(12)(441+210)}{2(12)} = 325.5$ Lbf

b) $My^+_3 = \frac{(2)Fz^+(15.625)}{8} = \frac{2(325.5)(15.625)}{8} = 1271.5$ IN-Lbf

c) $Mx^-_3 = \frac{Mc^+_{IN} - Mc^+_{OUT}}{\text{\# NOZZLES}} = \frac{12(441-210)}{2} = 1374$ IN-Lbf

2] Mc^-_{IN}, Mc^-_{OUT} :

a) $Fz^-_7 = \frac{Mc^-_{IN} + Mc^-_{OUT}}{2(12)} = \frac{12(720+332)}{2(12)} = 526$ Lbf

b) $My^-_7 = \frac{(2)Fz^-(15.625)}{8} = \frac{2(526)(15.625)}{8} = 2054.7$ IN-Lbf

c) $Mx^+_3 = \frac{Mc^-_{IN} - Mc^-_{OUT}}{\text{\# NOZZLES}} = \frac{12(720-332)}{2} = 2328$ IN-Lbf

3] Mc^+_{IN}, Mc^-_{OUT} :

a) $Fz^+_4 = \frac{Mc^+_{IN} - Mc^-_{OUT}}{2(12)} = \frac{12(441-332)}{2(12)} = 54.5$ Lbf

b) $My^+_4 = \frac{(2)(Fz^+)(15.625)}{8} = \frac{(2)(54.5)(15.625)}{8} = 212.9$ IN-Lbf

c) $Mx^-_4 = \frac{Mc^+_{IN} + Mc^-_{OUT}}{-} = 12(441+332) = 4638$ IN-Lbf

(8)

SUBJECT Full Flow Lube Oil Strainer

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4] Mc_{IN}^-, Mc_{OUT}^+ :

a) $Fz_8^- = \dfrac{Mc_{IN}^- - Mc_{OUT}^+}{2(12)} = \dfrac{12(720-210)}{2(12)} = 255$ lbf

b) $My_8^- = \dfrac{2(Fz^-)(15.625)}{8} = \dfrac{2(255)(15.625)}{8} = 996$ in-lbf

c) $Mx_4^+ = \dfrac{Mc_{IN}^- + Mc_{OUT}^+}{\# \text{ NOZZLES}} = \dfrac{12(720+210)}{2} = 5580$ in-lbf

G] Compilation Of Transferred Nozzle Loads:

1] Fx:

a) $Fx^+ = Fx_3^+ + Fx_5^+ = 353.5 + 292 = 645.5$ lbf

b) $Fx^- = Fx_1^- + Fx_3^- = 74 + 137 = 211$ lbf

2] Fy:

a) $Fy^+ = Fy_1^+ + Fy_2^+ + Fy_4^+ = 265.5 + 261.5 + 451.6 = 978.6$ lbf

b) $Fy^- = Fy_1^- + Fy_2^- + Fy_4^- = 68 + 231 + 157.8 = 456.8$ lbf

3] Fz:

a) $Fz^+ = Fz_1^+ + Fz_2^+ + Fz_3^+ = 205 + 344 + 325.5 = 874.5$ lbf

b) $Fz^- = Fz_1^- + Fz_4^- + Fz_7^- = 663.5 + 1335 + 526 = 2524.5$ lbf

4] Mx:

a) $Mx^+ = Mx_2^+ + Mx_4^+ = 6204 + 5580 = 11784$ in-lbf

b) $Mx^- = Mx_2^- + Mx_4^- = 4218 + 4638 = 8856$ in-lbf

5] My:

a) $My^+ = My_1^+ + My_2^+ + My_3^+ = 1601.6 + 1794 + 1271.5 = 4667.1$ in-lbf

b) $My^- = My_1^- + My_4^- + My_7^- = 5183.6 + 6951 + 2054.7 = 14189.3$ in-lbf

6] Mz:

a) $Mz^+ = Mz_1^+ + Mz_2^+ + Mz_4^+ = 531.3 + 1203 + 822 = 2556.3$ in-lbf

b) $Mz^- = Mz_1^- + Mz_2^- + Mz_4^- = 2074.2 + 1362 + 2352 = 5788.2$ in-lbf

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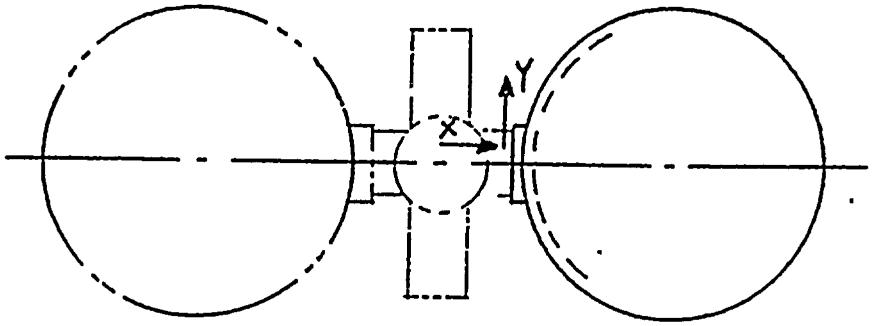
H] Documentation Of Transferred Nozzle Loads:



$F_X = +645.5\ Lb_f\ ;\ -211\ Lb_f$

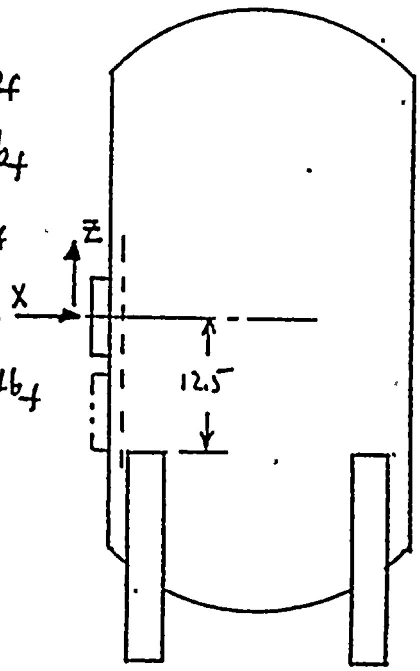
$F_Y = +978.6\ Lb_f\ ;\ -456.8\ Lb_f$

$F_Z = +874.5\ Lb_f\ ;\ -2524.5\ Lb_f$

$M_X = +11784\ \text{IN-}Lb_f\ ;\ -8856\ \text{IN-}Lb_f$

$M_Y = +4667.1\ \text{IN-}Lb_f\ ;\ -14189.3\ \text{IN-}Lb_f$

$M_Z = +2556.3\ \text{IN-}Lb_f\ ;\ -5788.2\ \text{IN-}Lb_f$



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WORTHINGTON CORPORATION

SUBJECT: Full Flow Lube Oil Strainer	CALCU.
TYPE:	GROUP: C-10
DRG. No. 10-089	Sheet 24 of ___ Shts.
CAL. BY: RLB APP.:	Date: 8/29/80

TANK SHELL INTEGRITY:

I HORIZONTAL SEISMIC BENDING STRESS:

σ_1 = LONGITUDINAL STRESS DUE TO HORIZONTAL SEISMIC LOAD. (BENDING)

$$\sigma_1 = \frac{(M_{\theta}/2)}{Z} + \frac{[(MAG)(WT)][L]}{2Z}$$

$$Z = \frac{\pi}{32}\left[\frac{D^4 - d^4}{D}\right] = \frac{\pi}{32}\left[\frac{16^4 - 15.625^4}{16}\right] = 36.4 \text{ IN}^3$$

$$\sigma_1 = \frac{\overset{(P.S)}{(144/2)}(12)}{36.4} + \frac{\overset{(P.S)}{[(.3)(\tfrac{1730}{2})]}[(2)(34-11.5)]}{(2)(36.4)}$$

$$= \pm 184.1 \text{ Lbf/IN}^2$$

II VERTICAL SEISMIC STRESS:

$$\sigma_2 = \frac{\frac{2}{3}(MAG.)(WT)}{AREA} = \frac{(\frac{2}{3})(.3)\overset{(P.S)}{(\frac{1730}{2})}}{\frac{\pi}{4}(16^2 - 15.625^2)} = +18.6 \text{ Lbf/IN}^2$$

-80.5 Lbf/IN² (GRAVITY INCLUDED)

III STRESS DUE TO INTERNAL PRESSURE:*

$$\sigma_{TANG} = \frac{PR}{t} = \frac{(100)(8)}{.1875} = +4266.7 \text{ Lbf/IN}^2$$

$$\sigma_3 = \sigma_{LONG} = \frac{PR}{2t} = \frac{(100)(8)}{2(.1875)} = +2133.3 \text{ Lbf/IN}^2$$

* (Operating pressure is less than 75 psi)

CE 01A

WORTHINGTON CORPORATION

SUBJECT Full Flow Lube Oil Strainer		CALCU. GROUP	C-10
TYPE	DRG. No. 10-089	Sheet 25 of	Shts.
CAL. BY RLB	APP.	Date	8/29/74

IV General Bending Stresses Due To Nozzle Loads:

It is found that the following loads contribute the maximum conservative bending loads to the tank: (sketch p.23)

A] $M_X^- = 12.5(F_Y^+) + M_X^-$

$= 12.5(978.6) + 8856 = 21088.6 \text{ IN-Lb}_f$

B] $M_Y^- = 12.5(F_X^-) + \left(\frac{16}{2}\right)(F_Z^-) + M_Y^-$

$= 12.5(211) + (8)(2524.5) + 14189.3) = 37022.8 \text{ IN-Lb}_f$

C] $M_{Noz} = \left[M_X^{-2} + M_Y^{-2}\right]^{1/2} = \left[21088.6^2 + 37022.8^2\right]^{1/2} = 42607.7 \text{ IN-Lb}_f$

D] $\sigma_4 = \frac{M_{Noz}}{Z} = \frac{42607.7}{36.4} = \pm 1170.5 \text{ Lb}_f/\text{IN}^2$

V Vertical Stress Due To Nozzle Loads:

1) $\sigma_5 = \frac{F_Z^-}{AREA} = \frac{2524.5}{\frac{\pi}{4}(16^2 - 15.625^2)} = -271 \text{ Lb}_f/\text{IN}^2$

2) $= \frac{F_Z^+}{AREA} = \frac{874.5}{\frac{\pi}{4}(16^2 - 15.625^2)} = +73.7 \text{ Lb}_f/\text{IN}^2$

VI Combined General Stresses:

A] $\sigma_L^+ = \sigma_1^+ + \sigma_2^+ + \sigma_3^+ + \sigma_4^+ + \sigma_5^+$

$= 184.1 + 18.6 + 2133.3 + 1170.5 + 73.7 = 3580.2 \text{ Lb}_f/\text{IN}^2$

B] $\sigma_L^- = \sigma_1^- + \sigma_2^- + \sigma_4^- + \sigma_5^-$

$= 184.1 + 80.5 + 1170.5 + 271 = -1706.1 \text{ Lb}_f/\text{IN}^2$

C] $\sigma_{TG} = \sigma_{TANG} = +4266.7 \text{ Lb}_f/\text{IN}^2$

CE 81A

SUBJECT Full Flow Lube Oil Strainer	CALCU. GROUP C-10
TYPE DRG. No. 10-089	Sheet 26 of Shts.
CAL. BY R.L.B. APP.	Date 8/30/74

VII USING WRC BULLETIN #107, THE LOCAL PRIMARY STRESSES IN THE TANK SHELL, DUE TO THE VERY CONSERVATIVE TRANSFERRED NOZZLE LOADS ON P.23, ARE SHOWN ON DATA SHEET, P.27, FROM PRINT OUT, P.28.

SINCE THE SHEAR INTENSITY IS small, EQUATION #2 FOR THE COMBINE STRESS INTENSITY ON DATA SHEET, P.27, WILL BE USED.

	A_U	A_L	B_U	B_L	C_U	C_L	D_U	D_L
$\sigma_\phi = SP(I) + \sigma_{rc}$	-4185.3	-4185.3	11284.7	11284.7	1779.7	1779.7	5229.7	5229.7
$\sigma_{x_1} = Sx(I) + \sigma_L^+$	-2572.8	-2572.8	6337.2	6337.2	-3771.8	-3771.8	7536.2	7536.2
$\sigma_{x_2} = Sx(I) + \sigma_L^-$	-7859.1	-7859.1	1050.9	1050.9	-9058.1	-9058.1	2249.9	2249.9
$\sigma_{EQ} = S =$	-7859.1	-7859.1	11284.7	11284.7	10837.8	10837.8	7536.2	7536.2

VIII SAFETY FACTOR : Y.S. = 30000 PSI (ASTM A-285 GR.C)

$$F.S. = \frac{Y.S.}{\sigma_{EQ}} = \frac{30000}{11284.7} = 2.66$$

WORTHINGTON CORPORATION

FULL FLOW LUBE OIL STRAINER

R.L.B. P.27

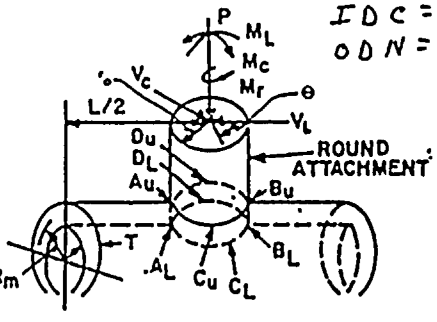
8/27/74

L = 3777.5 (P. 25)

TG = 4266.7 (P. 25)

Table 5—Computation Sheet for Local Stresses in Cylindrical Shells

ODC = 16.00
IDC = 15.625
ODN = 6.63



CYLINDRICAL SHELL

1. Applied Loads*
   - Radial load, P 645.5 lb.
   - Circ. Moment, M_c 5788.2 in. lb.
   - Long. Moments, M_L 141823 in. lb.
   - Torsion Moment, M_T 11784 in. lb.
   - Shear Load, V_c 928.6 lb.
   - Shear Load, V_L 2524.5 lb.
2. Geometry
   - Vessel thickness, T .1815 in.
   - Attachment radius, r_o 3.515 in.
   - Vessel radius, R_m 7.8125 in.
3. Geometric Parameters
   - γ $\frac{R_m}{T}$ 41.7
   - β $(0.875)\frac{r_o}{R_m}$ .37

Stress Concentration due to:
a) membrane load, Kn 1.0
b) bending load, Kb 1.0

*NOTE: Enter all force values in accordance with sign convention

	From Fig.	Read curves for	Compute absolute values of stress and enter result •		STRESSES – if load is opposite that shown, reverse signs shown: Au	AL	Bu	BL	Cu	CL	Du	DL	
1.6	3C	$\frac{N\phi}{P/R_m}$	$K_n\left(\frac{N\phi}{P/R_m}\right)\cdot\frac{P}{R_mT}$	AAP	−697	−697	−697	−697	−697	−697	−697	−697	FL
.025	1C	$\frac{M\phi}{P}$	$K_b\left(\frac{M\phi}{P}\right)\cdot\frac{6P}{T^2}$		−	+	−	+	−	+	−	+	
1.3	3A	$\frac{N\phi}{M_c/R_m^2\beta}$	$K_n\left(\frac{N\phi}{M_c/R_m^2\beta}\right)\cdot\frac{M_c}{R_m^2\beta T}$	CCP					−1750	−1750	+1750	+1750	FL
.064	1A	$\frac{M\phi}{M_c/R_m\beta}$	$K_b\left(\frac{M\phi}{M_c/R_m\beta}\right)\cdot\frac{6M_c}{R_m\beta T^2}$						−	+	+	−	
2.35	3B	$\frac{N\phi}{M_L/R_m^2\beta}$	$K_n\left(\frac{N\phi}{M_L/R_m^2\beta}\right)\cdot\frac{M_L}{R_m^2\beta T}$	EEP	−7755	−7755	+7755	+7755					FL
.0086	1B or 1B-1	$\frac{M\phi}{M_L/R_m\beta}$	$K_b\left(\frac{M\phi}{M_L/R_m\beta}\right)\cdot\frac{6M_L}{R_m\beta T^2}$		−	+	+	−					
	Add algebraically for summation of ϕ stresses, σ_ϕ		SP(I) = SP(I) + TG	SP(I) =	−8452	−8452	+7058	+7058	−2447	−2447	+1053	+1053	
3.9	4C	$\frac{N_x}{P/R_m}$	$K_n\left(\frac{N_x}{P/R_m}\right)\cdot\frac{P}{R_mT}$	AAX	−1698	−1698	−1698	−1698	−1698	−1698	−1698	−1698	FL
.01	2C	$\frac{M_x}{P}$	$K_b\left(\frac{M_x}{P}\right)\cdot\frac{6P}{T^2}$		−	+	−	+	−	+	−	+	
4.2	4A	$\frac{N_x}{M_c/R_m^2\beta}$	$K_n\left(\frac{N_x}{M_c/R_m^2\beta}\right)\cdot\frac{M_c}{R_m^2\beta T}$	CCX					−5654	−5654	+5654	+5654	FL
.025	2A	$\frac{M_x}{M_c/R_m\beta}$	$K_b\left(\frac{M_x}{M_c/R_m\beta}\right)\cdot\frac{6M_c}{R_m\beta T^2}$						−	+	+	−	
1.35	4B	$\frac{N_x}{M_L/R_m^2\beta}$	$K_n\left(\frac{N_x}{M_L/R_m^2\beta}\right)\cdot\frac{M_L}{R_m^2\beta T}$	EEX	−4455	−4455	+4455	+4455					FL
.014	2B or 2B-1	$\frac{M_x}{M_L/R_m\beta}$	$K_b\left(\frac{M_x}{M_L/R_m\beta}\right)\cdot\frac{6M_L}{R_m\beta T^2}$		−	+	+	−					
	Add algebraically for summation of X stresses, σ_x =		SX(I) = SX(I) + L	SX(I) =	−6153	−6153	+2757	+2757	−7352	−7352	+3956	+3956	
	Shear stress due to Torsion, M_T		$\tau_{\phi x} = \tau_{x\phi} = \frac{M_T}{2\pi r_o^2 T}$		+	+	+	+	+	+	+	+	
	Shear stress due to load, V_c		$\tau_{x\phi} = \frac{V_c}{\pi r_o T}$		+	+	−	−					
	Shear stress due to load, V_L		$\tau_{x\phi} = \frac{V_L}{\pi r_o T}$						−	−	+	+	
	Add Algebraically for summation of shear stresses, τ =				0	0	0	0	0	0	0	0	
	COMBINED STRESS INTENSITY, S												
	1) When σ_ϕ & σ_x have like signs		$S = \frac{1}{2}\left[\sigma_\phi + \sigma_x + \sqrt{(\sigma_\phi - \sigma_x)^2 + 4\tau^2}\right]$										
	2) When $\tau = 0$		S = largest of $\lvert\sigma_\phi\rvert$, $\lvert\sigma_x\rvert$ or $\lvert\sigma_\phi - \sigma_x\rvert$										
	3) When σ_ϕ & σ_x have unlike signs		$S = \sqrt{(\sigma_\phi - \sigma_x)^2 + 4\tau^2}$										

(14) FULL FLOW LUBE OIL STRAINER 0 0 0 . 1 0 0 0 0

RLB

8/27/74

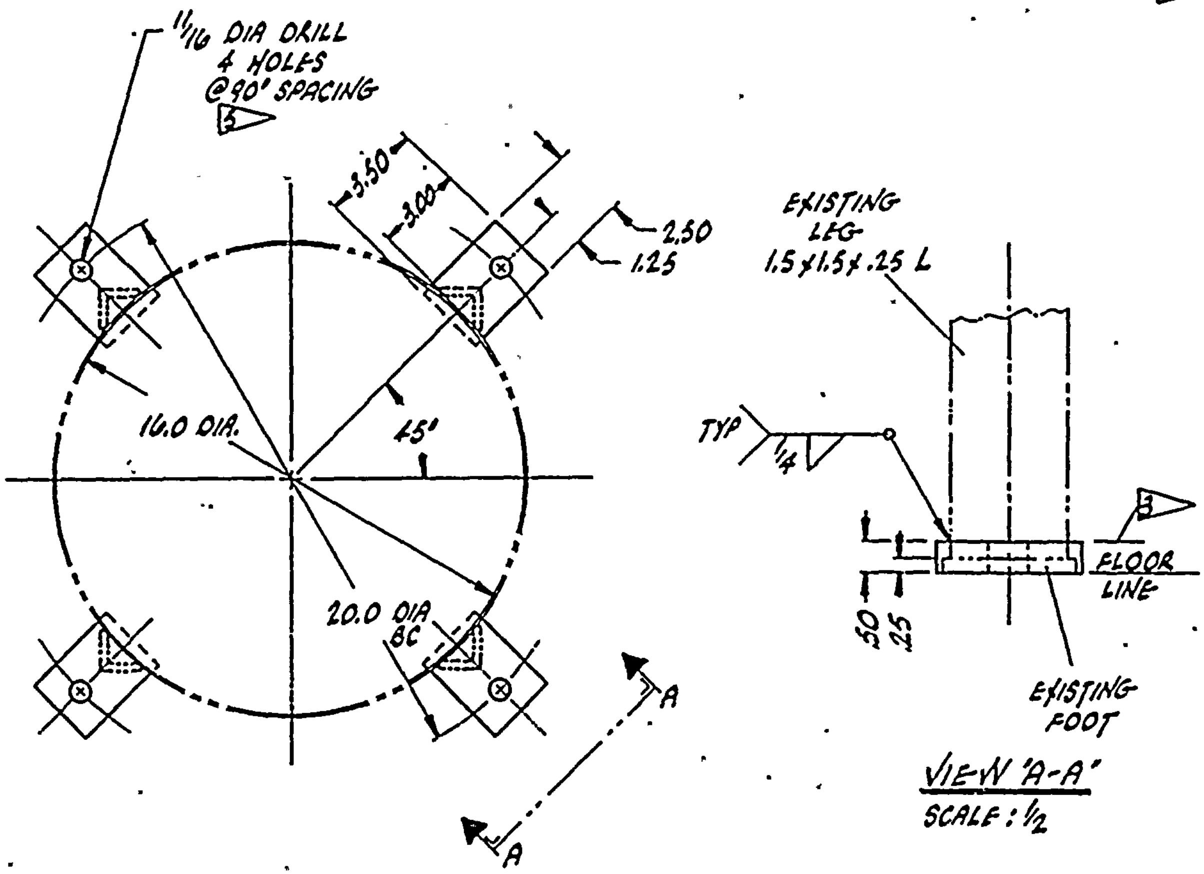
```
        run
?       ' F. F. L. O. strainer'
ODC,IDC,ODH,KH,KB
?       15., 15.625, 6.63, 1., 1.
P,MC,ML,MT,VC,VL
?       245.5, 5788.2, 14180.5, 11784, 378.6, 2524.4
F3C,F1C,F3A,F1A,F3B,F1B
?       1.6, .025, 1.3, .004, 2.35, .0086
F4C,F2C,F4A,F2A,F4B,F2B
?       5.0, .01, 4.2, .025, 1.35, .014
```

AAP=	897	AAX=	1698
BBP=	2754	BBX=	1102
CCP=	1750	CCX=	5654
DDP=	21790	DDX=	8514
EEP=	7755	EEX=	4455
FFP=	7100	FFX=	11683

LOCAL PRIMARY STRESSES TO BE COMBINED WITH GENERAL BENDING AND MEMBRANE STRESSES. NOZZLE LOAD VALUES USED ARE THOSE HAVING BEEN TRANSFERRED FROM ACTUAL PIPING CONNECTION TO SHELL WALL.

Y | SK7940

REF.	AMT.	PART NO.	NAME OF PART	MATERIAL	PATT. NO.
1	1	SK7940-1	MODIF.	WELD COMPL	REF 2-3
2	8	SK7940-2	FOOT	PL1	A285
3	1	REF ONLY	STRAINER	PUR	2



1. ONLY ONE SIDE OF STRAINER SHOWN
2. NUGENT 1554-AL3B-ON-100 FULL FLOW L.O. DUPLEX STRAINER PER NUGENT DWG 10-089
3. ORIGINAL EQUIPMENT 1/4" THK FEET MUST BE REMOVED ALONG WITH 1/4" OF EXISTING LEGS TO ACCOMMODATE THE NEW 1/2" THK. FEET WITHOUT ALTERING STRAINER POSITION
4. WELDING CODE : ASME-SECT IX
5. USE EXISTING 1/2" BOLTING ON EXISTING BOLT CIRCLE

REF. 1 COMPL.

UNLESS OTHERWISE SPEC. DIMENSIONS (inches)	TOLER. ±	GEOMETRIC SYMBOLS USASI-Y14.5-1966
1 PLACE DEC. (X.X)	.06	FLATNESS
2 PLACE DEC. (X.XX)	.02	STRAIGHTNESS
3 PLACE DEC. (X.XXX)	.010	ROUNDNESS
ANGLES	0° 30'	PARALLELISM
THREADS: UN-2A,2B		PERPENDICULAR
FILLETS .XX to .XX R		ANGULARITY
BREAK CORNERS .02 x 45° MAX.		RUNOUT
REMOVE BURRS		TRUE POSITION
		CONCENTRICITY
		SYMMETRY

* SEISMIC STUDY

SIMILAR TO DWG. NO. A-3
EXCEPT:

STRAINER MOUNTING MODIF. *

WORTHINGTON CORPORATION
COMPRESSOR & ENGINE DIV. BUFFALO, N.Y.

REPOSITORY	DATE	REPOSITORY	DATE
WORTHINGTON CANADA		NIIGATA WORTHINGTON	
MONTREAL LOCOMOTIVE		DEUTSCHE WORTHINGTON	
WORTHINGTON ARGENTINA		WORTHINGTON (FRANCE)	
WORTHINGTON (BRAZIL)		WORTHINGTON S.P.A.	
WORTHINGTON DE MEXICO		WORTHINGTON (SPAIN)	

DWN	CHK.	APPD.	DATE
J.S	[illegible]	[illegible]	[illegible] 74

SCALE	ORDER NO.		
1/2	[illegible]	Y	SK7940

0 0 0 0 0 0 1 0 0 0 0

Calculations

SUBJECT: WORTHINGTON LUBE OIL STRAINER SUMMARY

JOB NUMBER P2519.01
FILE NUMBER C-10
SHEET 30 OF
BY [illegible] DATE Sept 1984
APP DATE

1. Longitudinal stress in legs FS = 1.61 P 11.
2. Shear stress in legs FS = 21.2 P 12
3. Safety factor for bending of baseplate ¼" thick was found to be much less than 1.6. Changing the thickness to ½" was proposed in Worthington DWG No SK 7940. Based on ½" base plate thickness :-

   FS = 1.89 FOR O.B.E. & FS = 1.57 FOR DBE (SHEET 14A)

4. Holding down bolts Tension FS = 4.24 P 13
   Shear FS = 3.64 P 13
5. Leg to tank weld FS = 3.08 P 14
6. Shell Integrity FS = 2.66 P 26

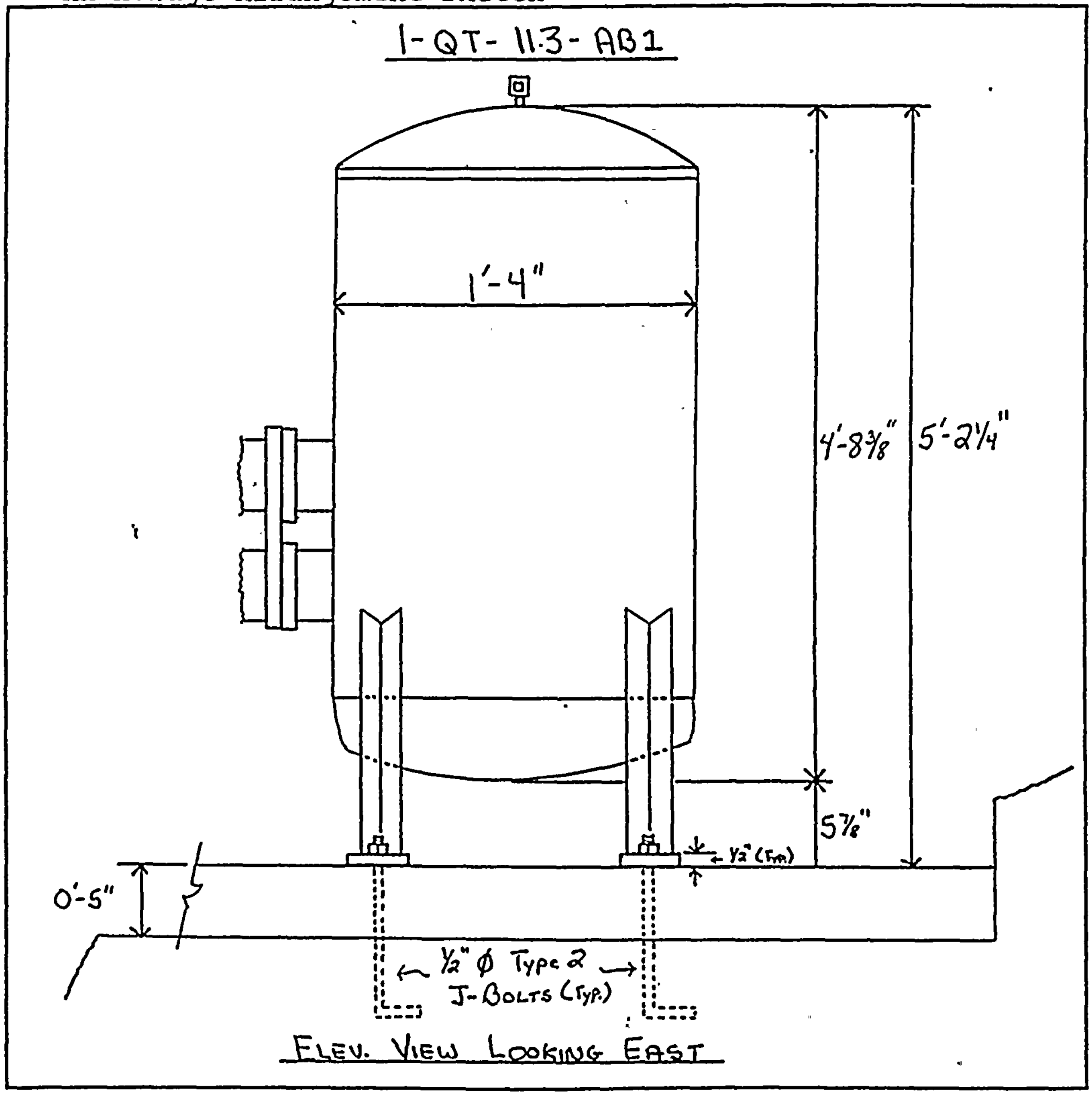
FORM NO. 152 REV. 1

ANCHOR INSPECTION DATA SHEET

1	Aux	AB Emerg. Diesel Lube Oil Pit
Unit #	Bldg.	Location

12-3229 / 11	1-QT-113-AB1
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: James Wisniewski Date: 2-24-92

Verified by: [signature] Date: 2-25-92
Qual./Cert. Inspector

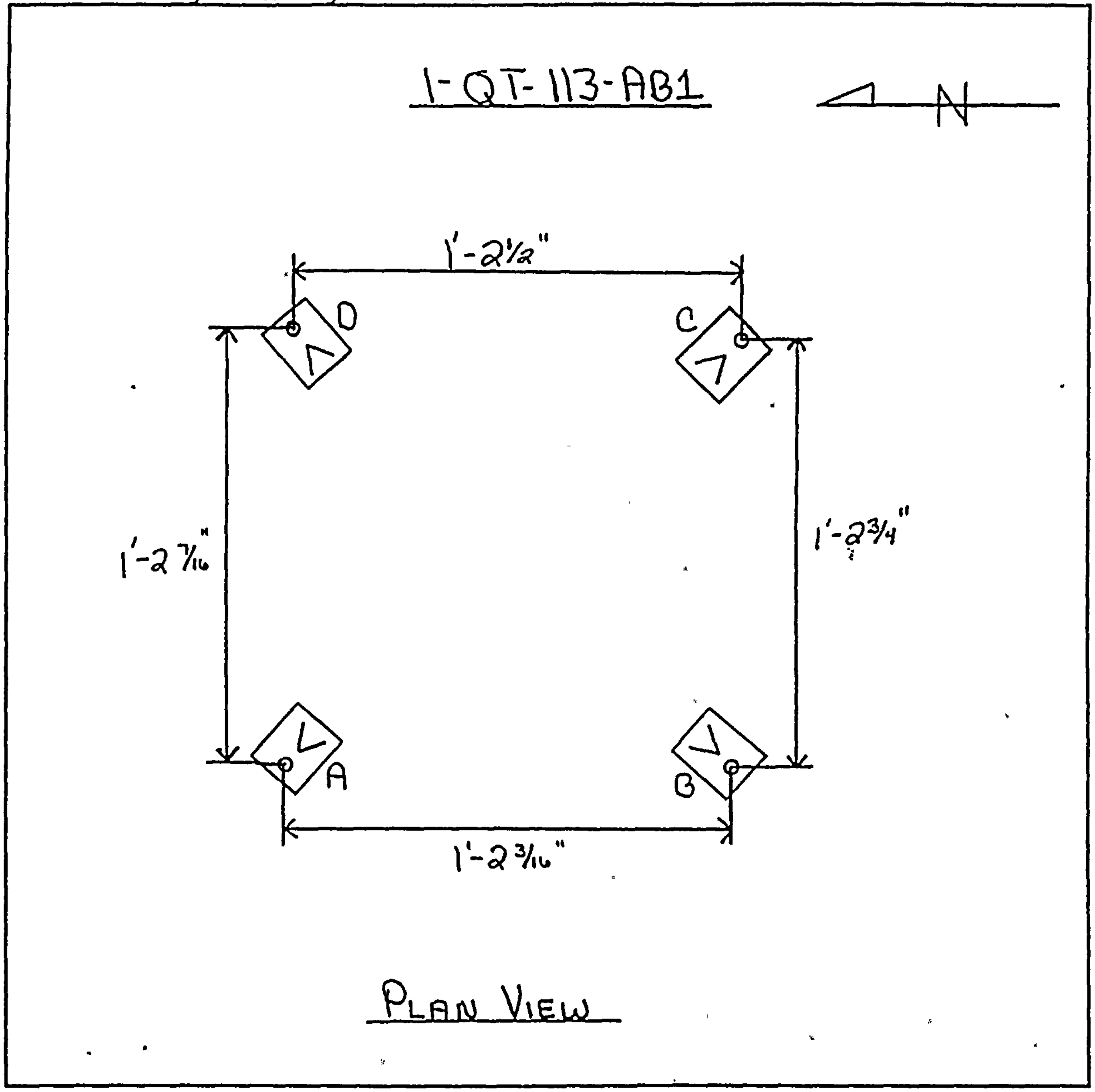
Reviewed by: James Wisniewski Date: 6/16/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	Aux.	AB Diesel Lube Oil Pit
Unit #	Bldg.	Location

12-3229 / 11	1-QT-113-AB1
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: James Wisniewski Date: 2-25-92

Verified by: [signature] Date: 2-26-92
Qual./Cert. Inspector

Reviewed by: James Wisniewski Date: 6/16/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-QT-113-AB1 Dwg No.: 12-3229-11

Anchor type: Type 2 J-Bolt Dia: 1/2" Dwg No.: 12-3073A-3

Tightness established by: ☒ "Snug Fit" ☐ Torque

Torque Wrench No.: N/A Cal. Due Date: N/A

Tightness verified? ☒ Yes ☐ No [signature] Construction ARE Date: 6/16/92

Equipment base flexible? ☐ Yes ☒ No [signature] Construction ARE Date: 6/16/92

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	0"	0"	0"	0"					
Anchor length	1'-4"	1'-4"	1'-4"	1'-4"					
Protruding length	6 3/4"	6 5/8"	6 7/8"	6 3/8"					
Embedment	9 1/4"	9 3/8"	9 1/8"	9 5/8"					
Bolt grip	5 1/2"	5 3/8"	5 1/4"	4 15/16"					
Concrete condition	ok	ok	ok	ok					
Edge distance	1'-10"	1'-0"	0'-5"	1'-7 1/2"					
Anchor spacing	1'-2 3/16"	1'-2 3/16"	1'-2 1/2"	1'-2 7/16"					
Anchor angularity	0°	0°	0°	0°					
Thread engagement	ok	ok	ok	ok					

Comments: No Anchor Lengths Are Taken From Drawings 12-3229-11 and 12-3073A-3. Also no washers are used. Edge Distance is due to sump in the area. Anchors A, B, C and D do not meet the minimum requirements for Embedment & Bolt Grip. This will require the review of AEPSC ARE. [initials] 2/24/92 Anchor "A" & "D" were tightened during the tightness verification. [initials] 6/16/92 ADD WASHER & RETORQUE THE BOLTS PER SDS 83; OTHER DISCREPENCIES DO NOT DICTATE ANY OPERABILITY CONCERN. T. [signature] 8-10-92.

Verified by: [signature] Date: 6-16-92
Qual./Cert. Inspector

Reviewed by: [signature] Date: 6/16/92
Construction ARE

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-QT-113-AB1 Dwg No.: 12-3229-11

Embedded Steel Dwg. No.: N/A

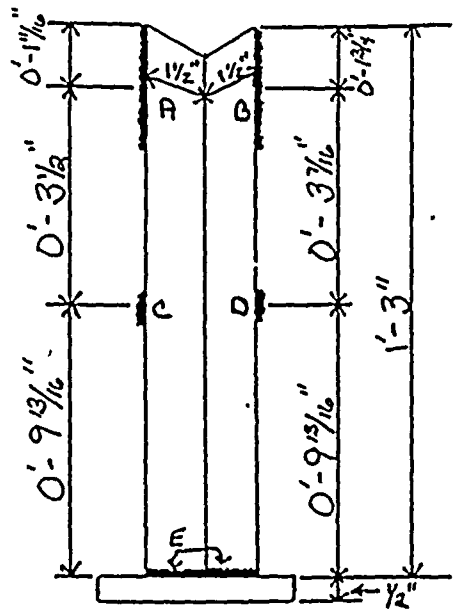
PHYSICAL CHARACTERISTICS

Weld ID	A	B	C	D	E			
Type	1	1	1	1	1			
Size	3/16"	3/16"	3/16"	3/16"	3/16"			
Length	3 7/16"	3 1/2"	1 7/16"	1 7/8"	2 3/4"			
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

SUPPORT BRACKET DETAILS

BRACKET A



BRACKET THICKNESS: 1/4"

Equipment base flexible: ☐ Yes ☒ No James Wisniewski Construction Are Date: 2-24-92

Reviewed by: James Wisniewski Construction Anchor Review Engineer Date: 2-24-92

Verified by: [signature] Qual./Cert. Inpsector Date: 2-25-92

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-QT-113-AB1 Dwg No.: 12-3229-11

Embedded Steel Dwg. No.: N/A

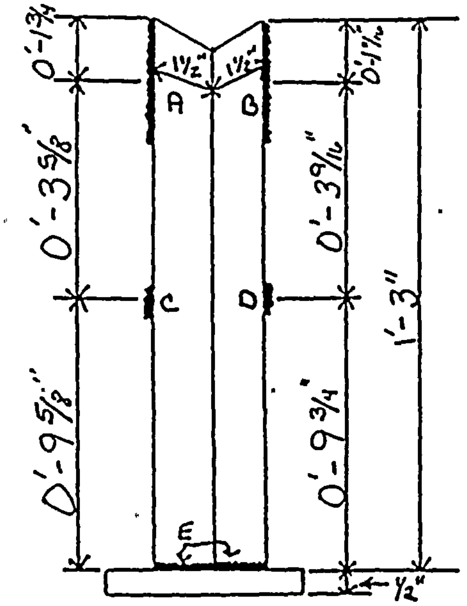
PHYSICAL CHARACTERISTICS

Weld ID	A	B	C	D	E			
Type	1	1	1	1	1			
Size	3/16"	3/16"	3/16"	3/16"	3/16"			
Length	3 9/16"	3 7/16"	1 7/8"	1 11/16"	2 3/4"			
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

SUPPORT BRACKET DETAILS

BRACKET B



BRACKET THICKNESS: 1/4"

Equipment base flexible: ☐ Yes ☒ No James Wisniewski Construction Are Date: 2-24-92

Reviewed by: James Wisniewski Construction Anchor Review Engineer Date: 2-24-92

Verified by: [signature] Qual./Cert. Inpsector Date: 2-25-92

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-QT-113-AB1 Dwg No.: 12-3229-11

Embedded Steel Dwg. No.: N/A

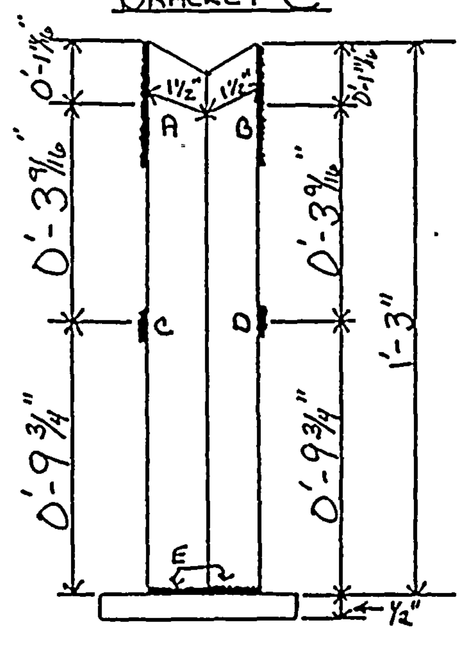
PHYSICAL CHARACTERISTICS

Weld ID	A	B	C	D	E			
Type	1	1	1	1	1			
Size	3/16"	3/16"	3/16"	3/16"	3/16"			
Length	3 3/8"	3 7/16"	1 11/16"	1 13/16"	2 7/8"			
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

SUPPORT BRACKET DETAILS

BRACKET C



BRACKET THICKNESS: 1/4"

Equipment base flexible: ☐ Yes ☒ No ____ Construction Are Date: 2-24-92

Reviewed by: ____ Construction Anchor Review Engineer Date: 2-24-92

Verified by: ____ Qual./Cert. Inpsector Date: 2-25-92

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-QT-113-AB1 Dwg No.: 12-3229-11

Embedded Steel Dwg. No.: N/A

PHYSICAL CHARACTERISTICS

Weld ID	A	B	C	D	E			-
Type	1	1	1	1	1			
Size	3/16"	3/16"	3/16"	3/16"	3/16"			
Length	3 1/2"	3 1/2"	1 1/2"	1 7/16"	2 3/4"			
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes

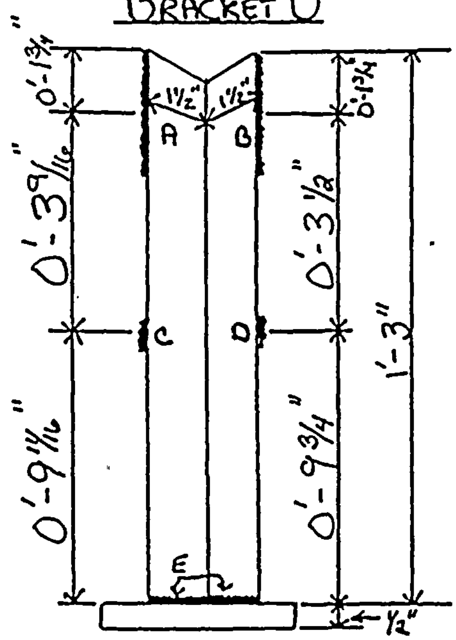
1 = Fillet

2 = Plug/Slot

3 = Groove

SUPPORT BRACKET DETAILS

BRACKET D



BRACKET THICKNESS: 1/4"

Equipment base flexible: ☐ Yes ☒ No Construction Are Date: 2-24-92

Reviewed by: Construction Anchor Review Engineer Date: 2-24-92

Verified by: Qual./Cert. Inpsector Date: 2-25-92

Equipment No.: 1-QT-113-AB1

Tightness established by "Snug Fit"

Tightness verified by: [signature] Date: 6-16-92

Qual./Cert. Inspector

Comments: Anchors A & D ~~[illegible]~~ JCW were tightened during the tightness verification check. JCW 6/16/92

Equip ID: 1-HE-13 Train: 12 Equip Class: 21

Drawing No.: 1-5129A 1-5135

.ction: RI

System: CVCS

Equip Desc: EXCESS LETDOWN HEAT EXCHANGER

Building: CONTAINMENT Room: REGENERATIVE HEAT EXCHANGER ROOM, AZ 295

Elev: 612 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: EXCESS LETDOWN HEAT EXCHANGER

Mfr: ATLAS INDUSTRIAL MANUFACTURING CO

Model:

el:

Elem. Drawing:

Wiring Drawing:

Power Source:

Walkdown: F, C Relay Eval : N

Comp Type: HEAT EXCHANGER

ISO Drawing:

Location: ON THE CONTAINMENT WALL SIDE OF THE RM

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 1
ID : 1-HE-13 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EXCESS LETDOWN HEAT EXCHANGER		
Building : CONTAINMENT	Floor El. : 612.00	Room, Row/Col : REGENERATIVE HEAT EXCHANGER RM, ON THE CONT WALL SIDE OF THE RM
Manufacturer, Model, Etc. : ATLAS INDUSTRIAL MANUFACTURING CO		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: George G. Thomas (S&A) and Tom Huang (AEP), April 13, 1995.

Ref: Unit 1 and 2 Anchor Bolt Schedule (Drwg. # 3073A-3 and 3073D), and Unit 1 & 2 Containment Building Concrete Floor (Drwg. # 1-2-3207-23)

Relatively small exchanger (1600 lbs) on two saddles in extremely high rad area.

Could not inspect anchorage due to it being hidden from view with insulation. Removal of insulation was not performed because of ALARA considerations.

Anchorage includes four 3/4" diameter J-bolts, embedded at least 2 feet into piers. Due to large anchorage (four 3/4" bolts) and small exchanger, the anchorage is acceptable by SRT judgment,

Evaluated by: Date:

George G. Thomas 12/9/95

T Chen Huang 12/18/95

SAFE SHUTDOWN EQUIPMENT LIST (SSELWP)

FUNCTION: ESW

Equipment Class: 21 Train: 2

Equipment ID: 1-HE-18E Drawing Number: 1-5113 1-5144

System: CONTAINMENT SPRAY

Equip Description: EAST CONTAINMENT SPRAY HEAT EXCHANGER

Building: AUXILIARY Room: E CONTAINMENT SPRAY HEAT EXCHANGER ROOM Elevation: 609

Normal state: Desired state: Power Required: N Sort: W,_ Notes:

Supporting System Drawing Number:

Required Interconnections and Supporting Components:

fety Related Status: NUCLEAR SR Min/Opt: MIN

ADDITIONAL INFORMATION

Alias Number: Power Train: NA

Component Served: EAST CONTAINMENT SPRAY HEAT EXCHANGER

Manufacturer: YUBA Model:

Panel:

Elem Drawing: N/A Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Only: NO

Component Type: HE
ISO Drawings:

Detailed Location:

.DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 2
ID : 1-HE-18E (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EAST CONTAINMENT SPRAY HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : E CONT SPRAY HEAT EXCHANGER RM,
Manufacturer, Model, Etc. : YUBA (VERTICAL)		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Tom Huang and Kailash Mahajan on 11/3/93.

Very well engineered support structure.

There is a ring support at top of the exchanger bracketed to the wall in each of the 4 quadrants. This takes the overturning loads on the exchanger.

Bottom support (at about the 1/4 point of the exchanger, with the remainder of the exchanger hanging below) is a heavy duty ring with gussets at the bolt locations. These are bolted to a steel support structure that is obviously well engineered.

Qualification data (Yuba Heat Transfer Division Calculation 69-G-226) indicates an analysis to the design basis. Based on the inspection and anchorage data collected the Heat Exchanger is adequate.

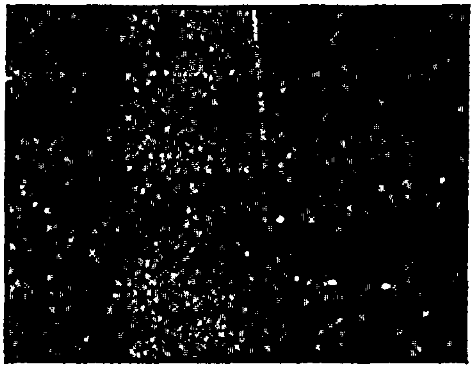
Evaluated by: Gary G. Thomas Date: 9/15/95

[signature] 10-19-95

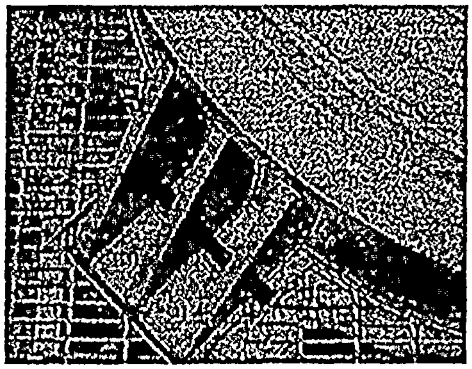
Attachment: Pictures

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 2
ID : 1-HE-18E (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EAST CONTAINMENT SPRAY HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : E CONT SPRAY HEAT EXCHANGER RM,
Manufacturer, Model, Etc. : YUBA (VERTICAL)		

PICTURES



BASE GUSSETED SUPPORT



TOP SUPPORT

File 6.2.3 Copy

6.2.2

YUBA HEAT TRANSFER DIVISION

P.O. BOX 3158 • TULSA, OKLAHOMA 74101 • (918) 939-2201

YUBA INDUSTRIES, INC.

December 7, 1971

American Electric Power
Two Broadway
New York, New York 10004

COOK PLANT
MED RECORD - MED COPY
SECTION NE&P
ENGINEER [illegible]
DATE 4/15/87
☒ PLANT LIFETIME
DATE TO PLANT ____
☐ NON PERMANENT
MINIMUM RETENTION ____ YRS.

Attention: Mr. R. A. Kadlec
Mechanical Engineering Division

Subject: Indiana & Michigan Electric Company
Donald C. Cook Nuclear Plant
Contract 1241
Containment Spray Heat Exchangers
Yuba Job Number 69-G-226

Gentlemen:

We are enclosing six (6) copies of our Seismic Stress Analysis for the subject job.

We refer to a letter of November 9, 1971, written by your Mr. A. Sherman, requesting additional clarification. As a result, we have completely rewritten this analysis as Rev. 2.

Please return one (1) copy indicating your approval and/or comments at your earliest convenience.

Very truly yours,

YUBA HEAT TRANSFER CORPORATION

B.F. Forman

B. F. Forman
Design Engineer

BFF:dc
cc: Mr. A. Sherman
Main File
Eng. File

2 cy to Alle. 12/9

6.2.2.

Seismic Stress Analysis
Indiana & Michigan Electric Company
Donald C. Cook Nuclear Plant
Contract 1241
Containment Spray Heat Exchangers
Yuba Reference 69-G-226

Stresses in the support ring structure resulting from the operating load on supports, the forces due to seismic acceleration and operating pressure will be investigated using the references listed below.

The support structure consists of two 4" x 2" rings encircling the exchanger together with a 1" thick wear plate and ½" shell plate. Refer to Page 5 for vertical support details.

The following stresses will be calculated:

1. Longitudinal bending stress due to shell acting as a cantilever beam and loaded with horizontal seismic force.
2. Bending stress in ring structure loaded with operating wt. and vertical seismic and horizontal seismic force acting at center of gravity of exchanger.
3. Circumferential and longitudinal stress in shell due to pressure in shell.

The period of vibration is determined using References 1 and 2 below:

1. "Introduction to Matrix Method of Structural Analysis", by Harold C. Martin, McGraw-Hill Book Company, 1966.
2. Yuba Computer Program to determine loads and reactions in structures by the direct stiffness method per reference 1 above. The program also calculates the natural frequencies of structures. See discussion on Pages 10 and 11.

$W = 94.4^k$ Total Operating Wt.

*Vertical Acceleration $A_V = .17$

*Horizontal Acceleration $A_H = .3$

$A = 10/12$ Ft.

$B = 18/12$ Ft.

$C = 9.42$ Ft.

$D = 3.46$ Ft.

$E = 6.92.$ Ft.

$\theta = 45°$

(See Fig. 2 Page 5)

$H_F = W \times A_H = 94.4^k \times .3 = 28.3^k$

$V_F = W \times (1 + A_V) = 94.4^k \times 1.17 = 110.4^k$

$2 \cdot PE \text{ Sin } \theta = V_F \text{ D Sin } \theta + CH_F$

$2 \text{ P} \times 6.92 \times .707 = 110.4^k \times 3.46' \times .707 + 9.42' \times 28.3^k$

$P = 54.9 \text{ k}$ (Vertical reaction at one support)

The following forces are horizontal components acting normal to the rings. Two forces act at each support - See Fig. 2 Page 5.

$R_1 = \dfrac{A \times P}{2/3B \times 2} = \dfrac{10/12' \times 54.9k}{2/3\ (18/12') \times 2} = 22.8$ k (Force due to moment caused by vertical reaction)

$h_1 = \dfrac{HF/2 \text{ Sin } \theta}{4 \times 2} = \dfrac{28.3^k/2 \times .707}{4 \times 2} = 1.25^k$ (Horizontal shear in each ring)

$h_2 = \dfrac{H_F \text{ Sin } \theta}{4 \times 2} = \dfrac{28.3^k \times .707}{4 \times 2} = 2.5^k$ (Force due to moment cuased by horizontal reaction)

$R = R_1 \pm h_1 + h_2 = 22.8\text{ k} \pm 1.25\text{ k} + 2.5\text{ k}$

$= 26.55\text{ k}, 24.05\text{ k}$ (Total horizontal force acting normal to the ring See Fig. 2 Page 4)

Using 4' x 2" Rings and the loading "R" shown in Figure 2, calculations were made to determine stresses.

For stress in rings see Page 6.

Stress in Shell
(Due to H_F Acting at CG)

$M = H_F \times C = 28.3^k \times 9.42' \times 12 = 3200$ in k (Moment in Shell)

Section Modulus

Where d = outside diameter of shell, in.
di = inside diameter of shell, in.

$$= .049087 \frac{(d^4 - d_i^4)}{R}$$

$$= .049087 \frac{(61^4 - 60^4)}{30.5} \quad \frac{43500}{30.5} = 1426 \text{ in}^3$$

$$\text{Stress} = \frac{M}{S} = \frac{3,200,000 \text{ in lb}}{.1426 \text{ in}^3} = 2245 \text{ psi Shell Stress}$$

* The above calculations were based on the horizontal & vertical acceleration given in your specification 42373-NHX.

The accelerations used to obtain stresses correspond closely to those obtained by calculating the natural frequency of the exchanger see Page 9 for values plotted on the response spectra curve at Floor EL.633.

The natural period of the exchanger as obtained from our computer program and based on loadings shown on Figure 1. Page 4 is 1.275 Second (maximum).

f. 28 cps
T. .035

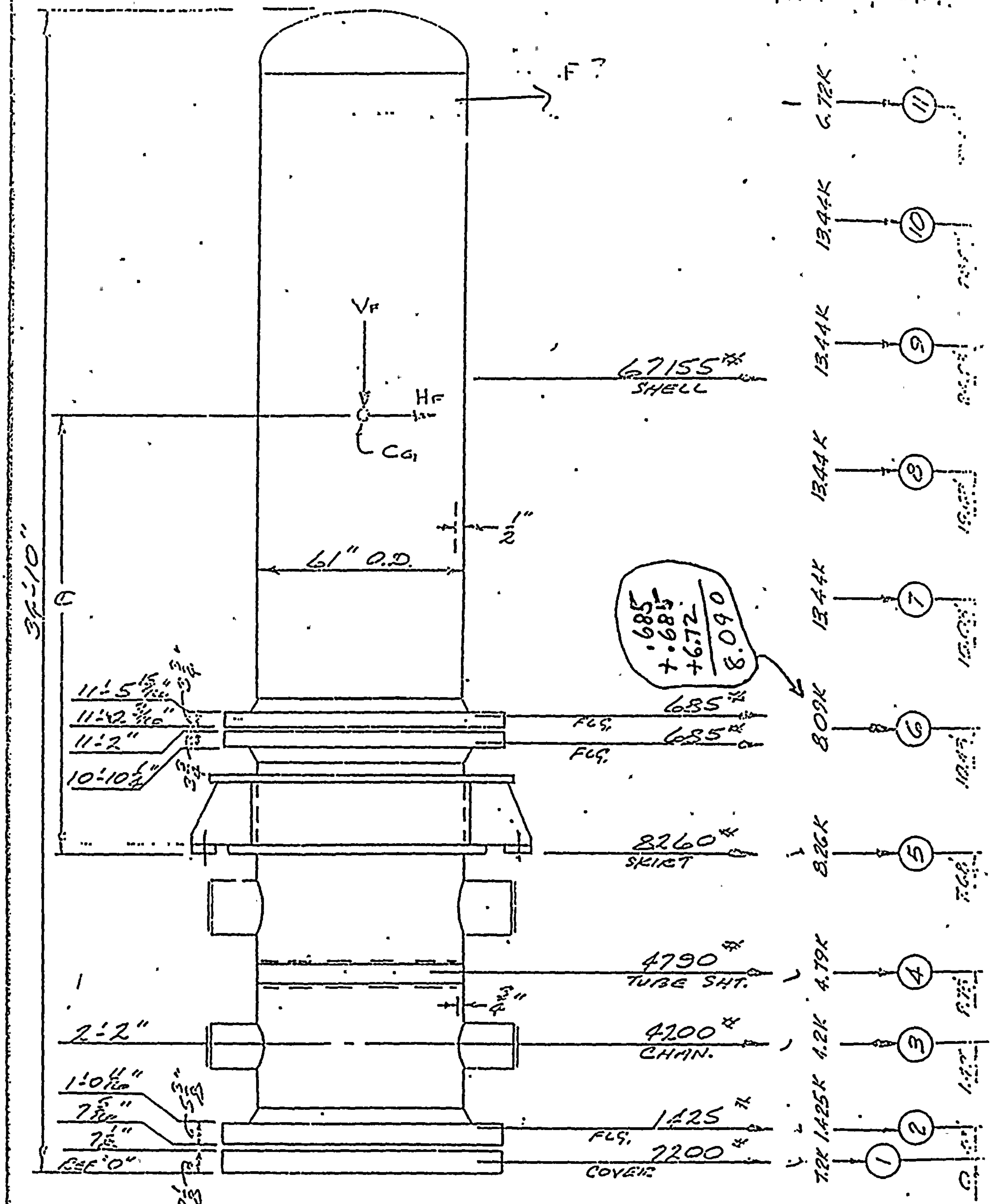


FIGURE 1

OPR. WEIGHTS

DWG.	YUBA HEAT TRANSFER CORPORATION	TITLE
CHK.	A SUBSIDIARY OF YUBA CONSOLIDATED INDUSTRIES, INC.	
APP.		DWG.
DATE	3515 DAWSON ROAD, TULSA, OKLAHOMA	69-G-226-1

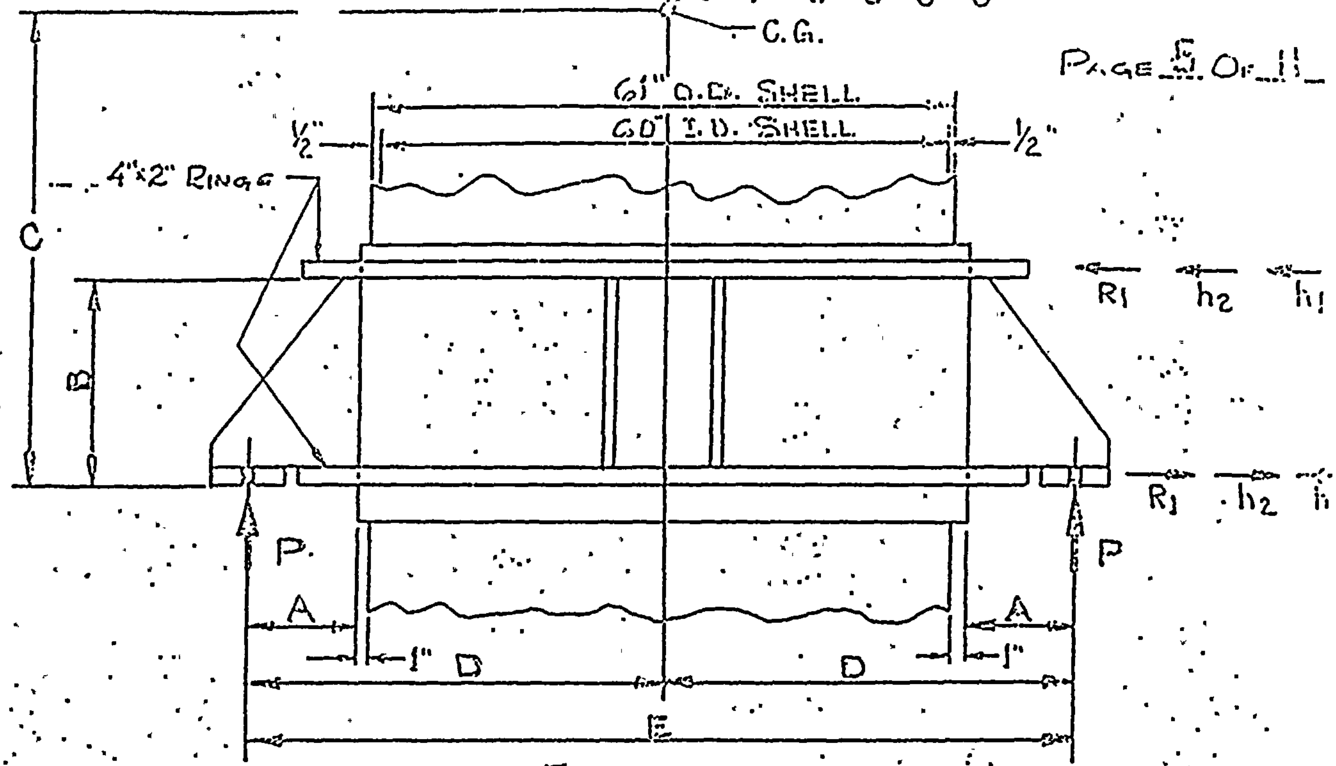
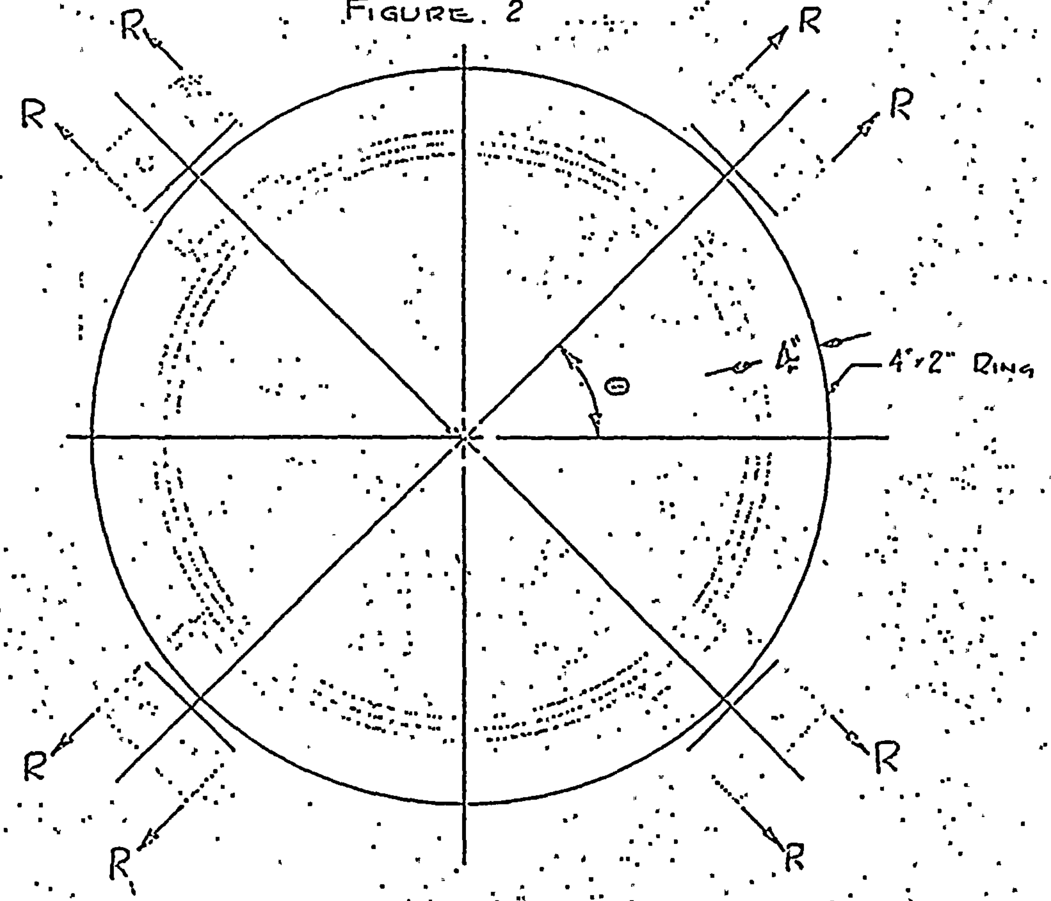


FIGURE. 2



A = 10/12'

B = 18/12'

C = 9.42'

D = 3.46'

E = 6.92'

θ = 45°

VERT SUPPORT DETA

STRESS IN RINGS

Reference "Formulas For Stress & Strain" by Roark (See Page 7)

Moments in Ring

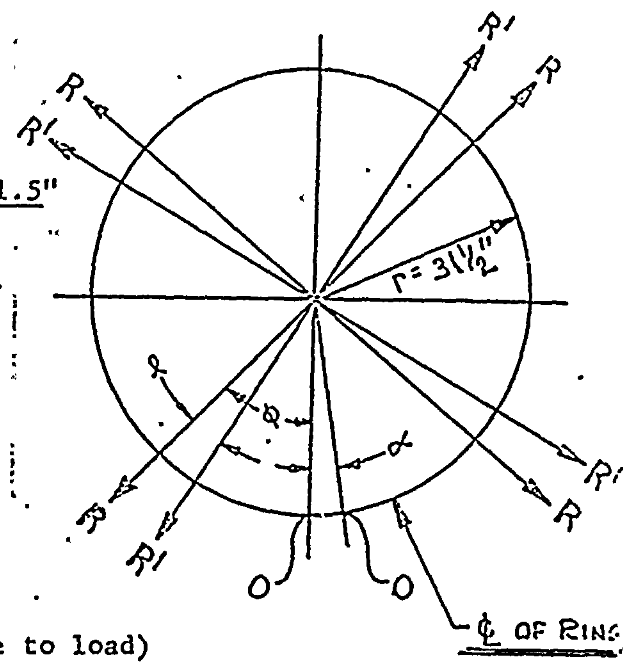
$\alpha = 17°$ $\qquad \cos\alpha = .9563$

$\theta - \alpha = 28°$ $\qquad \cos\theta - \alpha = .8830$

$R = 26.55\ k \qquad r = 31.5''$

$\frac{1}{2} R r = \frac{26.55\ k \times 31.5''}{2}$

$= 418$ in k



$M_R = -\frac{1}{2} R r \left(\frac{1}{\theta} - \cot\theta\right)$

$M_{R'} = \frac{1}{2} R r \left(\frac{\cos(\theta - \alpha)}{\sin\theta} - \frac{1}{\theta}\right)$

$M_O = \frac{1}{2} R r \left(\frac{1}{\sin\theta} - \frac{1}{\theta}\right)$

$M_{O'} = \frac{1}{2} R r \left(\frac{\cos\alpha}{\sin\theta} - \frac{1}{\theta}\right)$

$M_R = -418 \left(\frac{1}{.7853} - 1\right) = -113.8$ in k (Moment at load due to load)

$M_{R'} = 418 \left(\frac{.8830}{.707} - \frac{1}{.7853}\right) = -10.45$ in k (Moment at R' due to load at R)

$M_O = 418 \left(\frac{1}{.707} - \frac{1}{.7853}\right) = 59.4$ in k (Moment at O due to load at R)

$M_{O'} = 418 \left(\frac{.9563}{.707} - \frac{1}{.7853}\right) = 33.4$ in k (Moment at O' due to load at R)

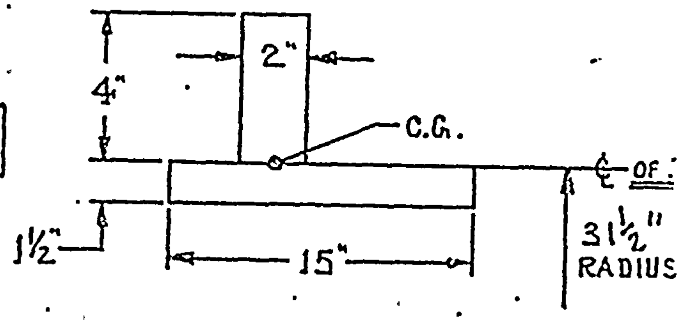
M_R (Total) $= (113.8 + 10.45) = -124.25$ in k

M_O (Total) $= (59.4 + 33.4) = 92.8$ in k

Moment of Inertia of Ring

$I = \frac{2 \times 4^3}{12} + \frac{15 \times 1.5^3}{12} + \left[8 \times 2^2 + 22.5 \times .75^2 \right]$

$I = 59.51\ in^4 \qquad S = \frac{I}{C} = \frac{59.51}{4} = 14.9\ in^3$



Max. Stress (at load) $= \frac{M}{S}$ or $\frac{Mc}{I}$

$= \frac{-124250\ \text{in. lbs.}}{14.9\ in^3} = 8,350$ psi (in 4" x 2" ring)

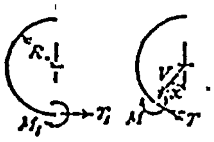
$CG = \frac{22.5 \times .75 + 8 \times 3.5}{2 \times 4 + 1.5 \times 15}$

$= \frac{-124250\ \text{in. lbs.} \times 1.5''}{59.51\ in^4} = 3,140$ psi (in shell)

$= 1.5''$

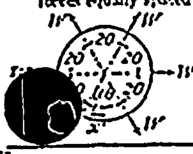
Copy Taken From
"Formulas For Stress and Strain" by Roark

TABLE VIII.—FORMULAS FOR CIRCULAR RINGS AND ARCHES



M_1, T_1, V_1, M, T, and V are positive when as shown, negative when reversed. All applied forces and couples are positive when as shown, negative when reversed. The following notation is employed: E = modulus of elasticity (lb. per sq. in.); I = moment of inertia of ring cross section (in.[4]); W or F as shown = applied load or reaction (lb.); w = applied load (lb. per lin. in.); k = weight of contained liquid (lb. per cu. in.); $z = \sin x$, $u = \cos x$; $s = \sin \theta$, $c = \cos \theta$; $n = \sin \phi$, $e = \cos \phi$; $p = \sin \beta$, $q = \cos \beta$. All angles in radians, distances in inches, forces in pounds, moments in inch-pounds. $+D_x$ or $+D_y$ means increase, $-D_x$ or $-D_y$ means decrease in diameters. $+\Delta R$ means increase, $-\Delta R$ means decrease, in upper half of vertical diameter.

TABLE VIII.—FORMULAS FOR CIRCULAR RINGS AND ARCHES.—(Continued)

Loading, support and case number	Formulas for bending moment M, circumferential tension T, radial shear V at angular distance x from bottom of ring and for D_x, change in horizontal diameter, and D_y, change in vertical diameter
9. Ring under any number of equal radial forces equally spaced 	($x = 0$ to $x = \theta$) $M = \frac{1}{2}WR\left(\frac{u}{s} - \frac{1}{\theta}\right)$; Max $+M = \frac{1}{2}WR\left(\frac{1}{s} - \frac{1}{\theta}\right)$ at $x = 0, 2\theta, 4\theta$, etc. Max $-M = -\frac{1}{2}WR\left(\frac{1}{\theta} - \cot\theta\right)$ at each load Max $T = \frac{1}{2}W\left(\frac{1}{s}\right)$ at $x = 0, 2\theta$, etc. $T = \frac{1}{2}W\cot\theta$ at loads. Radial displacement of each load point $= \frac{WR^3}{2EI}\left[\frac{1}{s^2}\left(\frac{1}{2}\theta + \frac{1}{2}sc\right) - \frac{1}{\theta}\right]$ outward Radial displacement at $x = 0, 2\theta, 4\theta$, etc. $= \frac{WR^3}{4EI}\left(\frac{2}{\theta} - \frac{1}{s} - \theta\frac{c}{s^2}\right)$ inward

SUMMARY OF STRESSES

Combined Longitudinal Stress

Longitudinal stress due to pressure = $\frac{r \times p}{2t} - .2\ p$

Where r = inside radius of shell, t = shell thickness & p = design pressure

$= \frac{30'' \times 150\ psi}{2 \times .5''} - .2 \times 150\ psi = 4{,}470\ psi$

Combines stress = pressure stress + bending stress (Page 3)

$= 4{,}470 + 2{,}245 = 6{,}715\ psi$

Combined Circumferential Stress

Circumferential stress due to pressure = $\frac{r \times p}{t} - .6\ p$

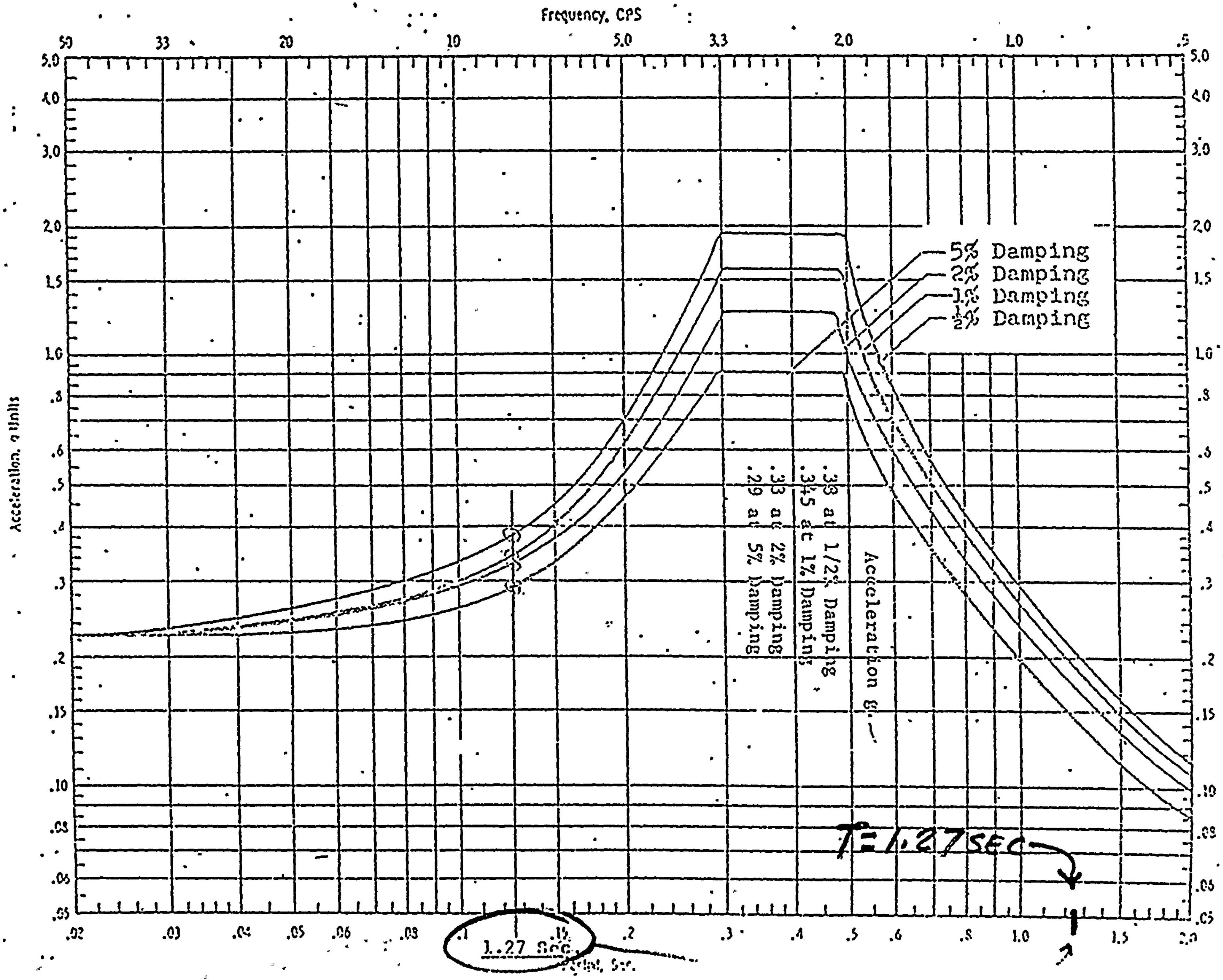
$= \frac{30'' \times 150\ psi}{.5''} - .6 \times 150\ psi = 8{,}910\ psi.$

Combined stress = pressure stress + bending stress (Page 6)

$= 8{,}910 + 3{,}140 = 12{,}050\ psi$

Shear Stress

The shear stress in the shell can be ignored since the ring structure takes the load in bending.



RESPONSE SPECTRA
COOK AUXILIARY BUILDING
FLOOR EL. 633

ENGINEERS

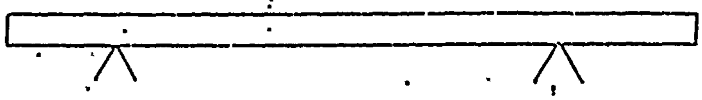
PROJECT
DESIGN BY
CHECKED BY
DATE
SHEET 3 OF

Computer Program for Determining Loads and Reactions in a Structure

This program uses the direct stiffness method as shown by H. C. Martin in 'Matrix Methods of Structural Analysis'.

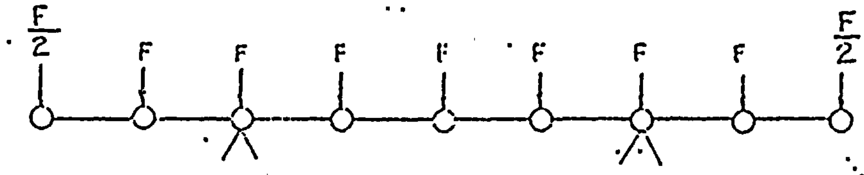
In the case of a beam with a distributed load, the load is divided into many point loads spaced along the beam.

W #/ft.



L = Length

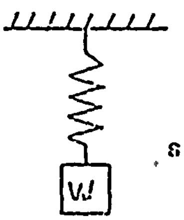
The problem would be approximated as



Where F = WL/(N-1) Where N = No. of Load Points

From here the program calculates the moments at each load point and the reactions at each load point and the reactions at each support. Also, with the input, the natural frequencies may be calculated.

To find the natural frequency the stiffness matrix found above is used in much the same way as a spring constant in a vibrating spring and mass system. For a spring



$F = -KX \qquad F = -\frac{W}{g}\ddot{X}$

$\frac{W}{g}\ddot{X} = -KX$ but for an oscillating system $\ddot{X} = W^2 X$

or $\left(W^2 - \frac{Kg}{W}\right)X = 0$

W is in radians/sec

$W = \sqrt{Kg/W}$

freq. $= W/2\pi$ cycles/sec

NOTE—This drawing is the property of Yuba Heat Transfer Division, and is not to be reproduced in whole, or in part, nor used for any purpose other than that for which it is specifically furnished, without the approval of Yuba Heat Transfer Division

For our case $F = K$, where K is the stiffness Matrix, $F = \begin{bmatrix} F_1 \\ F_2 \\ \vdots \\ F_N \end{bmatrix}$ are the

point loads and $X = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_N \end{bmatrix}$ are the displacements at the point loads.

$$F = -MW^2X, \qquad \text{where } M = \frac{W}{g}$$

$$\text{or } -M\lambda X = KX, \qquad \text{where } \lambda = W^2$$

or $(K + M\lambda)X = 0$, since the displacements are not all equal to Zero the determinate of the Matrix $(K + M\lambda)$ must equal Zero. Then $W = \sqrt{\lambda}$ and $F = \frac{W}{2\pi}$ cycles/sec.

NOTE—This drawing is the property of Yuba Heat Transfer Division, and is not to be reproduced in whole, or in part, nor used for any purpose other than that for which it is specifically furnished, without the approval of Yuba Heat Transfer Division

CONTAINMENT SPRAY HEAT EXCHANGERS
HE-018

INSTRUCTIONS

FOR

INSTALLATION, OPERATION AND MAINTENANCE

OF

SHELL AND TUBE HEAT EXCHANGERS

FOR

AMERICAN ELECTRIC POWER SERVICE CORPORATION

INDIANA & MICHIGAN ELECTRIC COMPANY

DONALD C. COOK NUCLEAR PLANT

UNIT 1 AND 2

CUSTOMER'S PURCHASE ORDER NUMBER

Contract 1241

YUBA HEAT TRANSFER DIVISION JOB NUMBER

69-G-226

DESIGNED AND BUILT

BY

YUBA HEAT TRANSFER DIVISION

TULSA, OKLAHOMA

YUBA HEAT TRANSFER DIVISION

P. O. BOX 3158 • TULSA, OKLAHOMA 74101 • (918) 939-2201

69-G-226

EXCHANGER SPECIFICATION SHEET

YUBA INDUSTRIES, INC.

	CUSTOMER	American Electric Power Corp.			DATE	9-18-70
					CUST. NO.	42373-XXX
	PLANT LOCATION	Donald C. Cook Nuclear Plant			PROPOSAL NO.	QG-898-69
1	SERVICE OF UNIT	Containment Spray Cooler			ITEM NO.	EA-1
2	SIZE	60-355	TYPE	CFU	POSITION	Vertical
3	SURF/UNITS (EFF.)	11,200	SHELLS PER UNIT	Four	SURF./SHELL XXXX	12,000 Gross
4	NO. OF UNITS	One	SHELL ARRANGEMENT	PARALLEL XXXXX	ENGRS.	JEB
5	ALTERNATE	PERFORMANCE OF ONE UNIT				
6		SHELL SIDE			TUBE SIDE	
7	FLUID CIRCULATED	Lake Michigan Water			Borated NaOH Water	
8	TOTAL FLUID ENTERING #/HR.	1,650,000 - 3300 GPM			1,600,000 - 3200 GPM	
9	VAPOR #/HR.					
10	LIQUID #/HR.	1,650,000			1,600,000	
11	STEAM #/HR.					
12	NON-CONDENSABLES #/HR.					
13	FLUID VAPORIZED OR CONDENSED #/HR.					
14	STEAM CONDENSED #/HR.					
15	GRAVITY-LIQUID °API					
16	VISCOSITY-LIQUID CP.					
17	MOLECULAR-WEIGHT-VAPORS					
18	SP. HEAT-BTU/#/°F ENTHALPY-BTU/#					
19	TEMPERATURE IN °F.	76			167.5	
20	TEMPERATURE OUT °F.	141.5			100	
21	OPERATING PRESSURE P.S.I.A. P.S.I.G.					
	UMBER OF PASSES PER SHELL	two			two	
	ELOCITY FT./SEC.				3.7	
24	PRESSURE DROP P.S.I.	10	ALLOWED 14	CALC.	10 ALLOWED 4.0	CALC.
25	FOULING RESISTANCE	.001			.0005	
26	HEAT EXCHANGED-B.T.U./HR.	107,850,000		M.T.D. XXXXXXXX °F.	25.6	
27	TRANSFER RATE-SERVICE	375				
28	CONSTRUCTION-EACH SHELL					
29	DESIGN PRESSURE P.S.I.	150			300	
30	TEST PRESSURE P.S.I.	225			450	
31	DESIGN TEMPERATURE °F.	200			200	
32	TUBES A249 TP316	NO. 1150 U	O. D. 5/8"	IN 20	BWG.AVG.XXXWALL	
33			LENGTH 29'-7"	PITCH 13/16"	△ XXXX	
34	SHELL	Steel	NOM. I. D. 60"		O. D.	
35	SHELL COVER (INTEGRAL XXXXXXXXXX	Steel		FLTG. HD. COVER	--	
36	CHANNEL	304 Stainless Steel		CHANNEL COVER	304 S.Steel Clad	
37	TUBE SHEETS-STATIONARY	Steel & Overlay		FLOATING	--	
38	BAFFLES-SEGMENTAL	Steel	PITCH	% CUT	FLOW	
39	BAFFLE-LONG	Steel		IMP'T.	Stainless Steel	
40	TYPE JOINTS-SHELL	Bolted		TUBES	Bolted	
41	GASKETS-SHELL	S.Steel Clad	FLTG. HD. --	CHANNEL	S.Steel Clad	
42	CONNECTIONS-SHELL-IN	18"	OUT 18"	SERIES	WE	
43	CHANNEL-IN	12"	OUT 12"	SERIES	WE	
44	CORROSION ALLOWANCE-SHELL SIDE	1/8"		TUBE SIDE	--	
	DE REQUIREMENTS-ASME	1968 Sect.IIIC Tube Sect:8		STAMP (YES) XXXX	TEMA CLASS	
4	GHTS-EACH SHELL AND BUNDLE	60,000	BUNDLE ONLY		FULL OF WATER	94,400
47	REMARKS:-	Eddy current test tubes.				
		Seal weld tubes.				
		Full support plate a U bends.				

JUL 11 1975

MH/ MWC
7/18

YUBA HEAT TRANSFER CORPORATION

P. O. BOX 3158 • TULSA, OKLAHOMA 74101 • (918) 939-2201

July 9, 1975

American Electric Power Service Corporation
Two Broadway
New York, New York 10004

Attention: Mr. Cherry

Subject: Indiana & Michigan Electric Co.
Donald C. Cook Nuclear Plant
Contract 1241
Containment Spray Heat Exchanger
Yuba Job Number 69-G-226

Reference: Seismic Report for American Electric Power

Gentlemen:

Confirming our recent telephone conversations regarding our Seismic Analysis, our 69-G-226 vertical containment spray heat exchanger for the Donald C. Cook Nuclear Power Plant, the natural period of vibration is .108 sec. rather than .787 sec. as stated in the report.

Please note that the .108 sec. period will result in lower accelerations and stresses than those in the Seismic Report.

If we may be of further assistance, please contact us.

Very truly yours,

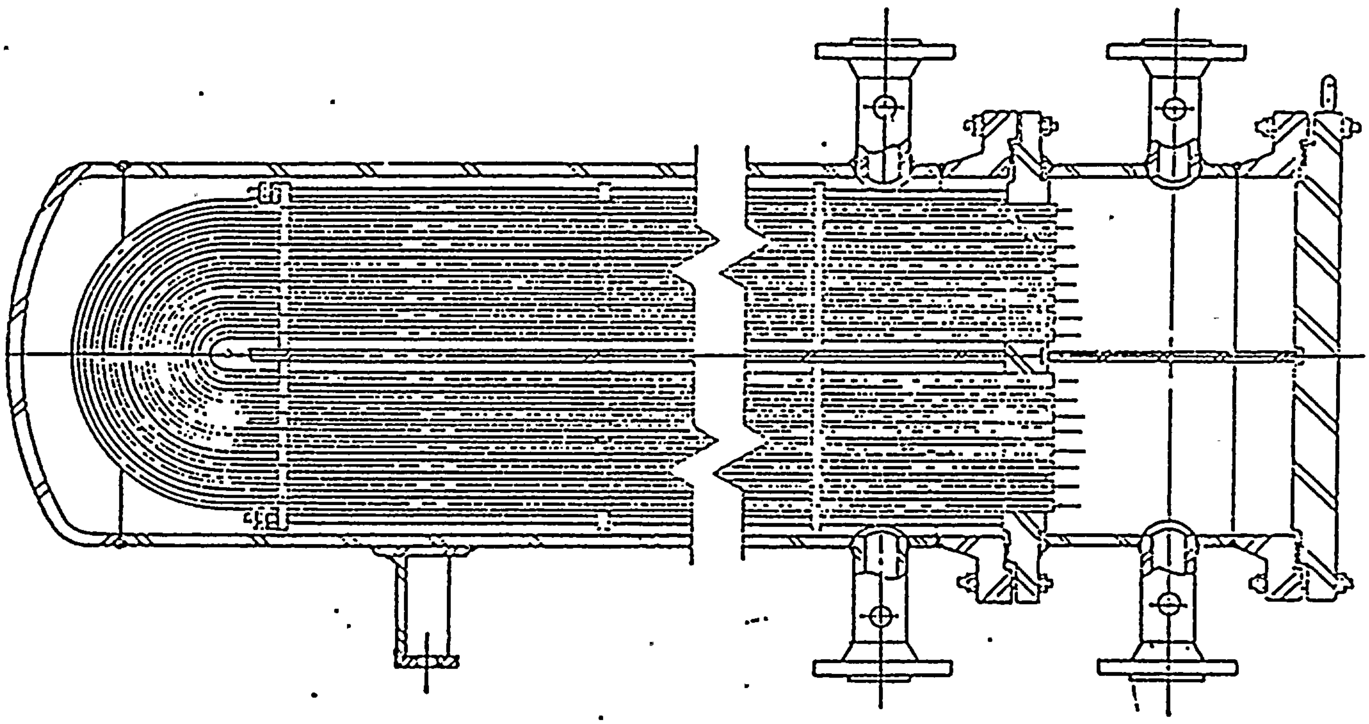
YUBA HEAT TRANSFER CORPORATION

William C. Newland

William C. Newland, Jr.
Design Engineer

WCN/et
cc:. Mr. R. H. Shaw
Mr. T. R. Harrington
Mr. Bill Newland
Main File
Engineering File

ALL AGREEMENTS CONTINGENT UPON STRIKES, ACCIDENTS AND OTHER CONDITIONS BEYOND OUR CONTROL.
ALL CONTRACTS ARE SUBJECT TO APPROVAL BY AN OFFICER OF THE COMPANY. QUOTATIONS SUBJECT TO CHANGE WITHOUT NOTICE.



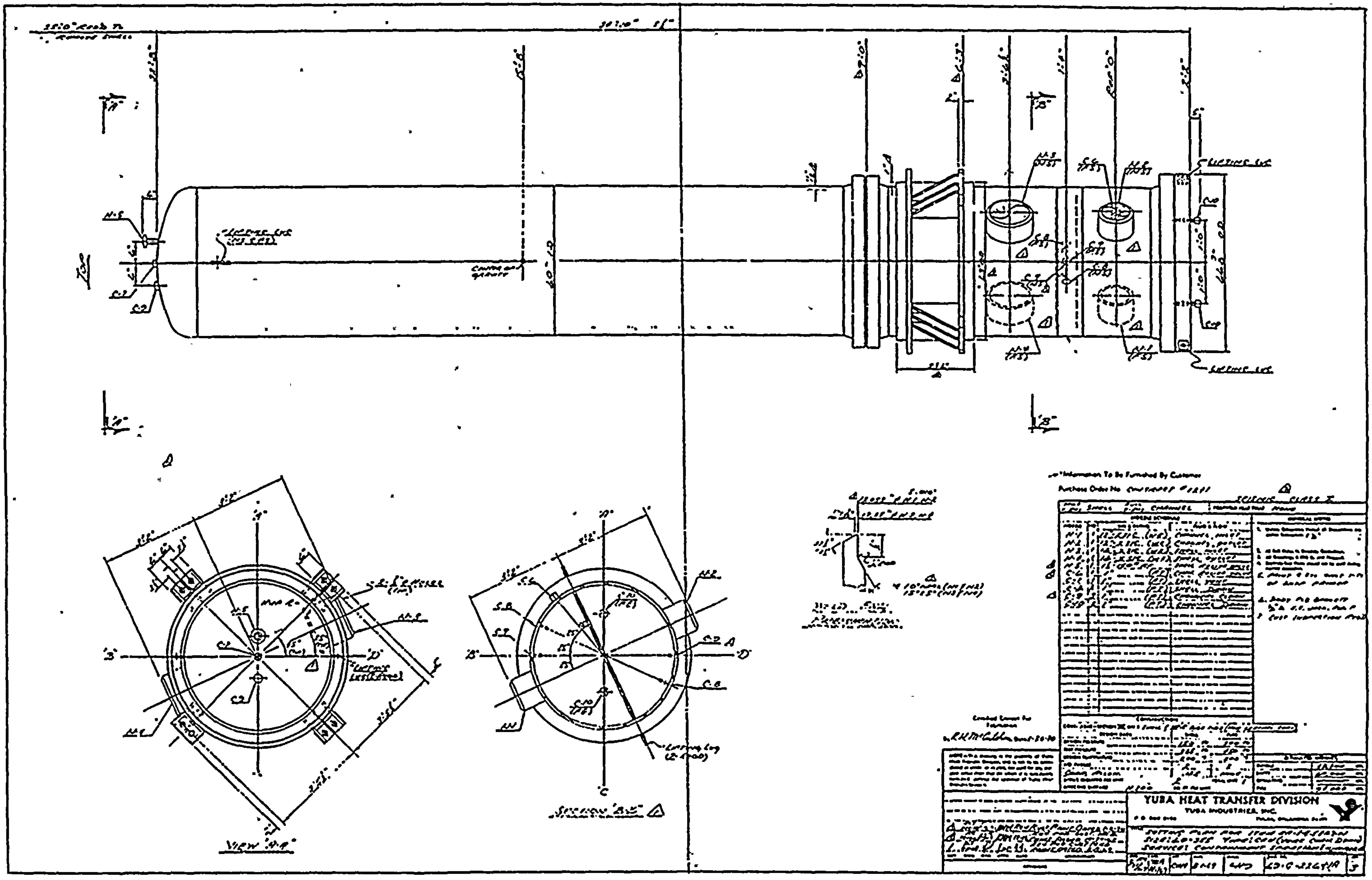
U-TUBE EXCHANGER
REMOVABLE CHANNEL AND COVER
TWO PASS SHELL
EVEN PASS TUBE SIDE
TEMA CLASS "R" CONSTRUCTION

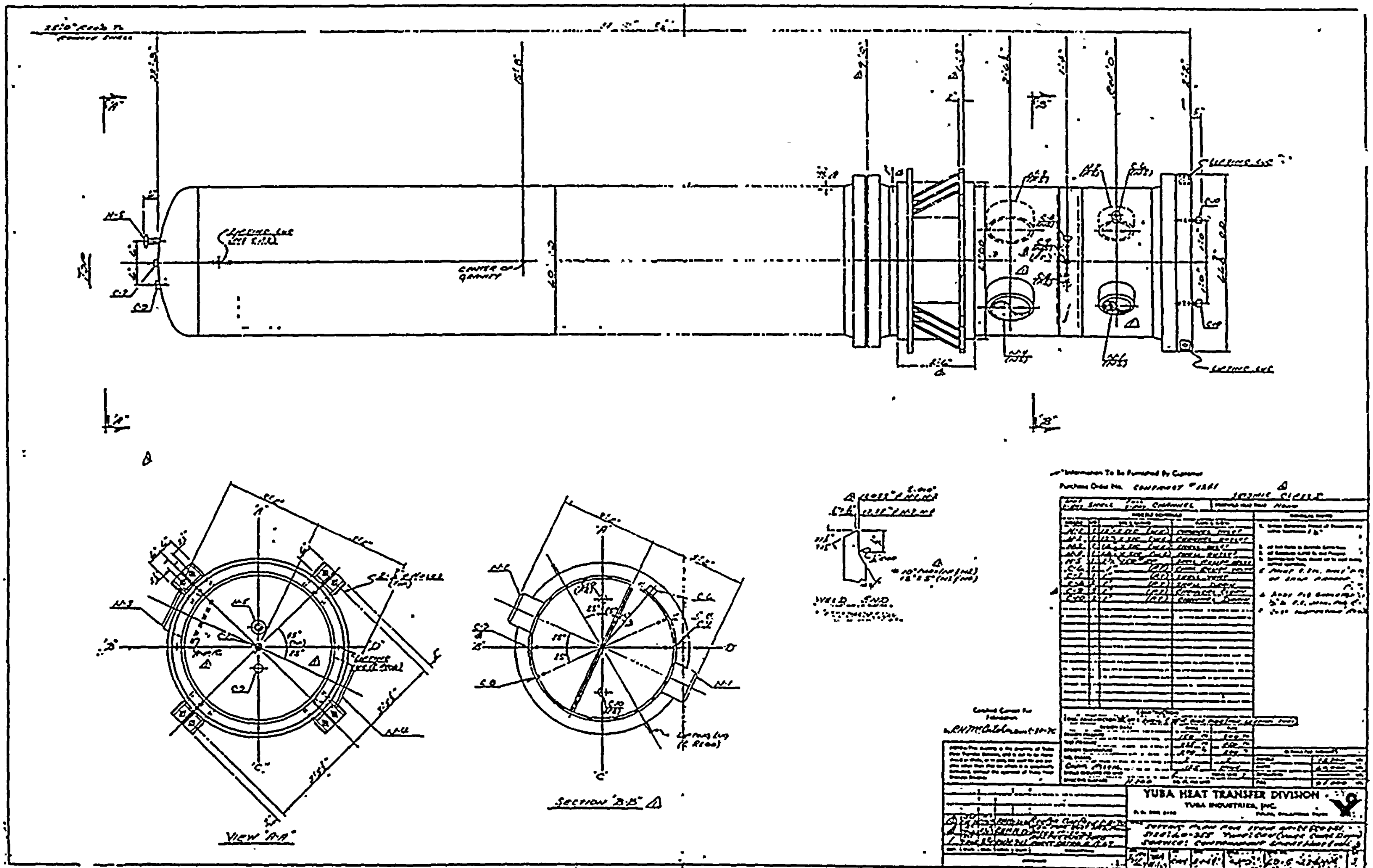
YUBA HEAT TRANSFER DIVISION

YUBA INDUSTRIES' INC'

TITLE
TYPICAL CONSTRUCTION FEATURES OF YUBA TYPE CFU EXCHANGER

DWG


Information To Be Furnished By Customer
Purchase Order No.
LIFTING LUG
VIEW 'A-A'
SECTION 'B-B'
YUBA HEAT TRANSFER DIVISION
YUBA INDUSTRIES, INC.


LIFTING LUG
CENTER OF GRAVITY
VIEW "A-A"
SECTION "B-B"
WELD END
YUBA HEAT TRANSFER DIVISION
YUBA INDUSTRIES, INC.

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 1-HE-18E Class 21

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ___ (If yes, check items that apply.)

	Remarks
Anchor Type	
Anchor Diameter	
Anchor Spacing ✓	NOT A CONCERN, LOADS ON THE ANCHOR BOLTS ARE NEGLIGIBLE.
Anchor Number	
Anchor Embedment	
Anchor Edge Distance	
Anchor Gap	
Anchor Thread Engagement	
Anchor Grip	I. Hu 11-3-93
Anchor Angularity	D. 11-3-93
Concrete Crack	

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

NONE

Actions Taken:

NONE

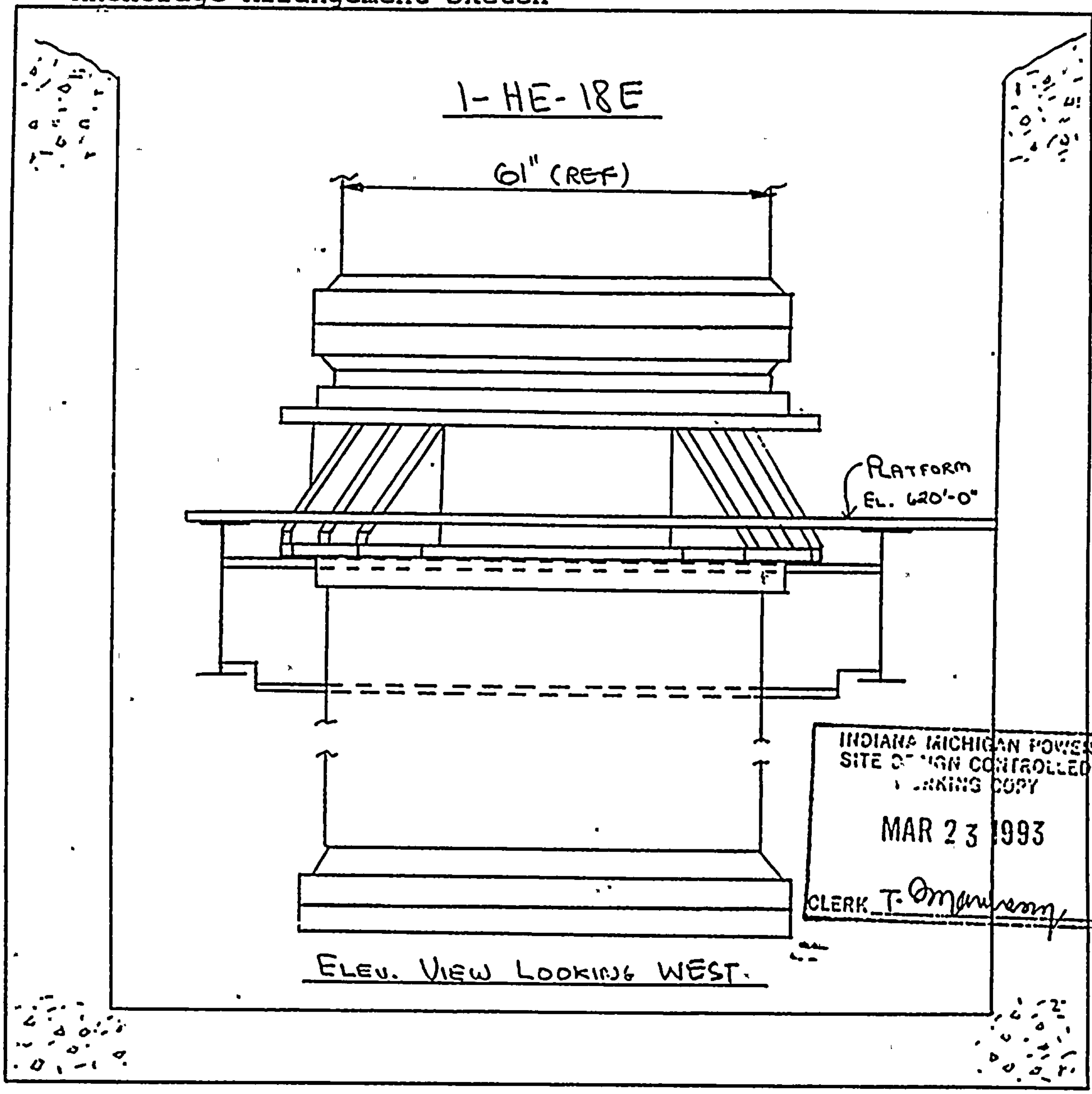
Prepared By T. Omaraom Date 3-23-93

ANCHOR INSPECTION DATA SHEET

1	AUX EL. 609'-0"	CONT. SPRAY H.E. ROOM
Unit #	Bldg.	Location

12-3915 A-0, 12-3915-1	1-HE-18E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
MAR 23 1993
CLERK T. Omanderson

Drawn by: T. Omanderson Date: 3-19-93

Verified by: [signature] Date: 3-22-93
Qual./Cert. Inspector

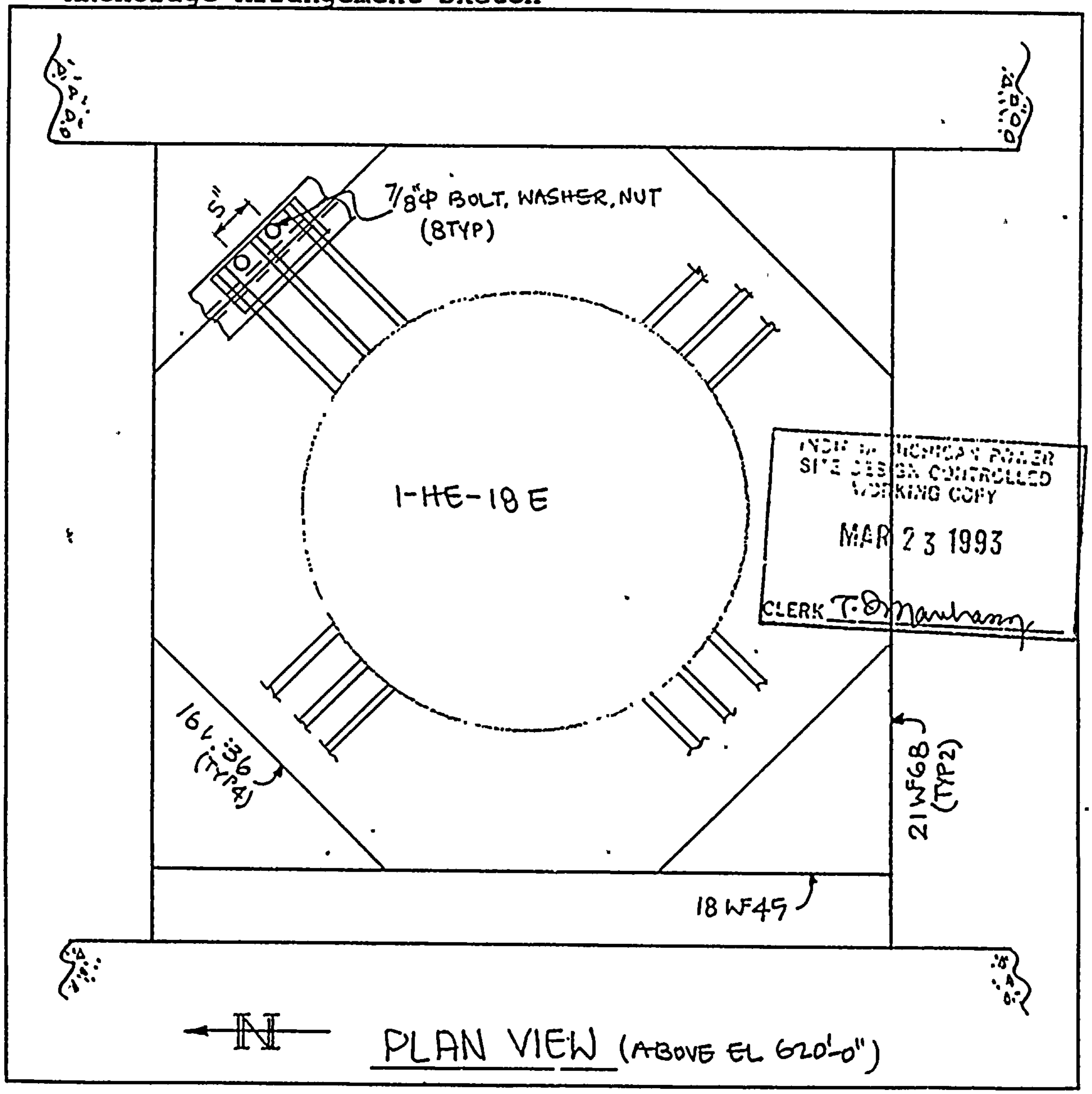
Reviewed by: T. Omanderson Date: 3-23-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Unit #: 1
Bldg.: AUX EL. 609'-0"
Location: CONT. SPRAY H-E. ROOM

Installation dwg. / Rev.: 12-3915-1, 12-3915A-0
Equipment No.: 1-HE-18E

Anchorage Arrangement Sketch



Drawn by: T. Omanlvany Date: 3-19-93

Verified by: [signature] Date: 3-22-93
Qual./Cert. Inspector

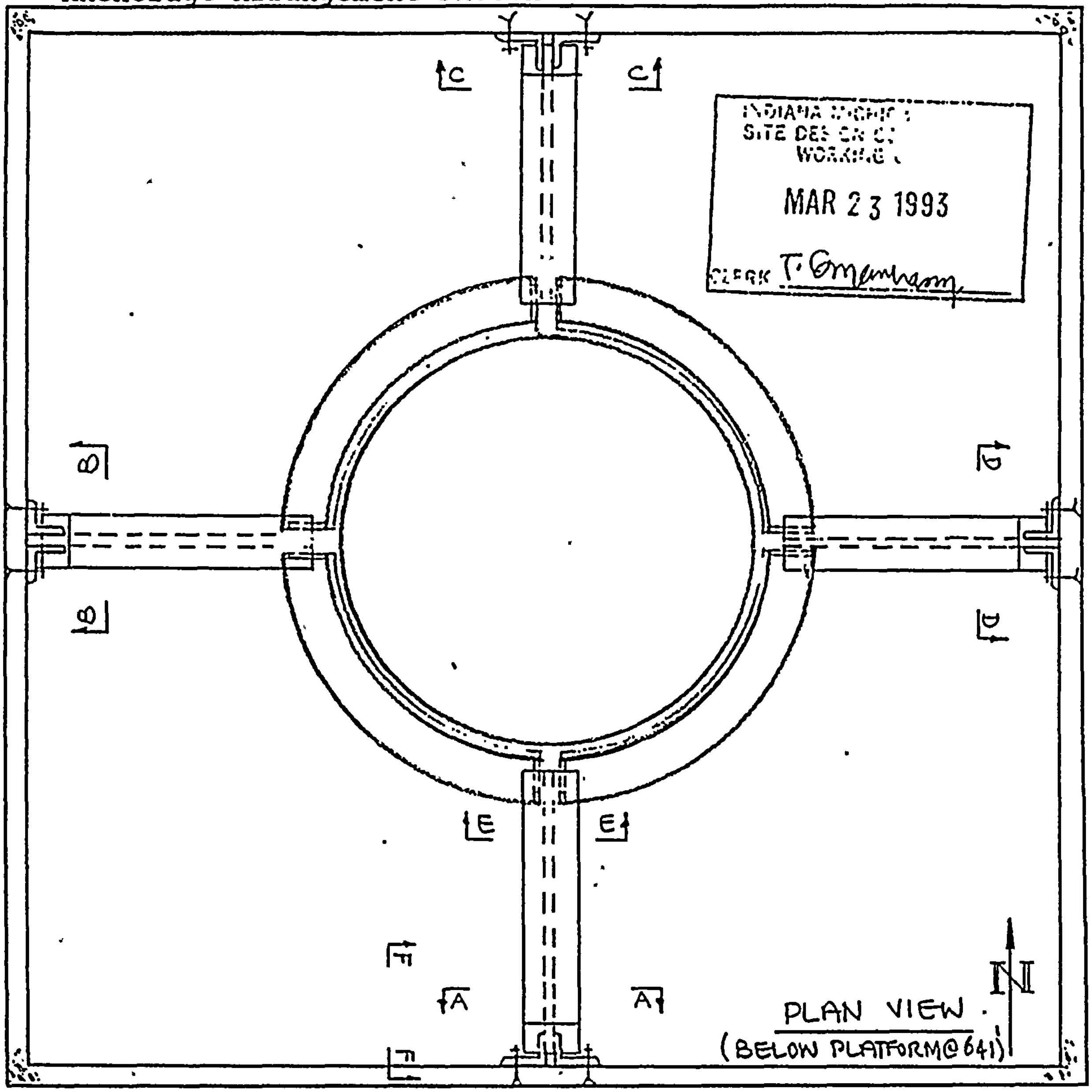
Reviewed by: T. Omanlvany Date: 3-23-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	AUX. EL. 609'-0"	CONT SPRAY H.E. ROOM
Unit #	Bldg.	Location

12-3915A / 0	1-HE-18E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: T. Omanhany Date: 3-19-93

Verified by: [signature] Date: 3-22-93
Qual./Cert. Inspector

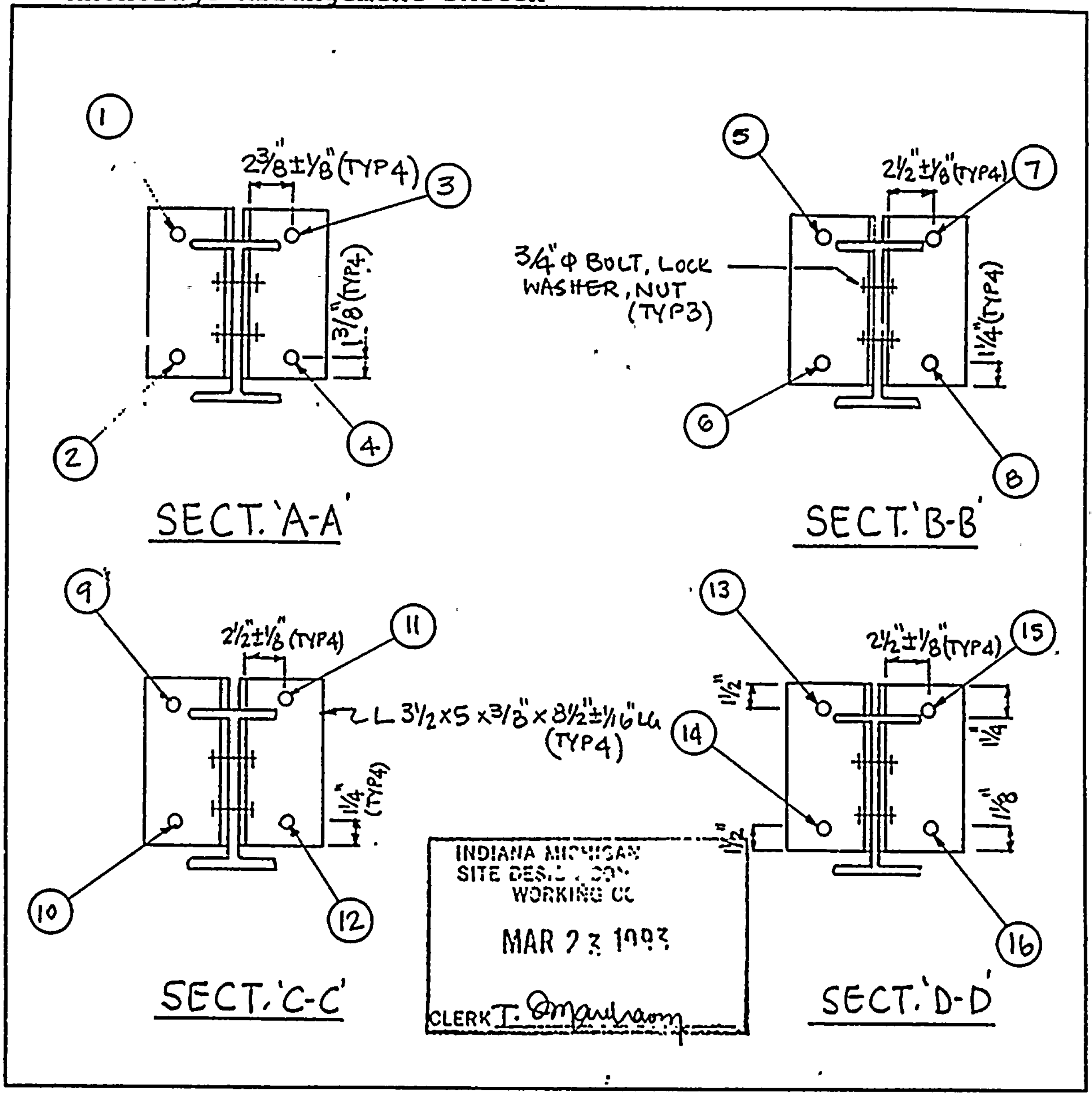
Reviewed by: T. Omanhany Date: 3-23-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	AUX EL. 609'-0"	CONT. SPRAY H.E. ROOM
Unit #	Bldg.	Location

12-3915A	1-HE-18E	
Installation dwg. / Rev.	Equipment No.	

Anchorage Arrangement Sketch



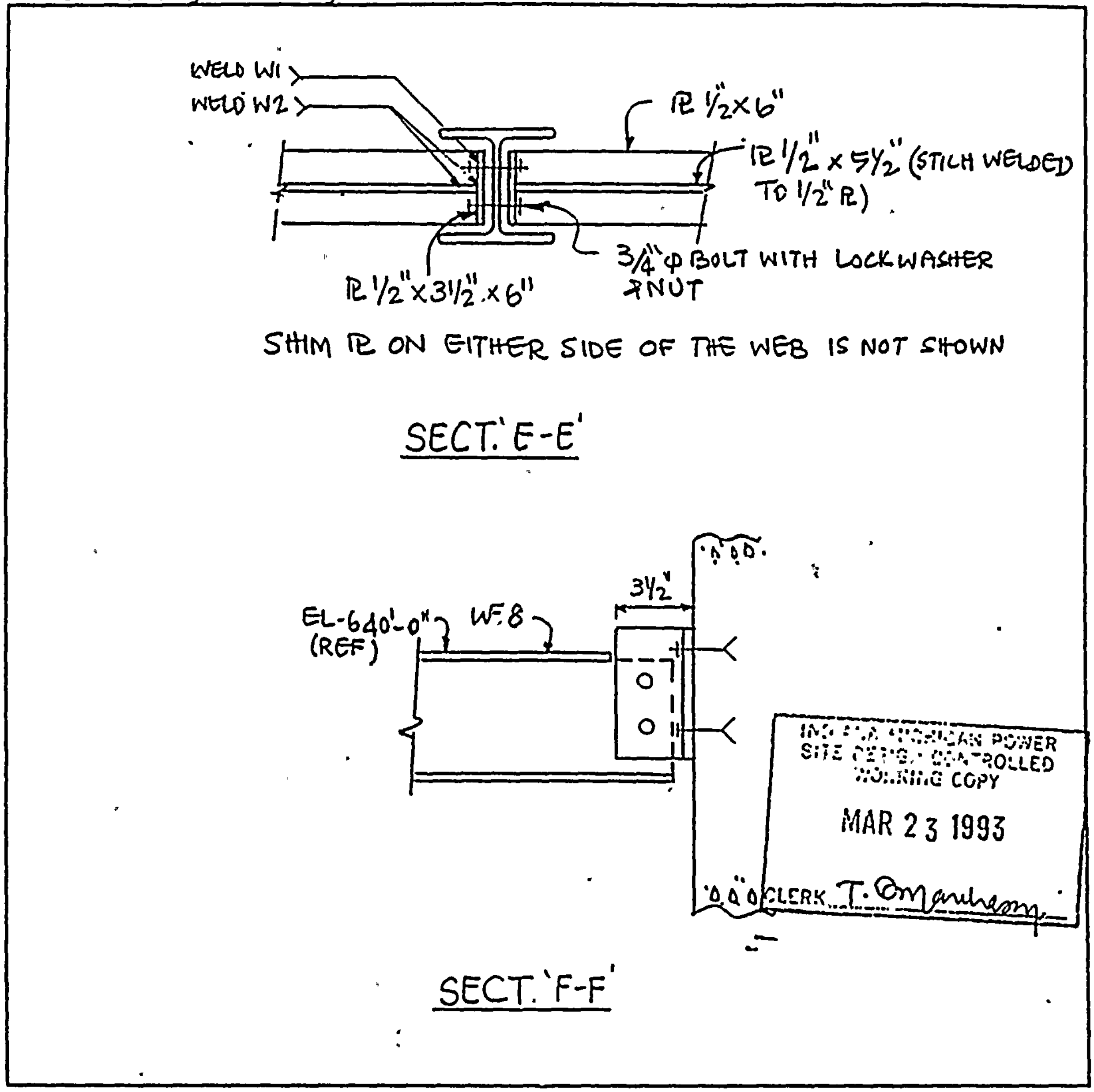
Drawn by:	T. Omanharm	Date:	3-19-93
Verified by:	[signature] Qual./Cert. Inspector	Date:	3-22-93
Reviewed by:	T. Omanharm Construction Anchor Review Engineer	Date:	3-23-93

ANCHOR INSPECTION DATA SHEET

1	AUX	CONT. SPRAY H.E. ROOM
Unit #	Bldg.	Location

12-3915A / 0	1-HE-18E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by:	T. Omanhesny	Date:	3-19-93
Verified by:	[signature] Qual./Cert. Inspector	Date:	3-22-93
Reviewed by:	T. Omanhesny Construction Anchor Review Engineer	Date:	3-23-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-HE-18E Dwg No.: 12-3915A-0
Anchor type: WEDGE ANCHOR Dia: 3/4" Dwg No.: ______
Tightness established by: ☐ "Snug Fit" ☒ Torque
Torque Wrench No.: CPM-519 Cal. Due Date: AUG. 04, 93
Tightness verified? ☒ Yes ☐ No T. Omanhasan, Construction ARE Date: 3-19-93
Equipment base flexible? ☐ Yes ☒ No T. Omanhasan, Construction ARE Date: 3-19-93

PHYSICAL CHARACTERISTICS

Bolt ID	1	2	3	4	5	6	7	8	Comments
Gaps	0	0	0	0	1/32"	0	0	0	
Anchor length	8.4"	8.4"	8.4"	8.4"	8.4"	8.4"	8.4"	8.4"	
Protruding length	1 15/16"	1 11/16"	2"	2 1/4"	1 1/2"	1 15/16"	2"	2 3/16"	
Embedment	6.46"	6.71"	6.4"	6.15"	6.9"	6.46"	6.4"	6.21"	
Bolt grip	1/2"	1/2"	1/2"	1/2"	9/16"	9/16"	9/16"	5/8"	
Concrete condition	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	
Edge distance	NA	NA	NA	NA	NA	NA	NA	NA	
Anchor spacing	6"	6"	6"	6"	6"	6"	6"	6"	
Anchor angularity	0°	0°	0°	0°	0°	0°	0°	0°	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: ______

Verified by: [signature] Qual./Cert. Inspector Date: 3-22-93 ~~3-22-93~~ 3-23-93

Reviewed by: T. Omanhasan, Construction ARE Date: 3-23-93

SITE DESIGN CONTROLLED
WORKING COPY
MAR 23 1993
CLERK T. Omanhasan

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-HE-18E Dwg No.: 12-3915A-0

Anchor type: WEDGE ANCHOR Dia: 3/4" Dwg No.: ______

Tightness established by: ☐ "Snug Fit" ☒ Torque

Torque Wrench No.: CPM-519 Cal. Due Date: AUG 04, 93

Tightness verified? ☒ Yes ☐ No T. Omartamy Construction ARE Date: 3-19-93

Equipment base flexible? ☐ Yes ☒ No T. Omartamy Construction ARE Date: 3-19-93

PHYSICAL CHARACTERISTICS

Bolt ID	9	10	11	12	13	14	15	16	Comments
Gaps	1/16"	1/16"	1/16"	1/16	3/16"	0	1/8"	0	BETWEEN CONC & L
Anchor length	8.4"	8.4"	8.4"	8.4"	8.4"	8.4"	8.4"	8.4'	
Protruding length	1 1/8"	1 5/8"	1 7/8"	2"	2"	2"	2 1/16"	1 7/8"	
Embedment	* 7.28'	* 6.78"	* 6.53"	* 6.4"	6.4"	6.4"	* 6.34"	* 6.53"	
Bolt grip	5/8"	5/8"	5/8"	5/8"	3/4"	5/8"	3/4	5/8	
Concrete condition	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	
Edge distance	NA	NA	NA	NA	NA	NA	NA	NA	
Anchor spacing	6"	6"	6"	6"	5 9/16"	5 9/16"	6"	6"	
Anchor angularity									
Thread engagement	1/8" RECESS *	OK	OK	OK	OK	OK	OK	OK	NUT 1 5/8" THICK.

Comments: ______

Verified by: * subtraction not accurate [signature] Qual./Cert. Inspector Date: 3-22-93

Reviewed by: T. Omartamy Construction ARE Date: 3-23-93

INDIANA MICHIGAN POWER
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MAR 23 1993

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-HE-18E Dwg No.: 1-3915A-0

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W1	W2						
Type	1	1						
Size	3/16	3/16	N					
Length	2 3/4"	5"		A				
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

WELDS @ TYPICAL LOCATIONS ARE SAME OR STRONGER THAN W1 & W2.
T. Omardraony 3-19-93

INDIANA MI[illegible] [illegible]ER
SITE DES[illegible] [illegible]ED
WC
MAR [illegible] - [illegible]93
CLERK T. Omardraony

Equipment base flexible: ☐ Yes ☒ No T. Omardraony Date: 3-19-93
Construction Are

Reviewed by: T. Omardraony Date: 3-23-93
Construction Anchor Review Engineer

Verified by: Verified welds W1 + W2 only. [signature] Date: 3-22-93
Qual./Cert. Inpsector

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 3/3/93 REQUEST NO. N/A

IDENTIFICATION

Unit ONE
Component 1·HE·13E
Item ANCHORS
Material C/S
Other SQUG PROGRAM

TECHNIQUE

Test Unit/ S/N KB USK7/CQC 405
Freq./Diameter 5MHZ / 250
Reference Standard QC# 30
Couplant/Batch No. ULTRAGEL II 9038

TEST DATA/REMARKS

ANCHOR	LENGTH
1	8.4"
2	8.4"
3	8.4"
4	8.4"
5	8.4"
6	8.4"
7	8.4"
8	8.4"
9	8.4"
10	8.4"
11	8.4"
12	8.4"
13	8.4"
14	8.4"
15	8.4"
16	8.4

PERFORMED BY: [illegible signature] LEVEL: II DATE: 3/3/93
REVIEWED BY: Stephen R. Varga LEVEL: II DATE: 3/3/93

FORM NO. 12 SHP 5050 NDE.008-1

SAFE SHUTDOWN EQUIPMENT LIST (SSELWP)

FUNCTION: CCW

Equipment Class: 21 Train: 2

Equipment ID: 1-HE-34-NE Drawing Number: 1-5135A

System: CCW

Equip Description: NORTH SAFETY INJECTION PUMP PP-26N OUTBOARD MECHANICAL SEAL HEAT EXCHANGER

Building: AUXILIARY Room: NORTH SAFETY INJECTION PUMP ROOM Elevation: 587

Normal state: Desired state: Power Required: N Sort: W,_ Notes:

Supporting System Drawing Number:

Required Interconnections and Supporting Components:

fety Related Status: NUCLEAR SR Min/Opt: MIN

ADDITIONAL INFORMATION

Alias Number: Power Train: NA

Component Served: NORTH SAFETY INJECTION PUMP PP-26N

Manufacturer: BORG-WARNER Model: NX-0500-FW

Panel:

Elem Drawing: N/A Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Only: N

Component Type: HE
ISO Drawings:

Detailed Location:

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 2
ID : 1-HE-34-NE (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : NORTH SAFETY INJECTION PUMP PP-26N INBOARD MECHANICAL SEAL HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : N SAFETY INJECTION PUMP RM,
Manufacturer, Model, Etc. : BORG-WARNER, NX-0500-FW		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Tom Huang and Kailash Mahajan on 11/1/93.

ANCHORAGE ACCEPTABLE BY ENGINEERING JUDGMENT OF THE SRT.

6" diameter by 8-3/4" high exchanger, attached to North Safety Injection Pump with 2 1/2" bolts. Could have screened with the pump using the rule of the box, however the exchanger was listed seperately on the SSEL.

Crane above in a parked and locked position.

Evaluated by: Date:

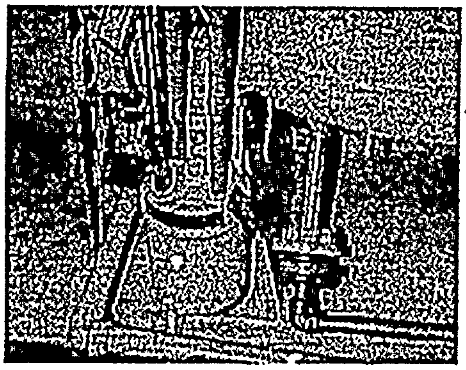
9/15/95

10-19-95

Attachment: Pictures

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 2
ID : 1-HE-34-NE (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : NORTH SAFETY INJECTION PUMP PP-26N INBOARD MECHANICAL SEAL HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : N SAFETY INJECTION PUMP RM,
Manufacturer, Model, Etc. : BORG-WARNER, NX-0500-FW		

PICTURES



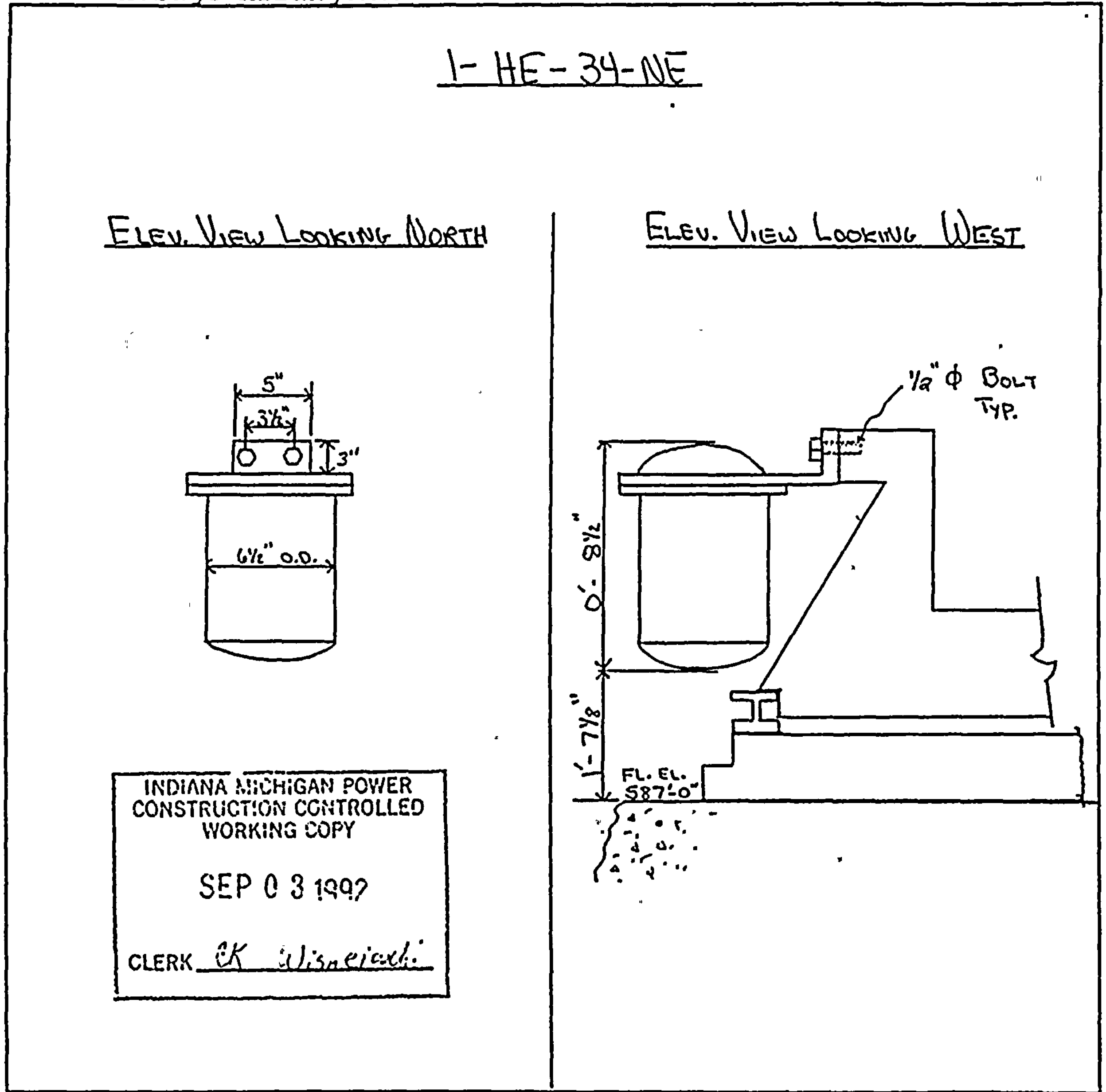
NORTH SAFETY INJECTION PUMP PP-26N

ANCHOR INSPECTION DATA SHEET

1	Aux.	N. Safety Injection Pump Rm
Unit #	Bldg.	Location

N/A	1-HE-34-NE
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
SEP 03 1992
CLERK CK Wisniewski

Drawn by: James Wisniewski Date: 10-15-91

Verified by: ST Cadle Date: 1-2-92
Qual./Cert. Inspector

Reviewed by: James Wisniewski Date: 1-3-92
Construction Anchor Review Engineer

Equipment No.: 1-HE-34-NE

Tightness established by "Snug Fit"

Tightness verified by: [signature] Date: 5-27-92

Qual./Cert. Inspector

Tightness Verified by: [signature] Date: 5/27/92

Construction ARE

Comments:

Equip ID: 1-TK-11 Train: 12 Equip Class: 21

Drawing No.: 1-5142

ction: RI

System: BORON INJECTION

Equip Desc: BORON INJECTION TANK

Building: AUXILIARY Room: BORON INJECTION TANK ROOM

Elev: 612 Sort: S,_ Notes:

Normal State: . Desired State: Power Req'd:

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train:

Comp Served: BORON INJECTION TANK

Mfr: STRUTHERS-WELL-CORP.

Model: 900 GALS, 4' DI

l:

Elem. Drawing: 1-98282

Wiring Drawing: 1-95222

Power Source: 1-AM-D-5A 1-AM-A-2A

Walkdown: F Relay Eval : N

Comp Type: TANK

ISO Drawing:

Location: IN THE MIDDLE OF ROOM, 15' SW OF THE ROOM'S ENTRANCE DOORWAY.

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 3
ID : 1-TK-11 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : BORON INJECTION TANK		
Building : AUXILIARY	Floor El. : 612.00	Room, Row/Col : BORON INJECTION TANK RM, IN THE MIDDLE OF RM, 15' SW OF THE RM'S ENTRANCE DOORWAY.
Manufacturer, Model, Etc. : STRUTHERS-WELL-CORP. 900 GALS, 4' DI		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Tom Huang and Kailash Mahajan on 11/3/93.

ADEQUACY OF ANCHORAGE AND TANK TO SUPPORT CONNECTION BASED ON JUDGMENT BY THE SRT AND COMPARISON TO THE BORIC ACID TANK EVALUATION.

Tank is 5' diameter by 10' in height supported by 4 Wide Flange Leg supports (10" WF w/ 5/8" flange) 4'-4" in height..

Each leg is bolted to the pedestal w/ two embedded 1 3/4" bolts with 2'-11" embedment.

Weld of leg to tank about 14" in length and 1/4" thickness on each side of the wide flange and 10" at the top of the wide flange.

Adjacent Block wall reinforced with column supports and it is not an interaction concern.

The Seismic Evaluation of the Boric Acid Tank (2-TK-12S) is seismically adequate. The Boron Injection Tank (1-TK-11) is much smaller but has about the same support. Therefore, Tank 1-TK-11 is judged adequate.

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 3
ID : 1-TK-11 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : BORON INJECTION TANK		
Building : AUXILIARY	Floor El. : 612.00	Room, Row/Col : BORON INJECTION TANK RM, IN THE MIDDLE OF RM, 15' SW OF THE RM'S ENTRANCE DOORWAY.
Manufacturer, Model, Etc. : STRUTHERS-WELL-CORP. 900 GALS, 4' DI		

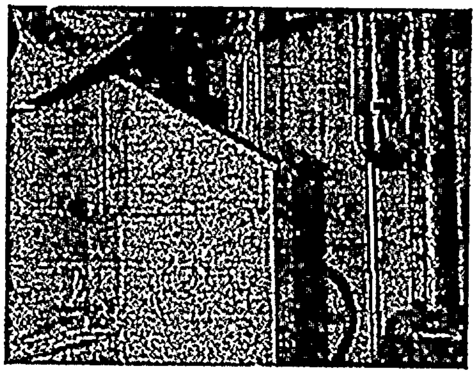
Evaluated by: [signature] Date: 9/15/95

[signature] 10-11-95

Attachment: Pictures

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 3
ID : 1-TK-11 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : BORON INJECTION TANK		
Building : AUXILIARY	Floor El. : 612.00	Room, Row/Col : BORON INJECTION TANK RM, IN THE MIDDLE OF RM, 15' SW OF THE RM'S ENTRANCE DOORWAY.
Manufacturer, Model, Etc. : STRUTHERS-WELL-CORP. 900 GALS, 4' DI		

PICTURES



BASE ANCHORAGE PEDESTAL

SUPPORT COLUMN TO TANK CONNECTION

Cook Nuclear-Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 1-TK-11 Class 21

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes √ No ___ (If yes, check items that apply.)

	Remarks
Anchor Type Anchor Diameter Anchor Spacing Anchor Number Anchor Embedment √	NOT A PROBLEM SINCE THE BOLTS HAVE A COMMON BEARING PLATE AT THE BOTTOM.
Anchor Edge Distance Anchor Gap Anchor Thread Engagement √ Anchor Grip Anchor Angularity Concrete Crack	THREAD ENGAGMENT JUDGED TO BE ADEQUATE.

Others (describe briefly)

I. Huey 11-3-93
D. Daniel 11-3-93

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

Actions Taken:

Prepared By T. Armstrong Date 7-9-93

ANCHOR INSPECTION DATA SHEET

ONE — Unit #

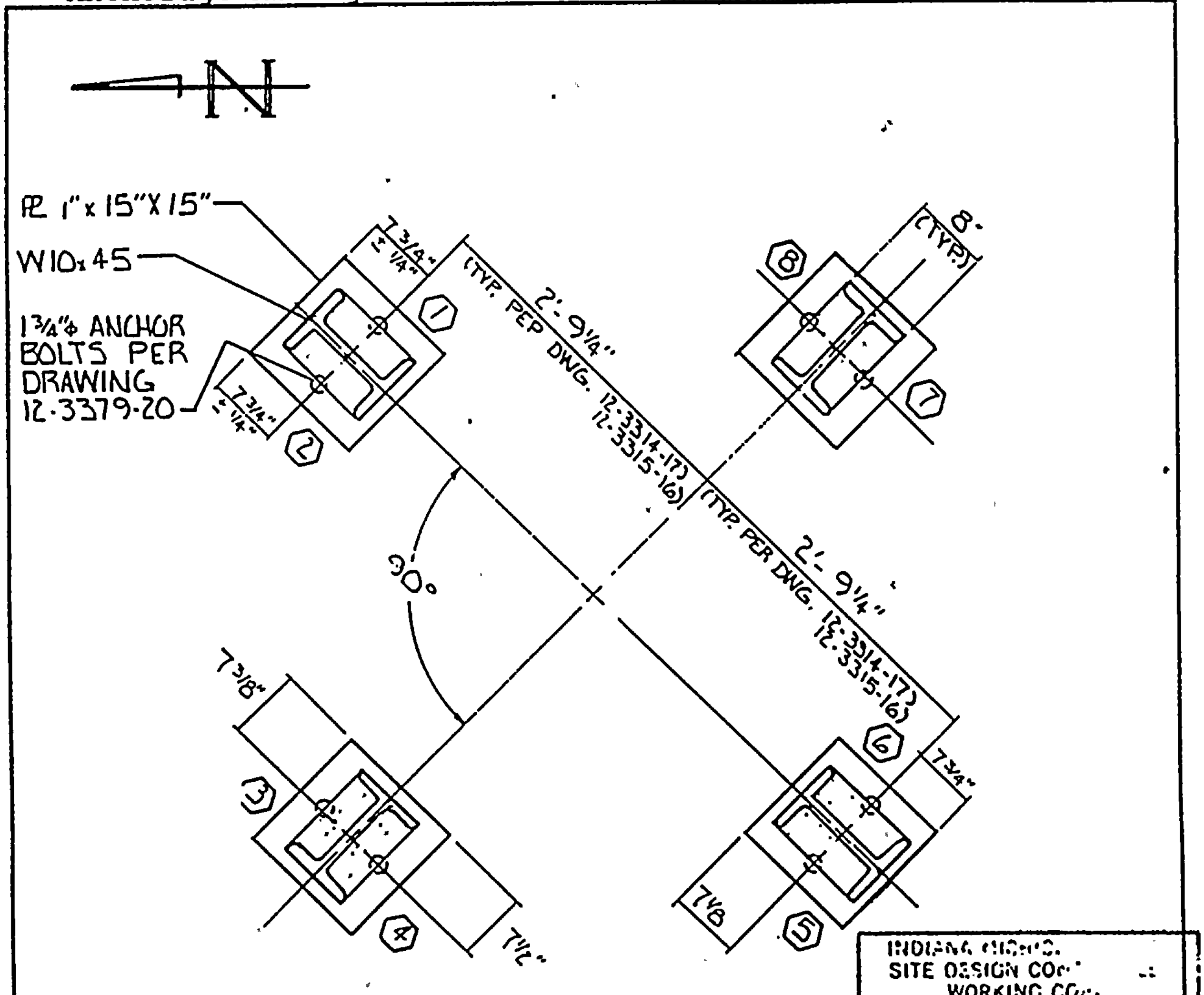
AUX 612'-0" EL — Bldg.

BORON INJECTION TANK ROOM — Location

12-3314-17 — Installation dwg. / Rev.

1-TK-11 — Equipment No. — No Equipment # on Tank, Location taken from Dwg. 12-3314-17

Anchorage Arrangement Sketch



INDIANA MICHIG. SITE DESIGN CO. WORKING CO.
JUL 13 1993
CLERK T. Omaniam

Drawn by: Judy Ross Date: 4-16-93

Verified by: R.W. Graham Date: 6-1-93
Qual./Cert. Inspector

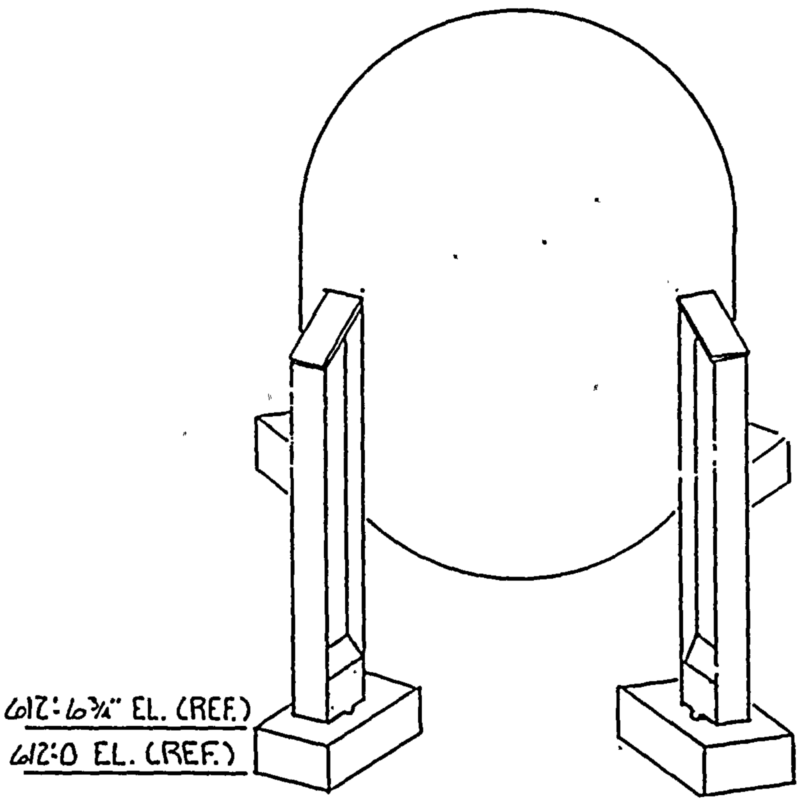
Reviewed by: T. Omaniam Date: 7-9-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Unit #	Bldg.	Location
ONE	AUX 612'-0" EL.	BORON INJECTION TANK ROOM

Installation dwg. / Rev.	Equipment No.
12-3314-17	1-TK-11

Anchorage Arrangement Sketch



ELEV. LKG. SOUTH

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Omanson

Drawn by: Judy Rose Date: 1-16-93

Verified by: [illegible] Date: 6-1-93
Qual./Cert. Inspector

Reviewed by: T. Omanson Date: 7-9-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-TK-11 (No Label on Tank) Dwg No.: 12-3311-17

Anchor type: STUD TYPE (#12) (CAST IN PLACE) Dia: 1 3/4"ϕ Dwg No.: 12-3379-20

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date: ______

Tightness verified? ☐ Yes ☐ No NA Construction ARE Date: ______

Equipment base flexible? ☐ Yes ☒ No T. Omanlam Construction ARE Date: 4-16-93

CONCRETE CONDITION FOUND TO BE OK. [illegible] 11/4/93 [illegible] 11/3/93

PHYSICAL CHARACTERISTICS

Bolt ID	1	2	3	4	5	6	7	8	Comments
Gaps	1/16" GAP BETWEEN NUT & WASHER	1/32" GAP BETWEEN NUT & WASHER	N/A	N/A	N/A	N/A	▲	▲	
Anchor length	2'-11" ■	2'-11"	2'-11" ●	[illegible] ●	2'-11"	2'-11" ●	2'-11" ▲	2'-11"	ANCHOR LENGTH PER DRAWING 12-3379-20
Protruding length	CAN'T VERIFY DUE TO GROUT	4 3/8"	RECESSED 3/8"	RECESSED 1/8"	4 3/8"	RECESSED 1/8"	▲	▲	NUT THICKNESS IS 1 7/16"
Embedment	—	2'-8 1/8"	—	—	2'-8 1/8"	—	—	—	
Bolt grip	2 13/16"	2 3/4"	2 3/4"	2 3/4"	2 3/4"	2 7/8"	▲	▲	
Concrete condition	CONCRETE	IS	CRACKED	—	—	—	—	—	1 1/2" GROUT PER DRAWING 12-3315-16
Edge distance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	EDGE DIST. 7/8" IN SLAB TJ 7-9-93
Anchor spacing	8 1/2"	8 1/2"	8"	8"	8"	8"	8"	8"	
Anchor angularity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ANCHOR ANGULARITY (5° TJ 7-9-93
Thread engagement	■ RECESSED	OK	3/8" RECESS	1/8" RECESS	OK	1/8" RECESS	OK	OK	NUT THICKNESS IS 1 7/16"

Comments: ▲ DATA NOT OBTAINED DUE TO CONTAMINATION.
■ INACCESSABLE
● UNOBTAINABLE DUE TO BOLT RECESSED.

Verified by: [signature] Qual./Cert. Inspector Date: 6-3-93

Reviewed by: T. Omanlam Construction ARE Date: 7-9-93

INDIANA MICH[illegible]
SITE DESIGN CONTROLLED
WORKING COPY
JUL 13 1993
CLERK T. Omanlam

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A   REPORT DATE: 3-23-93   REQUEST NO. N/A

IDENTIFICATION

Unit One
Component 1-TK-11
Item Anchors
Material C/S
Other Squg Program

TECHNIQUE

Test Unit/ S/N KB USK-7S CBC-405
Freq./Diameter 5mhz .250"
Reference Standard RC-8
Couplant/Batch No. Ultragel II 9085

TEST DATA/REMARKS

Anchor	Length
1	Inaccessable
2	35"
3	(Recessed) unobtainable
4	" "
5	35"
6	(Recessed) unobtainable
7	Inaccessable due to contamination
8	35"

PERFORMED BY: [signature]   LEVEL: II   DATE: 3-23-93
REVIEWED BY: Stephen R. Vargo   LEVEL: II   DATE: 3/23/93

FORM NO. 12 SHP 5050 NDE.008-1

Equip ID: 1-TK-37 Train: 12 Equip Class:21

Drawing No.: 1-5135A

Function: CCW

System: CCW

Equip Desc: COMPONENT COOLING WATER SURGE TANK

Building: AUXILIARY Room: ~~605~~ 650 HALLWAY

Elev: ~~609~~ 650 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: CONDENSATE COOLING TANK

MFR: SPEAR AND WOOD

Model: 10000GAL, 2' D x 12' H

Panel:

Elem. Drawing: N/A

Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Eval : N

Comp Type: TANK (COMMON DIVIDED BY BAFFLE)

Iso Drawing:

Location:

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 5
ID : 1-TK-37 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : COMPONENT COOLING WATER SURGE TANK		
Building : AUXILIARY	Floor El. : 650.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : SPEAR AND WOOD, 10000GAL, 2' D x 12' H		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas and Tom Huang on 11/3/93.

Skirted tank 11'-10 1/4" diameter and 17' in height. Skirt is 4'-6" high from the top of the pad to skirt connection to tank. Skirt has 1/2" thickness. There are 8 bolts evenly spaced around tank, with a solid steel washer 3-3/4" high x 4" length x 2" width.

Bolts supported from 3" x 3" x 1/2" angle.

Crane above tank has been evaluated by AEPSC for seismic loads.

The results gave a safety factor of 1.06 for the anchor bolts using the GIP penalty for J-bolt embedment.

A hand calculation that included in the package was performed for the bolt stresses.

Evaluated by: Date:

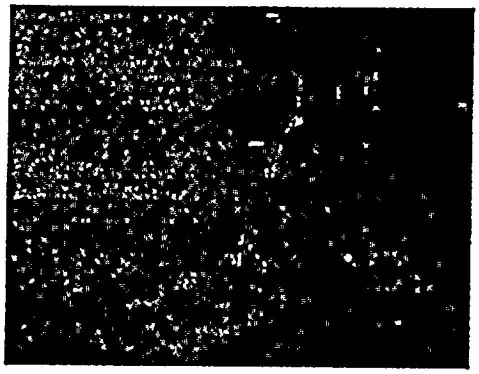
Gary D. Thomas 12/19/95

T Chen Huang 12-27-95

Attachment: Pictures
Attachment: External Anchorage Analysis for 1-TK-37

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 5
ID : 1-TK-37 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : COMPONENT COOLING WATER SURGE TANK		
Building : AUXILIARY	Floor El. : 650.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : SPEAR AND WOOD, 10000GAL, 2' D x 12' H		

PICTURES



BOLT TO TANK DETAIL

S&A
Stevenson and Associates
A Structural-Mechanical Consulting Engineering Firm

CLIENT AEPSC JOB No. 89C157 SHEET 1 OF 3

SUBJECT Component cooling water surge Tank (1-TK-37)

D.C. Cook

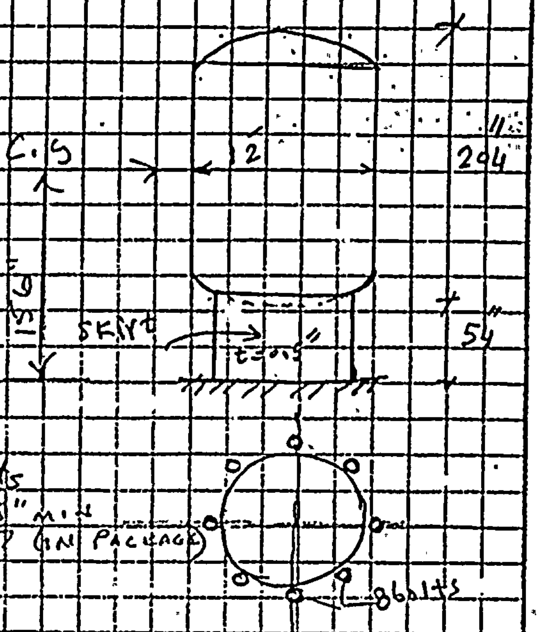
REVISIONS: BDD 8/30/95; DMG 9/15/95

Equip. ID : 1-TK-37

Building : Axiliary Elev: 650

8 bolts of 1 1/8" diameter

Total weight : 126,468 lbs



TANK PROPERTIES

Tank shell is modeled as a beam Elements

TANK SHELL R = 70" MIN t = .5" MIN

FROM SPEAR WOOD DRAWING # TK-37 (IN PACKAGE)

$I_x = \pi (70)^3 (.5) = 538,780 \ in^4$

$I_y = 538,780 \ in^4$

$A = \pi D t = 220 \ in^2$

FREQUENCY

FROM "FORMULAS FOR NATURAL FREQUENCY AND MODE SHAPE" BY ROBERT D. BLEVINS, 1979

IN TABLE 8-1 FREQUENCY FOR A BEAM W/ CLAMPED END AND FREE AT THE OTHER

$f_1 = \frac{(1.875)^2}{2\pi L^2} \left(\frac{EI}{m}\right)^{1/2}$

$m = \text{mass}/\text{length} = \frac{126,468 \text{ lb}}{258'' \cdot 386.4 \ in/s^2} = 1.27 \ \frac{lb \cdot s^2}{in^2}$

$L = 258''$ $E = 29,000,000 \ lb/in^2$

$f_1 = \frac{(1.875)^2}{2\pi (258)^2} \left(\frac{29,000,000 \ (538,780)}{1.27}\right)^{1/2} = 23.5 \ Hz$

S&A Stevenson and Associates — A Structural-Mechanical Consulting Engineering Firm	CLIENT: AEPSC JOB No. 89C1570 SHEET 2 OF 3
	SUBJECT: COMPONENT COOLING WATER SURGE TANK (1-TK-37)
	D. C. COOK
	REVISIONS: 0 — DDJ 8/30/95; DMG 9/15/95

HORIZONTAL ACCELERATION FROM 7% AND ABOVE FROM FLOOR SPECTRA IS 0.32 g, BOLT CIRCLE RADIUS = 5'-4 3/4"

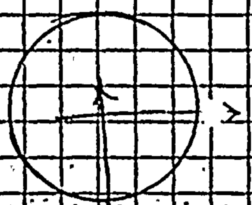
CHECK OF BOLT STRESS (WEAK LINK)

EQUIV. THICKNESS OF 8 BOLTS

$$A_{TOTAL} = 8 \times .994 \frac{in^2}{BOLT} = 7.952\ in^2$$

$$t_{EQUIV} = \frac{7.952\ in^2}{\pi \cdot (129.5)_D} = .0195\ in$$

$$I_{EQUIV\ BOLT\ CIRCLE} = \pi (64.75)^3_R \cdot .0195 = 16,630\ in^4$$



FOR AN SRSS COMBINATION THE MOST HEAVILY LOADED BOLT IN A CIRCULAR SECTION IS DUE TO EARTHQUAKE LOAD IN ONE DIRECTION, (LOAD ON BOLT FROM OTHER DIRECTION IS 0)

$$\sigma_{B\ EQUIV\ EARTHQUAKE\ FROM\ SRSS\ COMBINATION} = \left[\left(\frac{.32 \cdot \underbrace{(1.25)}_{\text{FACTOR FOR MEDIAN SPECTRA}} \cdot 126,468\ LB \cdot 156'' \cdot \overbrace{(64.75)}^{C}}{\underbrace{16,630}_{I}}\right)^2 + \left(\frac{\frac{2}{3} \cdot 1.25 \cdot (.32) \cdot 126,468\ LB}{\underbrace{7.952\ in^2}_{A}}\right)^2_{\text{VERTICAL}}\right]^{1/2} = 31,018\ psi$$

Stevenson and Associates

A Structural-Mechanical Consulting Engineering Firm

CLIENT AEP JOB No. 95Q1?? SHEET 3 OF 3

SUBJECT Component Cooling Water Surge Tank (1-TK-37)

D. C. Cook

REVISIONS: DDJ 8/30/95; DMG 9/15/95

SUBTRACT OUT DEAD WT.

$\sigma_{TEN\ MAX/BOLT} = 31,018\ PSI - \frac{126,468\ LB}{7.952\ IN^2} = 15,114\ PSI/BOLT$

$T_{LOAD/BOLT\ MAX} = 15,114\ \#/IN^2\ (.994)\ IN^2 = 15,023\ LB/BOLT$

CRITICAL SHEAR ON 1 BOLT FOR SRSS VECTOR SUM

$V_{LOAD/BOLT\ MAX} = \frac{\sqrt{1.414\,(.32)(1.25)}\cdot 126,468\ LB}{8\ BOLTS} = 7,519\ LB/BOLT$

BOLT ALLOW T FROM GIP (2) = 33.8 K FOR 1 1/8" ϕ J BOLT

MIN EMBEDMENT = 2'-3 1/2" = 27.5"

REDUCTION FOR EMBEDMENT FROM GIP FOR 90° HOOK

$\frac{27.5 + 8\,(1.125)}{62.5\,(1.125)} = .52$

$\therefore T_A = .52\,(33.8^K) = 17.6^K > 15.1^K$ OK

V_A FROM GIP $= 16.9^K > 7.52^K$ OK

F.S. TENSION $= \frac{17.6}{15.11} = 1.16$

F.S. V $= \frac{16.9}{7.52} = 2.25$

V - TEN. INTERACTION (GIP ALLOWS SRT TO SELECT METHOD WILL USE ?)

$\left(\frac{V}{V_{AL}}\right)^2 + \left(\frac{T}{T_{AL}}\right)^2 \le 1 \Rightarrow \left(\frac{15.11}{17.6}\right)^2 + \left(\frac{7.52}{16.9}\right)^2 = .94 < 1.0$ OK

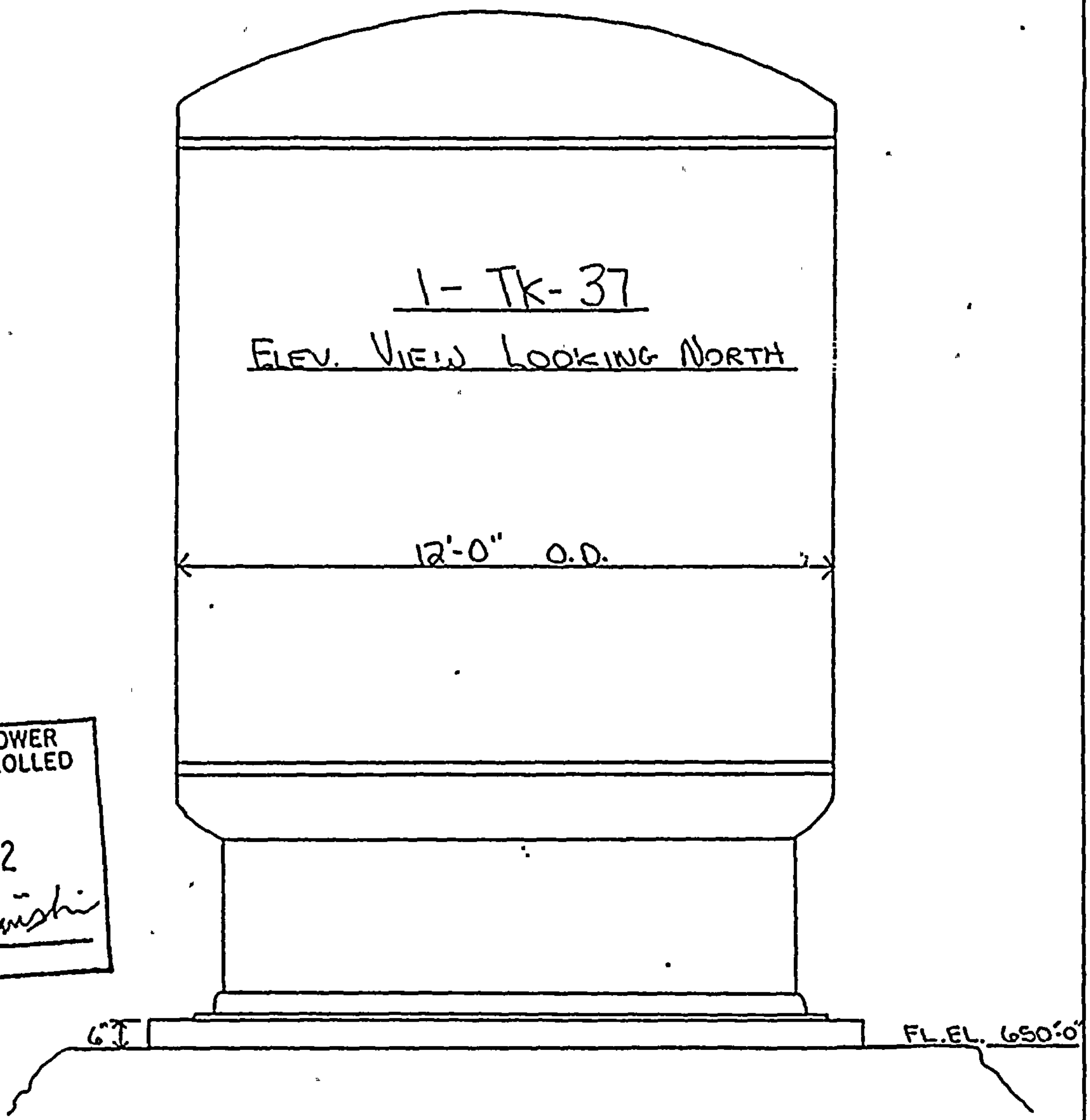
SF = 1/.94 = 1.06 (BECAUSE OF THE SEVERE PENALTY FOR TENSION IN THE GIP FOR J-BOLT EMBEDMENT)

ANCHOR INSPECTION DATA SHEET

Unit #: 1
Bldg.: AUX
Location: 650 HALLWAY

Installation dwg. / Rev.: 12-3327 / 18
Equipment No.: 1-TK-37

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
AUG 13 1992
CLERK [signature]

Drawn by: [signature] Date: 10-11-91

Verified by: [signature] Date: 7-21-92
Qual./Cert. Inspector

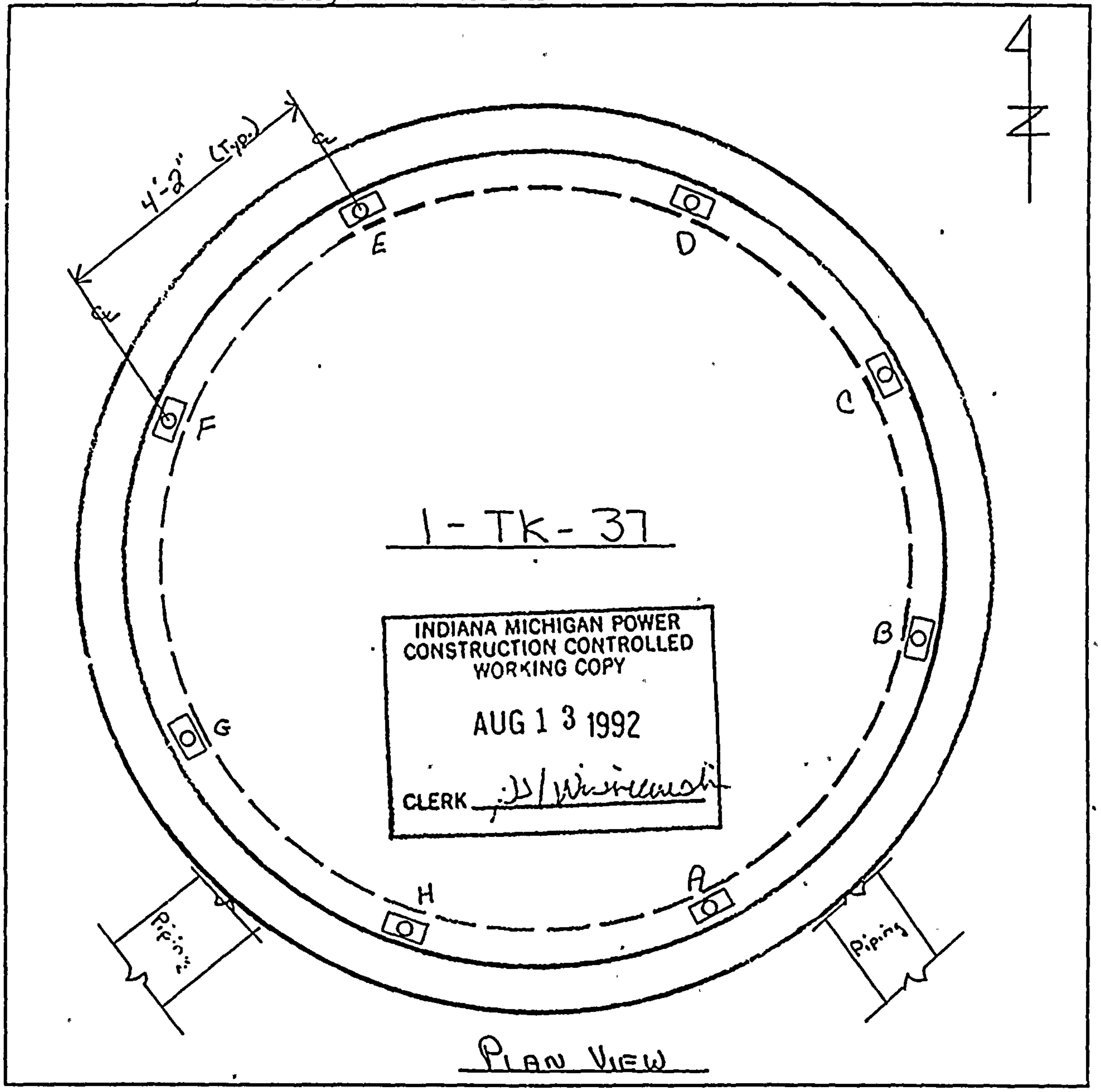
Reviewed by: [signature] Date: 5/27/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	Aux.	650 Hallway
Unit #	Bldg.	Location

12-3327 / 18	1-TK-37
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: James Wisniewski Date: 10-11-91

Verified by: [signature] Date: 2-21-92
Qual./Cert. Inspector

Reviewed by: James Wisniewski Date: 5/27/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	Aux	650 Hallway
Unit #	Bldg.	Location

12-3327 / 18 — Installation dwg. / Rev.

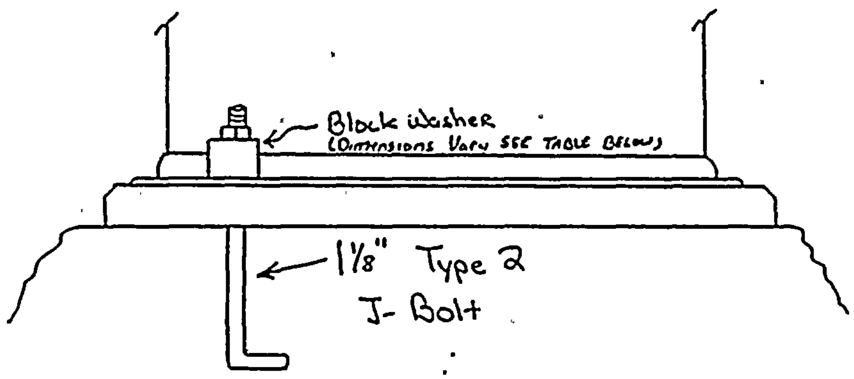
1-TK-37 — Equipment No.

Anchorage Arrangement Sketch

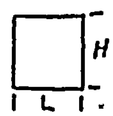
1-TK-37

ANCHORAGE DETAILS

INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
AUG 13 1992
CLERK D. Wisniewski



	A	B	C	D	E	F	G	H
Length	4"	4"	4"	4"	4"	4"	4"	4"
Height	4"	4 1/2"	3 5/8"	4"	3"	4"	3 5/8"	3 3/4"
Width	2 1/4"	2 1/4"	2 1/4"	2 1/4"	2 1/4"	2 1/4"	2 1/4"	2 1/4"



ELEV. VIEW

Drawn by: James Wisniewski Date: 10-11-91

Verified by: Tom Rich Date: 2-21-92
Qual./Cert. Inspector

Reviewed by: James Wisniewski Date: 5/27/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-Tk-37 Dwg No.: 12-3327-18

Anchor type: Type 2 J-Bolt Dia: 1 1/8" Dwg No.: 12-5414-6

Tightness established by: ☒ "Snug Fit" ☐ Torque

Torque Wrench No.: N/A Cal. Due Date: N/A

Tightness verified? ☒ Yes ☐ No James Wisniewski Construction ARE Date: 5/27/92

Equipment base flexible? ☐ Yes ☒ No James Wisniewski Construction ARE Date: 5/27/92

EMBEDMENT WILL BE PROPERLY CONSIDERED IN THE ANCHOR CAPACITY CALC. I. Huq 11-3-93, D. Davis 11-3-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D	E	F	G	H	Comments
Gaps	0"	0"	0"	0"	0"	0"	0"	0"	
Anchor length	3'-5"	3'-5"	3'-5"	3'-5"	3'-5"	3'-5"	3'-5"	3'-5"	
Protruding length	1'-0 7/8"	1'-1 1/2"	1'-1 7/16"	1'-2 1/2"	1'-0 3/8"	1'-0 3/4"	11 3/8"	1'-1 1/2"	
Embedment	2'-4 1/8"	2'-3 1/2"	2'-3 9/16"	2'-2 1/2"	2'-4 5/8"	2'-4 1/4"	2'-5 5/8"	2'-3 1/2"	
Bolt grip	10 5/8"	10 3/4"	10 1/2"	11 3/4"	9 3/4"	9 3/4"	9 7/8"	10 7/8"	
Concrete condition	ok	ok	ok	ok	ok	ok	ok	ok	
Edge distance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Anchor spacing	4'-2"	4'-2"	4'-2"	4'-2"	4'-2"	4'-2"	4'-2"	4'-2"	
Anchor angularity	0°	0°	0°	0°	0°	0°	0°	0°	
Thread engagement	ok	ok	ok	ok	ok	ok	ok	ok	

Comments: Anchor length is taken from drawing 12-3379-20. Anchors A, B, C & D, E, F, G & H do not meet the requirements for embedment and bolt grip. This package will have to be reviewed by the AEPSC ARE. JGW 5/27/92

THE ABOVE NOTED DISCREPENCY DOES NOT CONSTITUTE/DICTATE ANY operability concerns. K.F. Lepley 7-24-92

Verified by: [signature] Qual./Cert. Inspector Date: 5-27-92

Reviewed by: James Wisniewski Construction ARE Date: 5/27/92

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Equipment No.: 1-TK-3

Tightness established by "Snug Fit"

Tightness verified by: [signature] Date: 5-22-90
Qual./Cert. Inspector

Comments:

Equip ID: 12-TK-47-AB Train: 1 Equip Class:21

Drawing No.: 2-5151C

Function: EMERG DIESEL

System: DIESEL FUEL OIL

Equip Desc: AB EMERG DIESEL FUEL OIL STORAGE TANK (BURIED IN THE YARD)

Building: GROUNDS Room: INNER PLANT GROUNDS

Elev: 609 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: AB FUEL OIL STORAGE TANK

MFR:

Model: 60,000 GALS (12' DIA X 72' LONG)

Panel:

Elem. Drawing: N\A

Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Eval : N

Comp Type: TANK (COMMON FOR UNIT 1 AND UNIT 2)
240 HRS FULL LOAD.

Iso Drawing: 7

Location: BEING REPLACED UNDER RFC 12-4113, CI NOT APPROVED AS OF 9-15-92.

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 11
ID : 12-TK-47-AB (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : AB EMERG DIESEL FUEL OIL STORAGE TANK		
Building : GROUNDS	Floor El. : 609.00	Room, Row/Col : INNER PLANT GROUNDS UNIT # 2 BURIED SOUTH OF TURBINE BUILDING
Manufacturer, Model, Etc. : 12' DIA X 69'-10"LONG, 60000 GALS		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank..	N/A
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: George G. Thomas (S&A) and Tom Huang (AEP)

Underground tank. SRT evaluated this tank based on the available documentation in the equipment package.

A tank calculation was performed (included in the tank package) based on the reference drawings The tank was modeled as a beam on elastic foundation. The overall tank stresses were very low (on the order of 3.6 ksi).

Evaluated by: Date:

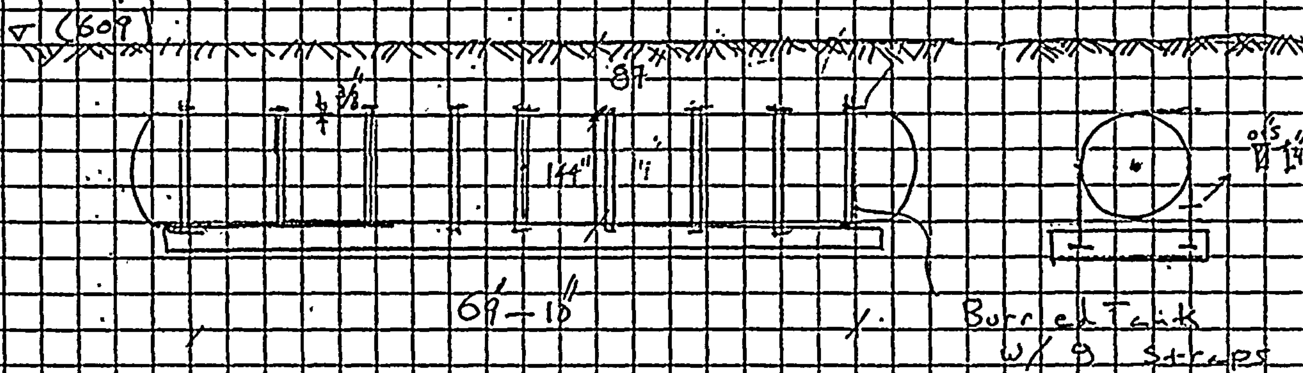
George G. Thomas 11/20/95

T Chin Huang 11-29-95

Attachment: EVALUATION OF STRESSES IN THE TANK

S&A Stevenson and Associates — A Structural-Mechanical Consulting Engineering Firm	CLIENT AEPSC — JOB No. 8961570 — SHEET 1 OF 10
SUBJECT AB Emergency Diesel Fuel oil storage Tank 12-TK-47-AB buried Tank D. C. Cook	REVISIONS: 0 B-Mahmoud 9/10/95; 8/30/96

- Introduction



Dimensions : as shown above

The capacity of the Tank = 60,000 gallon

Diameter : 144"

Thickness : 7/8"

The Tank is anchored by 9 straps of 1/2 x 4" to Concrete block at each end.

- This analysis was made to evaluate the seismic design adequacy of the underground Tank for the ground response spectrum.

- The Tank is modeled as a finite Beam on elastic foundation

S&A Stevenson and Associates
A Structural-Mechanical Consulting Engineering Firm

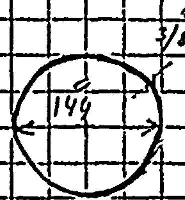
CLIENT: AEPSC JOB No.: 95C1570 SHEET 2 OF 10

SUBJECT: 12-TK-47-AB

D. C. Cook

REVISIONS: 0 — B. Mahmoud 7/10/95; 8/30/95

• Properties of Area



$$A = \frac{\pi}{4}\left(144^2 - 143.25^2\right) = 169.2 \text{ sq. in}$$

$$I = \frac{\pi}{64}\left(144^4 - 143.25^4\right) = 436{,}300 \text{ in}^4$$

$$E = 30E6 \text{ psi}$$

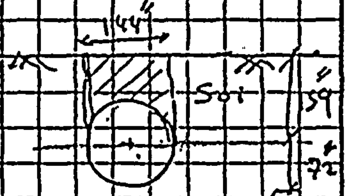
• Weights & Masses

$$m_{Tank} = \rho \cdot A \cdot 1$$

$$= 0.7339 \times 10^{-3} \times 169.2 \times 1 = \boxed{0.1242} \ \frac{\text{lb/in}}{\text{in/sec}^2}$$

$$m_{fluid} = \frac{60{,}000 \times 7.1}{838 \times 386.4} = 1.32 \ \frac{\text{lb/in}}{\text{in/sec}^2}$$

$$m_{soil} = \left(159 \times 144 - \frac{\pi}{2}(72)^2\right) \times L \times \frac{\rho}{386.4}$$



$$= 14{,}753 \times \frac{0.06}{386.4} = 2.29 \ \frac{\text{lb/in}}{\text{in/sec}^2}$$

assume $\rho = \frac{0.06}{386.4}$

$$m_{total} = 0.121 + 1.32 + 2.29$$

$$= \boxed{3.73} \ \frac{\text{lb/in}}{\text{in/sec}^2}$$

CLIENT	AEPSC	JOB No.	B9C157-0	SHEET 3	OF 10

SUBJECT: 12-TK-47-AB

D.C. Cook

REVISIONS: B. Mahmoud 3/10/9_ ; _ 8/30/95

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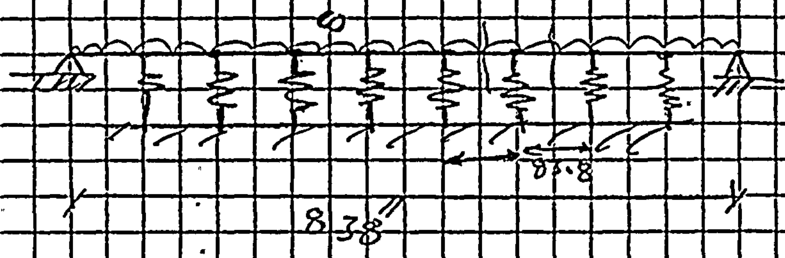
• Model



, simply supported finite beam on elastic foundation

$$C_u = \frac{2.26\,G}{(1-\nu)\sqrt{A}}$$ (ref. (B), soil Dynamics, Shamsher Prakash) p.p 115

where : C_u is the coefficient of elastic uniform compression of soil, G is shear modulus, ν is poisson ratio and A is contact area.

assume $G = 5400$ psi
$\nu = 0.4$

and we have $A = 144 \times 83.8 = 12,067$ in^2

$$\therefore C_u = \frac{2.26 \times 5400}{(1-0.4)\sqrt{12,067}} = 115$$

$\therefore k = C_u \cdot A = 115 \times 12,067 = 1.4\,E6$ lb/inch

$\therefore K = \frac{1.4E6}{83.8} \simeq \boxed{16,000}$ lb/inch^2

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CLIENT AEP SC JOB No. 89C1570 SHEET 4 OF 10

SUBJECT
~~12-TK-47-AB~~
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REVISIONS
B. Mahmoud 7/10/95
DJS 8/30/05

From (ref. (2) formulas for natural frequency and mode shape, Robert D. Blevins)

we can calculate the natural frequency from eqn (8-11) (p.p 108)

$$f_i = \left(\frac{i^4 \pi^4}{4\pi^2 L^4} \frac{EI}{M} + \frac{E_f}{4\pi^2 M} \right)^{1/2} ; \quad i = 1, 2, 3$$

where, $E_f = K = 16,000\ lb/in^2$

for the first mode $i = 1$

$$f_1 = \left[\frac{\pi^2}{4 (838)^4} \frac{30 \times 10^6 \times 436,300}{3.73} + \frac{16,000}{4\pi^2 (3.73)} \right]^{1/2} = 11.2\ HZ$$

So, The Tank is rigid.

From The Ground Responce spectra we find;

$$\boxed{S_a' = 0.2g}$$

So, The horizontal acceleration is 0.2g
and The vertical acceleration $\frac{2}{3} \times 0.2g \simeq 0.14g$

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CLIENT AEP&C JOB No. 89C1570 SHEET 5 OF 10

SUBJECT 12 - TK - 47 - AB

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Straining Actions

For the Beam on elastic Foundation we can calculate the Bending Moment and Shear force from ref.(1) " formulas for Stress and Strain, R.J. Roark & Young" (pp. 132 → 136)

$$\beta = \sqrt[4]{\frac{K}{4EI_z}}$$

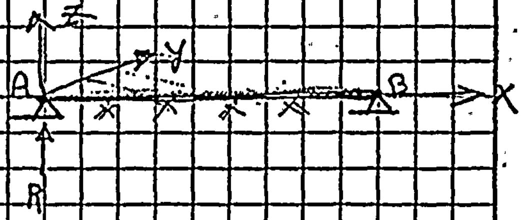
$I_z = 436,300 \text{ in}^4$, $E = 30 \times 10^6$ psi, $K = 16,000$ psi

$$\beta = \sqrt[4]{\frac{16,000}{4 \times 30 \times 10^6 \times 436,300}} = 0.004$$

$$a = \frac{2\pi}{\beta} = 506 \text{ in}$$

$\beta L = 3.35 \rightsquigarrow$ beam of medium length $0.6 < \beta L < 5$

$M_A = 0$, $Y_A = 0$



$$R_A = \frac{w}{2\beta}\left(\frac{C_2 C_{a5} + C_4 C_{a5}}{C_{11}}\right)$$

$$\theta_A = \frac{w}{4EI\beta^3}\left(\frac{C_2 C_{a5} - C_4 C_{a3}}{C_{14}}\right)$$

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CLIENT AEPSC JOB No. 89C1570 SHEET 6 OF 10

SUBJECT

12 - TK - 47 - AB

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$C_2 = \cosh\beta l \sin\beta l + \sinh\beta l \cos\beta l = F_2 = -18.3$

$C_4 = \cosh\beta l \sin\beta l - \sinh\beta l \cos\beta l = F_4 = 10.64$

$C_{14} = \sinh^2\beta l + \sin^2\beta l = 221$

$C_{a3} = \sinh\beta(l-x_0)\,\sin\beta(l-x_0) = F_3 = -3.82$

$C_{a5} = 1 - [\cosh\beta(l-x_0)\cos\beta(l-x_0)] = 1+14.5 = 15.5$

- Transverse shear $= V = R_A \cdot F - \theta_A \cdot 2EI\beta^2 F_3 - \frac{\omega}{2\beta} F_2$

- Bending moment $= M = \frac{R_A}{2\beta} F_2 - \theta_A \cdot EI \cdot \beta \cdot F_4 - \frac{\omega}{2\beta^2} F_3$

vertical direction

Total weight $= (1+0.14)\,g\,.\,m$

$= 1.14 \times 386.4 \times 3.73 = 1643$ lb/in

$$R_A = \frac{1643}{2(0.004)}\left(\frac{(-18.3)\times(-3.82) + (10.64)\times(15.5)}{221}\right)$$

$= 205{,}381 \times 1.06 = \boxed{217{,}705}$ lb

$$\theta_A = \frac{1643}{4\times 30E6 \times 436{,}300 \times (0.004)^3}\left(\frac{-18.3\times15.5 - 10.64\times -3.82}{221}\right)$$

$= -5.36\times10^{-4}$ rad.

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	SUBJECT 12 - TK - 47 - AB	REVISIONS: B. Mahmoud 3/10/95; 8/30/95
	D. C. Cook	

M_{max} occurs at the midspan at $X = L/2$

$\beta X \simeq 1.6$

$F_2 = 2.51$, $F_4 = 2.65$, $F_3 = 2.37$

$M_{max} = 27.2 \times 10^6 (2.51) + 28.04 \times 10^6 (2.65) \quad 51.2 \times 10^6 (2.37) = 12.10 \times 10^6$ Ib.in

$V_{max} = R_A = 217,705$ Ib

- horizontal direction (Y-direction)

$S_a = 0.2 g$

load $= 0.2 g \cdot m$

$= 0.2 \times 386.4 \times 3.73$

$= 288$ Ib/in

$R_A = 38,194$ Ib

$\theta_A = -0.94 \times 10^{-4}$ rad

$M_{max} = 3.675 \times 10^6$ Ib.in

$V_{max} = 38,194$ Ib.in

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CLIENT AEPSC JOB No. 89C1570 SHEET 8 OF 10

SUBJECT

12 - TK - 47 - AB

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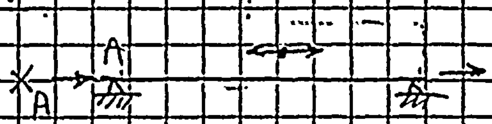
— horizontal direction (X — direction)

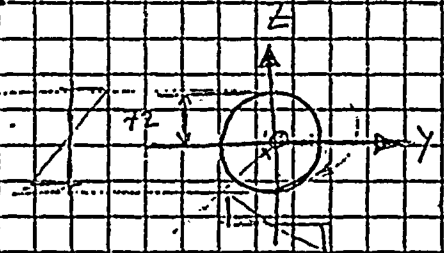


$X_A = 0.2g \cdot m \times \frac{L}{2}$

$= 288 \times \frac{838}{2} = 120,672$ lbs

$N_{max} = X_A = 120,672$ lbs

* check The stresses on the Tank shell:



$I_y = 436,300 \ in^4$

$A = 169.2 \ in^2$

* $M_y = 21.0 \times 10^6$ lb·in

* $M_z = 3.675 \times 10^6$ lb·in

* $N_x = 120,672$ lb

* $Q_z = 217,705$ lbs

* $Q_y = 38,194$ lbs

$\sigma_1 = \frac{M_y}{I_y} x = \frac{21 \times 10^6}{436,300}(72) = 3,466$ psi

$\sigma_2 = \frac{M_z}{I_z} y = \frac{3.675 \times 10^6}{436,300}(72) = 606$ psi

$\sigma_3 = \frac{N}{A} = \frac{120672}{169.2} = 713$ psi

CLIENT AEPSC JOB No. 89C1570 SHEET 9 OF 10

SUBJECT

12 - TK - 47 - AB

D. C. Cook

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using SRSS

$$\sigma_{max} = \sqrt{(3,466)^2 \; (606)^2 + (713)^2} = 3,590 \text{ psi}$$

$$= 3.59 \text{ ksi} < 36 \text{ ksi} \quad (\text{o.k})$$

$$F.S = \frac{36}{3.59} = 10$$

$$\tau_1 = \frac{Q}{A} = \frac{217.705}{169.2} = 1.29 \text{ ksi}$$

$$\tau_2 = \frac{Q}{A} = \frac{38.194}{169.2} = 0.26 \text{ ksi}$$

$$\tau_{max} = \sqrt{\tau_1^2 + \tau_2^2}$$

$$= \sqrt{(1.29)^2 + (0.26)^2} = \underline{\underline{1.32}} \text{ ksi} \quad (\text{very safe})$$

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CLIENT AEPSC JOB No. 89C1570 SHEET 10 OF 10

SUBJECT 12 - TK - 47 - AB

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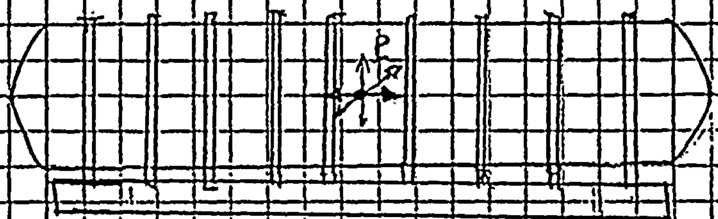
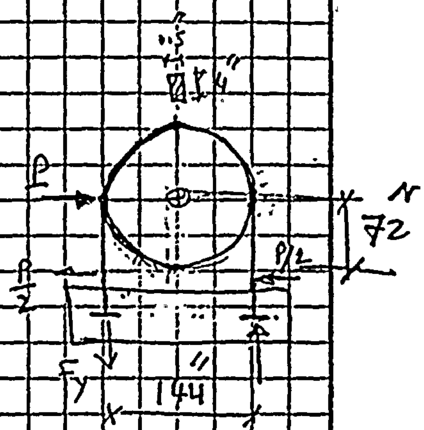
* check the stresses on the strap





The weight of the Tank transfer to the ground by contacting with the soil

and the strap prevent the relative movement of the tank and the concrete block and it acts like a link

WILL ASSUME ONLY THE TWO END STRAPS ARE ACTIVE.

$$F_y = \frac{P(72)}{(144)} = \frac{P}{2} = \frac{38.194}{2} = 19.1 \text{ kip}$$

$$\sigma_t = \frac{19.1}{0.5 \times 4} \approx 9.6 \text{ ksi} \quad (o.k)$$

$$\tau = \frac{P/2}{A} = 9.6 \text{ ksi} \quad (o.k)$$

* Conclusion:

The results of this Analysis show that this Tank will maintain its structural and leak tight integrity during the prescribed ground response spectra

Equip ID: 2-HE-11 Train: 12 Equip Class: 21

Drawing No.: 2-5129A 2-5135

ction: _RI_

System: REACTOR COOLANT PUMP SEAL WATER INJ/LEAKOFF

Equip Desc: REACTOR COOLANT PUMP SEAL WATER HEAT EXCHANGER

Building: AUXILIARY Room: SEAL WATER HEAT EXCHANGER ROOM

Elev: 609 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: REACTOR COOLANT PUMP

Mfr: ATLAS INDUSTRIAL MANUFACTURING CO.

l:

Panel:

Elem. Drawing: N/A

Wiring Drawing: N/A

Power Source:

Walkdown: F Relay Eval : N

Comp Type: HEAT EXCHANGER

ISO Drawing: 2-CS-91 2-CS-100

Location: IN WEST AREA OF ROOM

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 7
ID : 2-HE-11 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : REACTOR COOLANT PUMP SEAL WATER HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : SEAL WTR HEAT XCHGR RM - IN WEST AREA OF ROOM
Manufacturer, Model, Etc. : ATLAS INDUSTRIAL MANUFACTURING CO.		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas and Tom Huang on 11/3/93.

Vertical Heat Exchanger on a Gusseted steel pedestal. Each Pedestal is anchored to the floor with 8 - 3/4" J-Bolts embedded 20" into floor.

Exchanger is 16" in diameter and 14' in height.

Exchanger is bolted to the steel pedestal with 2 1" diameter steel bolts on 6" centers in weak direction and 2'-8" in strong direction. This connection is more limiting than the anchorage to the floor.

Attached calculation was to judge adequacy of these for bolts.

The exchanger has a frequency of 10.6 Hz and the bolts had a safety factor in tension of 3.54.

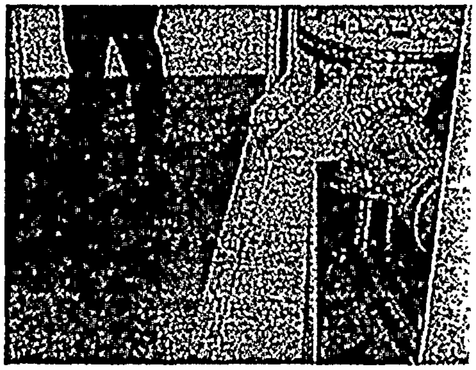
Evaluated by: George D. Thomas — Date: 10/4/95

T Chen Huang — 10-25-95

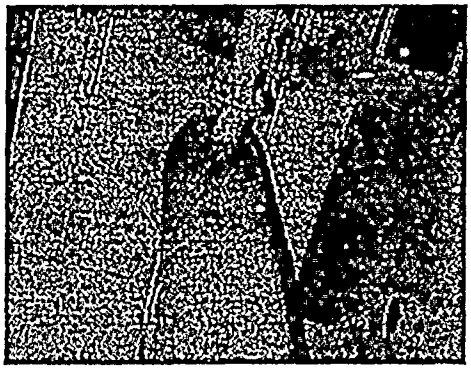
Attachment: Pictures
Attachment: Verification of Bolt Connection

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 7
ID : 2-HE-11 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : REACTOR COOLANT PUMP SEAL WATER HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : SEAL WTR HEAT XCHGR RM - IN WEST AREA OF ROOM
Manufacturer, Model, Etc. : ATLAS INDUSTRIAL MANUFACTURING CO.		

PICTURES



SUPPORT PEDESTAL



TOP OF THE EXCHANGER

I. Description
The 1-HE-11 Tank Anchorage is described in the Figures shown below.
Obviously, the weakest link of the Tank is the failure of the steel-steel bolts at the top of the legs.
The anchorage at the base including 16 J bolts is oversized, thus represents no concern.

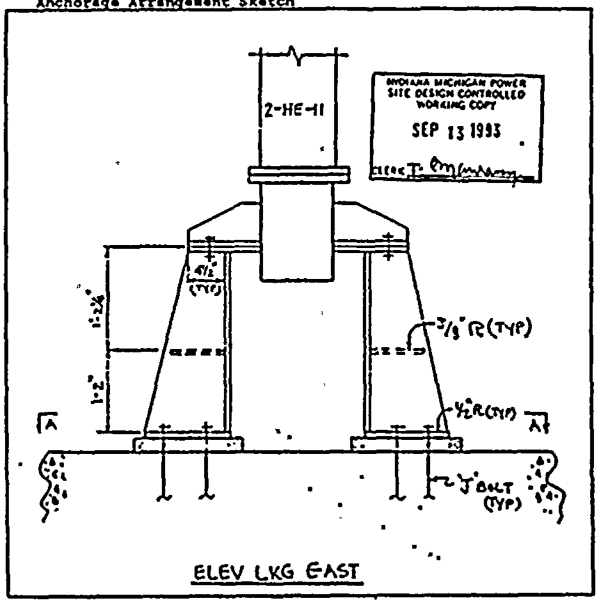


Figure 1

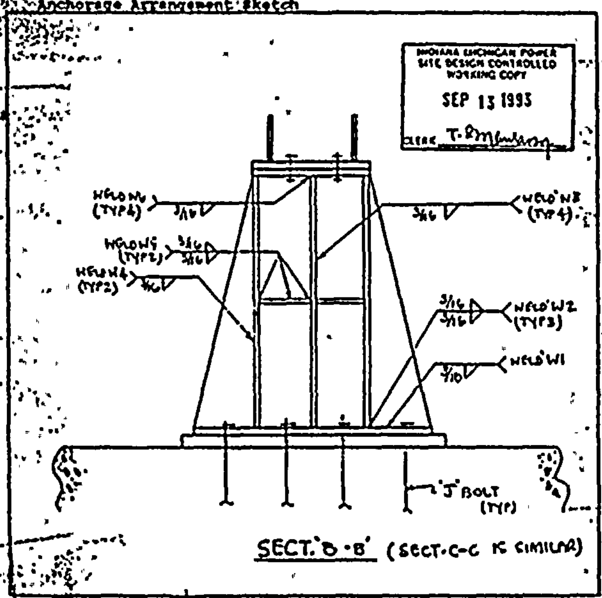


Figure 2

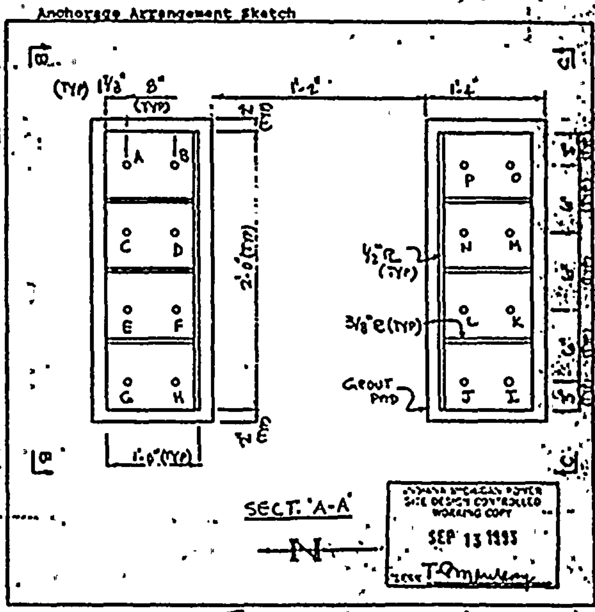


Figure 3

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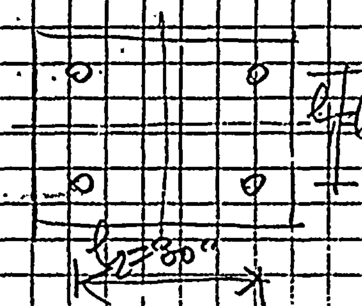
CLIENT AEP JOB No. 89C1570 SHEET 2 OF 7

SUBJECT REACTOR COOLANT PUMP SEAL WATER HEAT EXCHANGER 1,2-HE-11

DC Cook

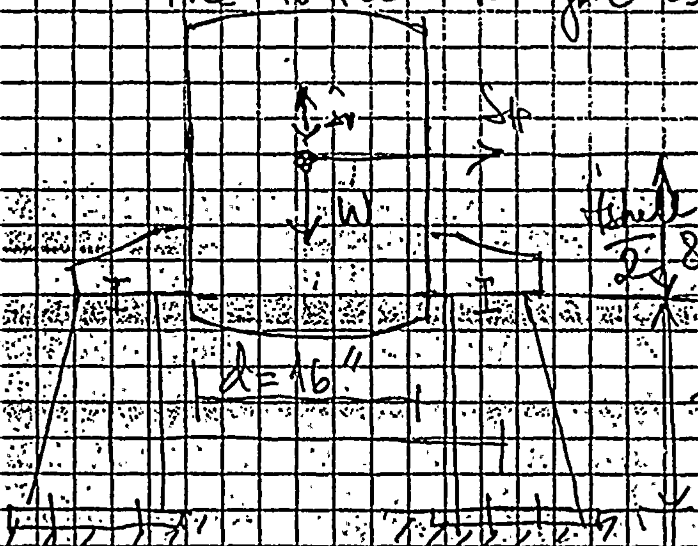
REVISIONS: DMG 9/20/95; DDS 9/24/95

IV Verification of bolts at the top of legs



The Tank is anchored to its legs by 4 bolts, $\phi = 1$".

The weight of the Tank is W' = 3350 lb.
An additional weight is coming from the attached pipe. SRT judged an additional weight of 20ft × 31.5 lb/ft = 630 lb (see SEWS)
The total weight is W = 3350 + 630 = 3980 lb.



Tank Shell Frequency

$m = \frac{W}{g} / L = \frac{3980}{386.4 \times 168} =$

$m = 0.0613 = 6.13 \times 10^{-2}$ lb/in · s²/in

t = .375" d = 16"

$A = \pi d t = 18.85$ in²

$I_x = \frac{\pi d^3 t}{8} = 603.2$ in⁴ $= I_y$

Using "Formulas for Natural Frequency and Mode Shapes" by R. Blevins, 1979, Table 8-1 for beams w/ clamped end and free at the other end.

CLIENT AEP JOB No. 891570 SHEET 3 OF 7

SUBJECT REACTOR COOLANT PUMP SEAL WATER HEAT EXCHANGER 1,2-HE-11

DC COOK

REVISIONS: 0 DWG 9/20/95; DDD 9/24/95

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$$f_{shell} = \frac{1.875^2}{2\pi L^2}\left(\frac{EI_x}{m}\right)^{1/2} =$$

$$f_{shell} = \frac{1.875^2}{2\pi \times 168^2}\sqrt{\frac{29E6 \times 603.2}{613 \times 10^{-3}}} = \underline{10.6\ Hz}$$

The spectral acceleration for 10.6 Hz is 0.25g including 1.25 (conservative) factor the floor acceleration is 0.31g in horizontal direction and 0.21g in vertical direction.

A. Tension in bolts

$$N_{bolt} = \frac{W}{4}\sqrt{\left(\frac{S_v}{4}\right)^2 + \left(\frac{S_H \cdot H_{shell}}{2\times 2\times \ell_1}\right)^2 + \left(\frac{S_H \cdot H_{shell}}{2\times 2\times \ell_2}\right)^2}$$

$$N_{bolt} = -\frac{3980}{4} + \sqrt{\left(\frac{836}{4}\right)^2 + \left(\frac{103,656}{2\times 6}\right)^2 + \left(\frac{103,656}{2\times 80}\right)^2} = -995 + 8812$$

(209; 8638; 1,296)

$\underline{N_{bolt} = 7817\ lb}$

$S_v = 0.21 \times 3980 = 836\ lb$; $S_H = 0.31 \times 3980 = 1234\ lb$

$H_{shell}/2 = 84''$; $\ell_1 = 6\ in$; $\ell_2 = 30\ in$

$\phi = 1'' \rightarrow A = 0.785\ in^2$

Normal stress in bolts → safety factor

$\sigma_{bolt} = \frac{7817}{0.785} = 9,957\ psi$ | $FS = \frac{32,800}{9157} = 3.54$ OK.

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CLIENT AEP JOB No. 89C1570 SHEET 4 OF 4

SUBJECT REACTOR COOLANT PUMP SEAL WATER HEAT EXCHANGER 1,2-HE-4

D.C. COOK NPP

REVISIONS: 0 DWG 9/20/95 DDS 9/25/95

B. Shear in bolts

$$V_{bolt} = \frac{SH}{4} = \frac{1237}{4} = 308.5 \text{ lb.}$$

$$A_{sh} = 0.785 \text{ in}^2$$

$$\tau_{bolt} = 393 \text{ lb}$$

For two horizontal directions of earthquake

$$\tau_{bolt} = \sqrt{2} \times 393 = 554 \text{ psi}$$

Safety factor is

$$F_S = \frac{(32400)}{2 \times 554} = 29.3 \quad OK$$

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 2-HE-11 Class 21

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ___ (If yes, check items that apply.)

	Remarks
Anchor Type	
Anchor Diameter	
Anchor Spacing	
Anchor Number	THE 'J' BOLTS ARE NOT
Anchor Embedment ✓	THE GOVERNING ONE (THERE
Anchor Edge Distance	ARE 8 OF THEM AT EACH
Anchor Gap	PEDESTAL) THEREFORE OK
Anchor Thread Engagement	
Anchor Grip	
Anchor Angularity	
Concrete Crack	I. [signature] 11-3-93
Others (describe briefly)	D. [signature] 11-3-93

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

NONE

Actions Taken:

NONE

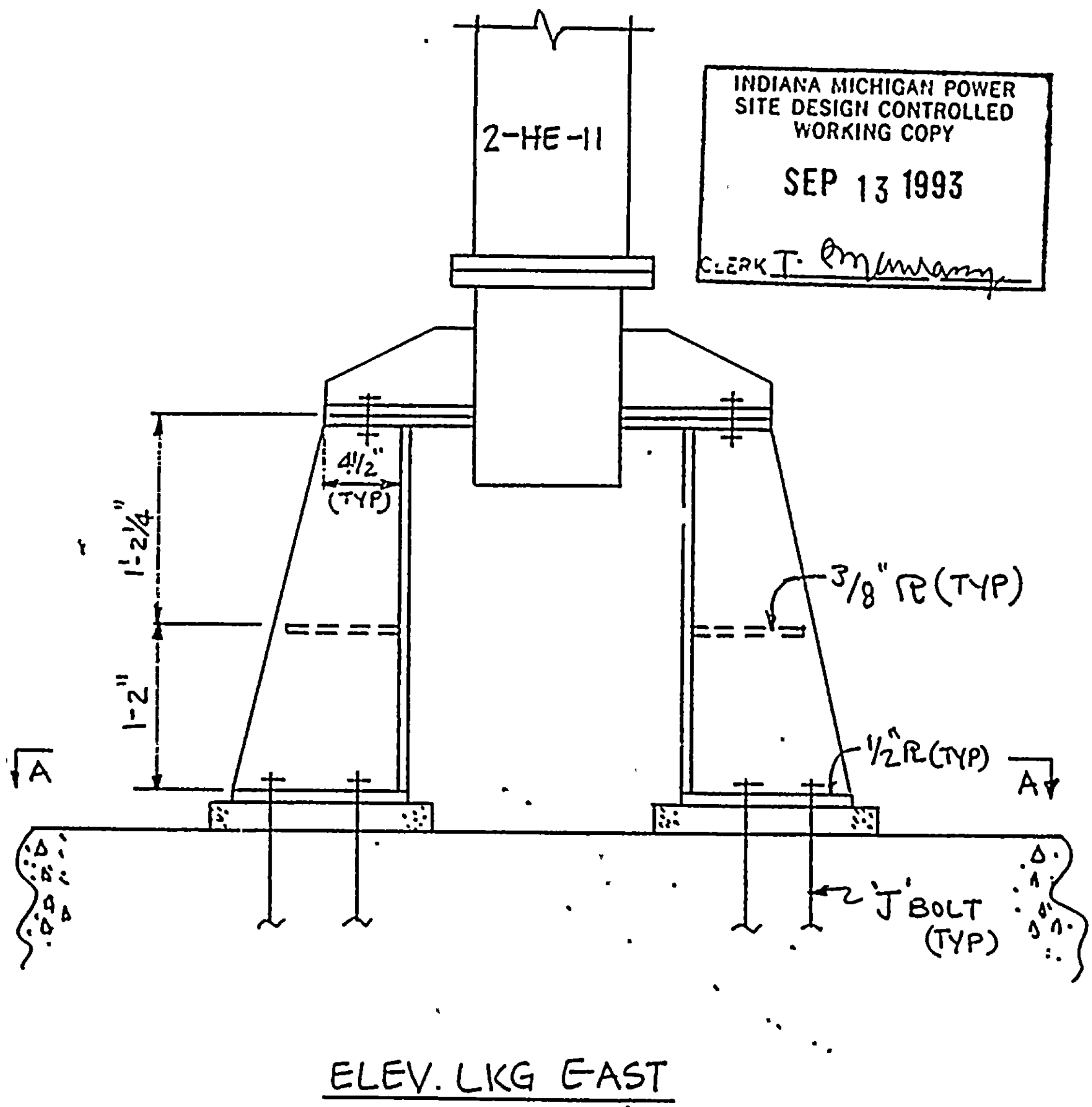
Prepared By T. [signature] Date 9-13-93

ANCHOR INSPECTION DATA SHEET

Unit #	Bldg.	Location
2	AUX. EL. 609'-0"	SEAL WATER HEAT EXCHANGER ROOM

Installation dwg. / Rev.	Equipment No.
12-3285	2-HE-11

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 13 1993
CLERK T. Emmanuel

Drawn by: T. Emmanuel Date: 9-7-93

Verified by: Jerry Marris Date: 9-9-93
Qual./Cert. Inspector

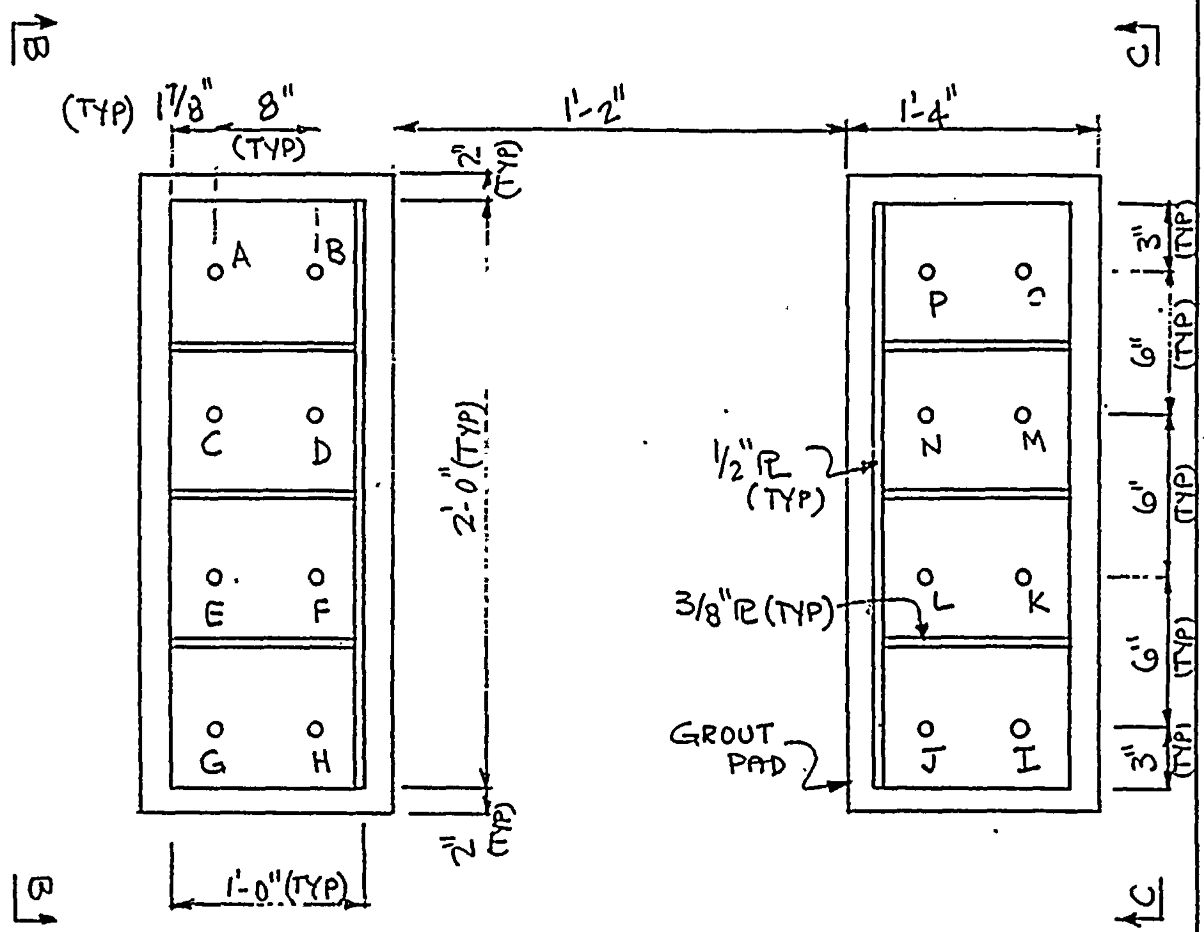
Reviewed by: T. Emmanuel Date: 9-13-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

2	AUX. EL. 609'-0"	SEAL WATER HEAT EXCHANGER ROOM
Unit #	Bldg.	Location

12-3285	2-HE-11
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



SECT. 'A-A'

N

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 13 1993
CLERK T-Manlerong

Drawn by:	T-Manlerong	Date:	9-7-93
Verified by:	Jerry Marie Qual./Cert. Inspector	Date:	9-8-93
Reviewed by:	T-Manlerong Construction Anchor Review Engineer	Date:	9-13-93

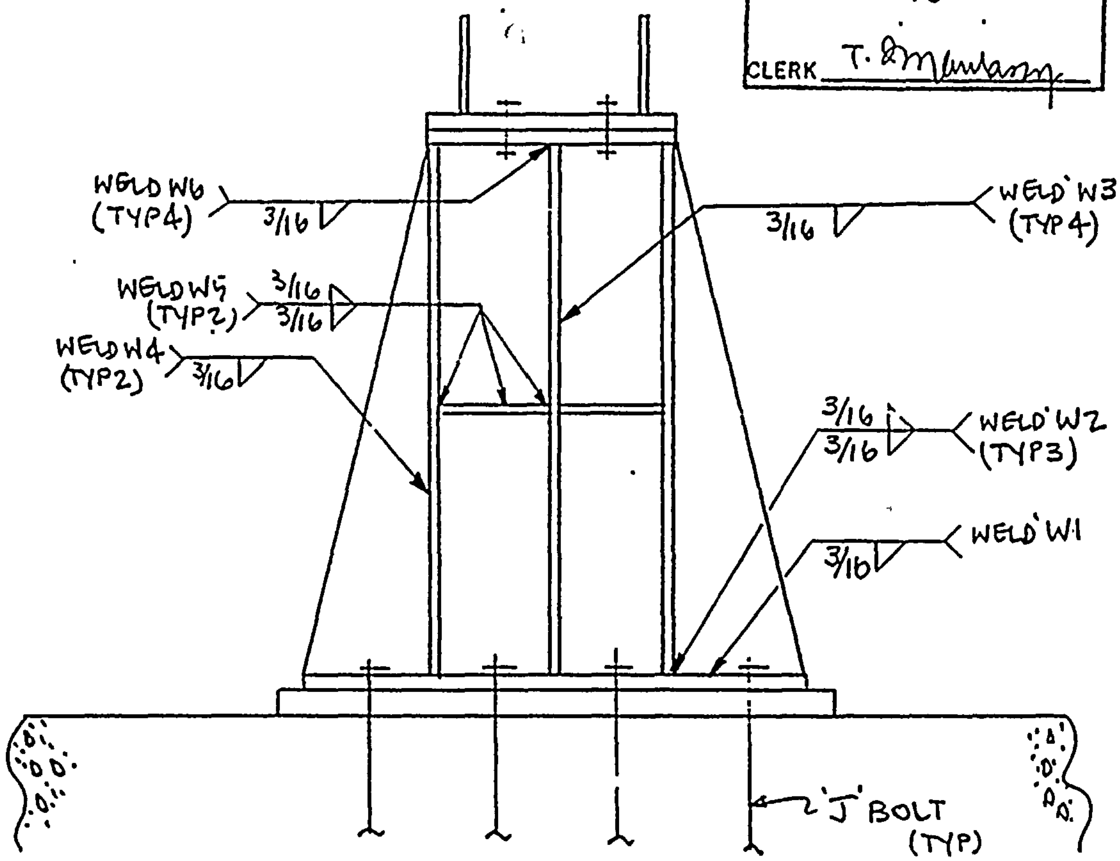
ANCHOR INSPECTION DATA SHEET

	AUX EL. 609'-0"	SEAL WATER HEAT EXCHANGER ROOM
Unit #	Bldg.	Location

12-3285	2-HE-11
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
SEP 13 1993
CLERK T. Amantarry



SECT. B-B' (SECT. C-C IS SIMILAR)

Drawn by: T. Amantarry Date: 9-7-93

Verified by: Jerry Morris Date: 9-9-93
Qual./Cert. Inspector

Reviewed by: T. Amantarry Date: 9-13-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-HE-11 Dwg No.: ______

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W1	W2	W3	W4	W5	W6		
Type	1	1	1	1	1	1		
Size	1/8	1/8	3/16	3/16	3/16	3/16		
Length	2 1/4"	11 1/4"	26"	26"	18 1/2"	3 1/2"		
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

W1 - 9" LG. UNDERCUT
W5 - 5 1/2" LG. UNDERCUT OVERLAP @ VARIOUS SPOTS (1")
W6 - OVERLAP 1/2".

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CLERK T. Emanuson

Equipment base flexible: ☐ Yes ☒ No T. Emanuson Construction Are Date: 9-7-93

Reviewed by: T. Emanuson Construction Anchor Review Engineer Date: 9-13-93

Verified by: Jerry Morris Qual./Cert. Inpsector Date: 9-9-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-HE-11 Dwg No.: 12-3286

Anchor type: J BOLT Dia: 3/4" Dwg No.: 12-3285

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date:

Tightness verified? ☐ Yes ☑ No T. Omanson Construction ARE Date: 9-7-93

Equipment base flexible? ☐ Yes ☑ No T. Omanson Construction ARE Date: 9-7-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D	E	F	G	H	Comments
Gaps	0	0	1/8" BET WASHER & NUT	1/32" BET WASHER & NUT	0	1/32" BET. WASHER &	0	0	
Anchor length	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"	FROM DWG 12-3073B
Protruding length	2 15/16"	3"	3"	3"	2 3/4"	2 7/8"	2 3/4"	2 5/8"	
Embedment	1'-9 1/16"	1'-9"	1'-9"	1'-9"	1'-9 1/4"	1'-9 1/8"	1'-9 1/4"		
Bolt grip	1 7/8"	1 7/8"	1 3/4"	1 5/8"	1 5/8"	1 5/8"	1 3/4"	1 5/8"	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	>12"	>12"	>12"	>12"	>12"	>12"	>12"	>12"	
Anchor spacing	6"	6"	6"	6"	6"	6"	6"	6"	
Anchor angularity	0°	0°	15°	0°	0°	0°	0°	0°	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments:

Verified by: Jerry Marvin Qual./Cert. Inspector Date: 9-9-93

Reviewed by: Construction ARE Date:

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
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SEP 13 1993
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ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-HE-11 Dwg No.: 12-3286

Anchor type: 'J' BOLT Dia: 3/4" Dwg No.: 12-3285

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date:

Tightness verified? ☐ Yes ☒ No T. Omanason Construction ARE Date: 9-7-93

Equipment base flexible? ☐ Yes ☒ No T. Omanason Construction ARE Date: 9-7-93

PHYSICAL CHARACTERISTICS

Bolt ID	I	J	K	L	M	N	O	P	Comments
Gaps	0	0	0	0	0	0	1/16" BET NUT & WASHER	0	
Anchor length	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"	2'-0'	FROM DWG 12-3073B
Protruding length	3 1/16"	3 1/8"	3 5/16"	3 1/4"	3 3/16"	3 3/8"	3 1/2"	3 1/8"	
Embedment	1'-8 15/16"	1'-8 7/8"	1'-8 11/16"	1'-8 3/4"	1'-8 13/16"	1'-8 5/8"	1'-8 1/2"	1'-8 7/8"	
Bolt grip	1 1/2"	1 5/8"	1 1/2"	1 3/4"	1 3/4"	1 3/4"	1 3/4"	1 11/16"	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	>12"	>12"	>12"	>12"	>12"	>12"	>12"	>12"	
Anchor spacing	6"	6"	6"	6"	6"	6"	6"	6"	
Anchor angularity	0°	0°	0°	0°	0°	0°	0°	12°	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments:

Verified by: Jerry Morris Qual./Cert. Inspector Date: 9-9-93.

Reviewed by: T. Omanason Construction ARE Date: 9-13-93

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S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 4/20/93 REQUEST NO. N/A

IDENTIFICATION

Unit TWO
Component 2-HE-11
Item Anchors
Material C/S
Other SQUG

TECHNIQUE

Test Unit/ S/N ~~KBUSH 7S~~ KBUSK-7S 4/20/93 CQC-405
Freq./Diameter 5mhz / .250
Reference Standard QC-8
Couplant/Batch No. Ultragel II #9088

TEST DATA/REMARKS

Anchors	Length	Anchors	Length
A	*	I	*
B	*	J	*
C	*	K	*
D	*	L	*
E	*	M	*
F	*	N	*
G	*	O	*
H	*	P	*

NOTE: A BACK REFLECTION INDICATING ANCHOR LENGTH WAS NOT OBTAINED DURING THIS EXAM. THIS WOULD BE INDICATIVE OF A J-BOLT TYPE ANCHOR.

PERFORMED BY: [signature] LEVEL: II DATE: 4-20-93
REVIEWED BY: Stephen R. Vargo LEVEL: II DATE: 4/21/93

FORM NO. 12 SHP 5050 NDE.008-1

Equip ID: 2-HE-38E Train: 2 Equip Class:21

Drawing No.: 2-5135A

Function: CCW

System: MISCELLANEOUS SEALING AND COOLING

Equip Desc: EAST CENTRIFUGAL CHARGING PUMP PP-50E LUBE OIL COOLER

Building: AUXILIARY Room: EAST CENTRIFUGAL CHARGING PUMP ROOM

Elev: 587 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: EAST CENTRIFUGAL CHARGING PUMP

MFR: AMERICAN PRECISION INDUSTRIES (BASCO)

Model:

Panel:

Elem. Drawing: N/A

Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Eval : N

Comp Type: HE

Iso Drawing: 2-CCW-515, 2-CCW-508

Location: IN THE NORTHEAST PART OF THE ROOM, 2 FEET NORTHEAST OF EAST CENTRIFUGAL CHARGING PUMP #2-PP-50E

DC COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 2
ID : 2-HE-38E (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EAST CENTRIFUGAL CHARGING PUMP PP-50E LUBE OIL COOLER		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : E CENTRIFUGAL CHARG PMP ROOM - IN THE NORTHEAST PART OF THE ROOM, 2 FEET NORTHEAST OF EAST CENTRIFUGAL CHARGING PUMP #2-PP-50E
Manufacturer, Model, Etc. : MIDLAND-ROSS/ROSS-OPERATING VALVE CO.		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Tom Huang and Kailash Mahajan on 11/2/93.

ANCHORAGE TO PUMP ACCEPTABLE BY ENGINEERING JUDGMENT OF THE SRT.

Small exchanger 1'-6" long and 5" in diameter bolted to 2 1' long channel columns that are welded to the skid of the East Centrifugal Charging Pump. Could have screened with the pump using the rule of the box, however the exchanger was listed seperately on the SSEL.

Crane above in a parked and locked position.

Evaluated by: Date:

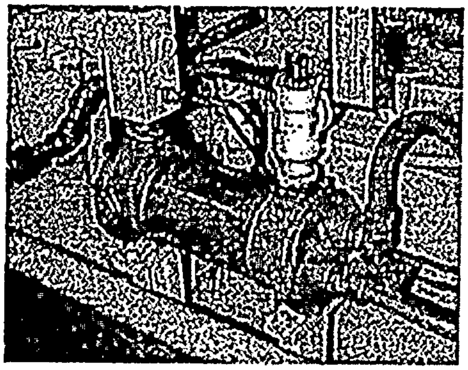
[signature] 9/15/95

[signature] 10-19-95

Attachment: Pictures

DC COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 2
ID : 2-HE-38E (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EAST CENTRIFUGAL CHARGING PUMP PP-50E LUBE OIL COOLER		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : E CENTRIFUGAL CHARG PMP ROOM - IN THE NORTHEAST PART OF THE ROOM, 2 FEET NORTHEAST OF EAST CENTRIFUGAL CHARGING PUMP #2-PP-50E
Manufacturer, Model, Etc. : MIDLAND-ROSS/ROSS-OPERATING VALVE CO.		

PICTURES



EAST CENTRIFUGAL CHARGING PUMP PP-50E
LUBE OIL COOLER

ANCHOR INSPECTION DATA SHEET

2	AUX. EL. 587'-0"	EAST CENTRIFUGAL CHARGING PUMP ROOM
Unit #	Bldg.	Location

NA	2-HE-38E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch

2-HE-38E

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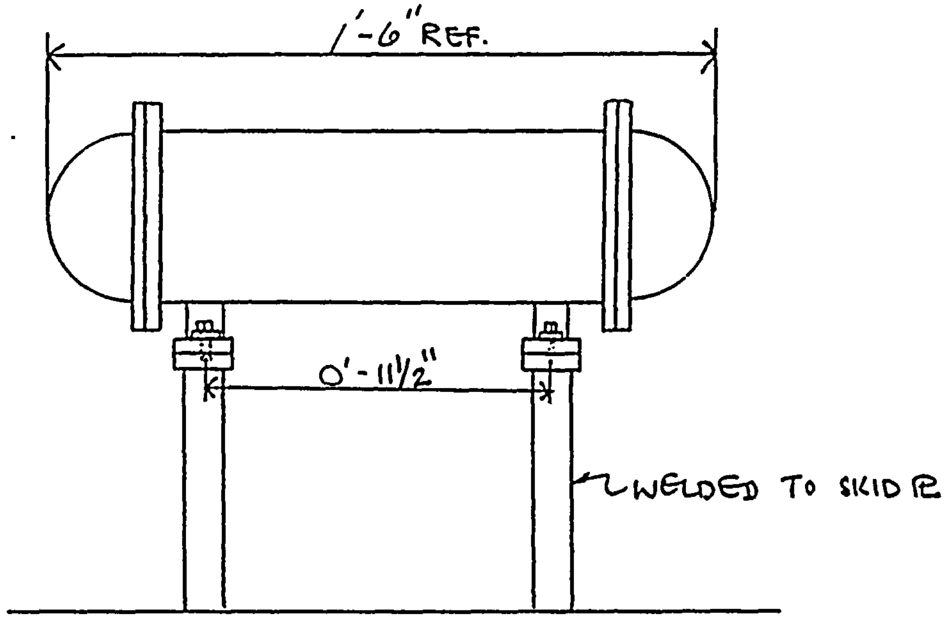


ELEV. VIEW LOOKING WEST

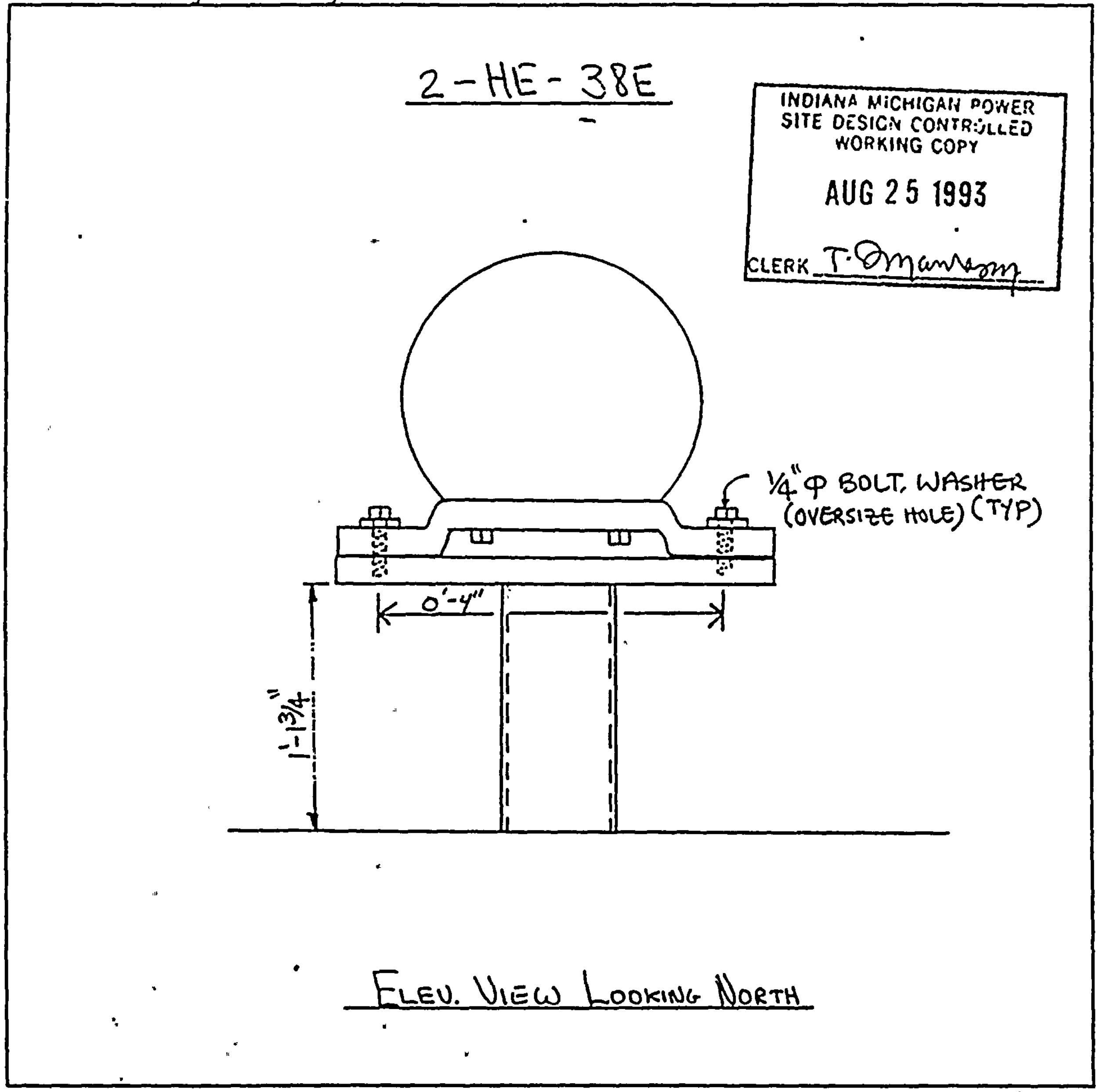
Drawn by:	T. Omanlanan	Date:	5-20-93
Verified by:	R.W. Graham Qual./Cert. Inspector	Date:	6-2-93
Reviewed by:	T. Omanlanan Construction Anchor Review Engineer	Date:	8-25-93

ANCHOR INSPECTION DATA SHEET

2	AUX-EL. 587'-0"	EAST CENTRIFUGAL CHARGING PUMP ROOM
Unit #	Bldg.	Location

NA	2-HE-38E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: T. Omanovic Date: 5-20-93

Verified by: [signature] Date: 6-2-93
Qual./Cert. Inspector

Reviewed by: T. Omanovic Date: 8-25-93
Construction Anchor Review Engineer

Equip ID: 2-QT-134-CD Train: 2 Equip Class:21

Drawing No.: 2-5151D

Section: EDG

System: DIESEL JACKET WATER

Equip Desc: CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)

Building: AUXILIARY Room: CD EMERGENCY DIESEL GENERATOR ROOM

Elev: 587 Sort: S,_ Notes: B

Normal State: Desired State: Power Req'd: Y

Support System Drawing: 2-12030 2-98014

Req'd Support Comp: 2-ABD-C-1D

Safety Related Status: STANDARD Min/Opt: MIN

Alias No: Power Train: A

Comp Served: CD AUXILIARY JACKET WATER HEATER

MFR: INDEECO

Model: 75KW HEATER

Panel: 2-DGCD

Elem. Drawing: 2-98014

Wiring Drawing: 2-95302

Power Source: 2-ABD-C-1D

Walkdown: F Relay Eval : N

Comp Type: TANK

Iso Drawing:

Location: IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 14
ID : 2-QT-134-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,
Manufacturer, Model, Etc. : 75KW HEATER		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? **Yes**

COMMENTS

SRT: W. Djordjevic and TR Satyan Sharma. 10/6/93.

REF: 1. Anchor Inspection Data Sheets: Anchorage Arrangement Sketches and Physical Characteristics Data Sheet, Certified 8/31/93.
2. Dwg # 12-3468-13.
3. Worthington Corp. Dwg. SK7938, 8-23-74

Anchorage: 2-QT-134-CD is the J.W. Heater, separately mounted by three1/2" coupling configuration of rod and Phillips Redhead wedge type anchors. Tightness was verified by torque, 6/28/93.

For anchorage evaluation, see External ANCHOR analysis, File: 2QT134CD.ANC. Weight of full water tank is estimated as 550 lb (assumed with 12.75" OD, .375" Wall thickness, flat .375" thick end plates, 64" height, and 4.18 cu. ft volume of water). Considered as a cantilever with distributed load, the fundamental frequency is estimated to be 82.5 Hz. Actual response is governed by fixity of the base; anchorage system consists of three 5/16" x 2" x 6.25" plates welded to the bottom of the tank at 120 degree intervals. Considering the base flexibility and configuration, the frequency was estimated to be 8.96 Hz. as indicated on the attached calculation. The ANCHOR analysis indicates a factor of safety of 3.74, however, the capacity of the anchorage is controlled by the base plates with a factor of safety of 1.84 as shown in the attached calculation.

<table>
<tr><td colspan="3">DC Cook Unit 2
SCREENING EVALUATION WORK SHEET (SEWS)</td><td>GIP Rev 2, Corrected, 2/14/92
Status: Yes
Sheet 2 of 14</td></tr>
<tr><td colspan="2">ID : 2-QT-134-CD (Rev. 0)</td><td colspan="2">Class : 21 - Tanks and Heat Exchangers</td></tr>
<tr><td colspan="4">Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)</td></tr>
<tr><td>Building : AUXILIARY</td><td colspan="2">Floor El. : 587.00</td><td>Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,</td></tr>
<tr><td colspan="4">Manufacturer, Model, Etc. : 75KW HEATER</td></tr>
</table>

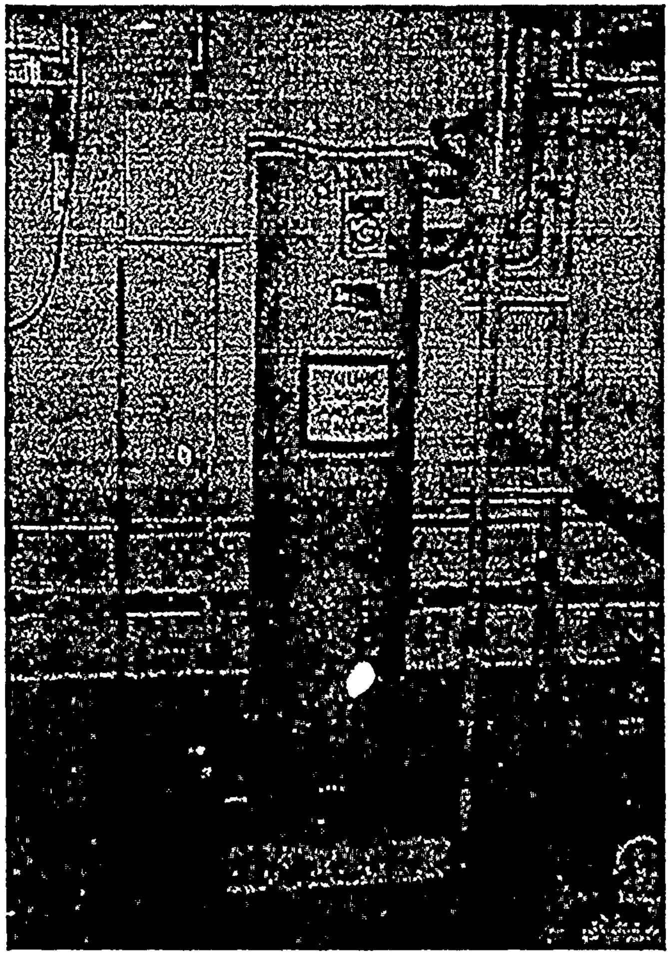
Evaluated by: [signature] Date: 12/13/95

[signature] 12/14/95

Attachment: Pictures
Attachment: Anchor Plate Seismic Capacity Evaluation for 2-QT-134-CD

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 14
ID : 2-QT-134-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,
Manufacturer, Model, Etc. : 75KW HEATER		

PICTURES



2-QT-134-CD

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CLIENT AEP JOB No. 89C1570 SHEET 1 OF 9

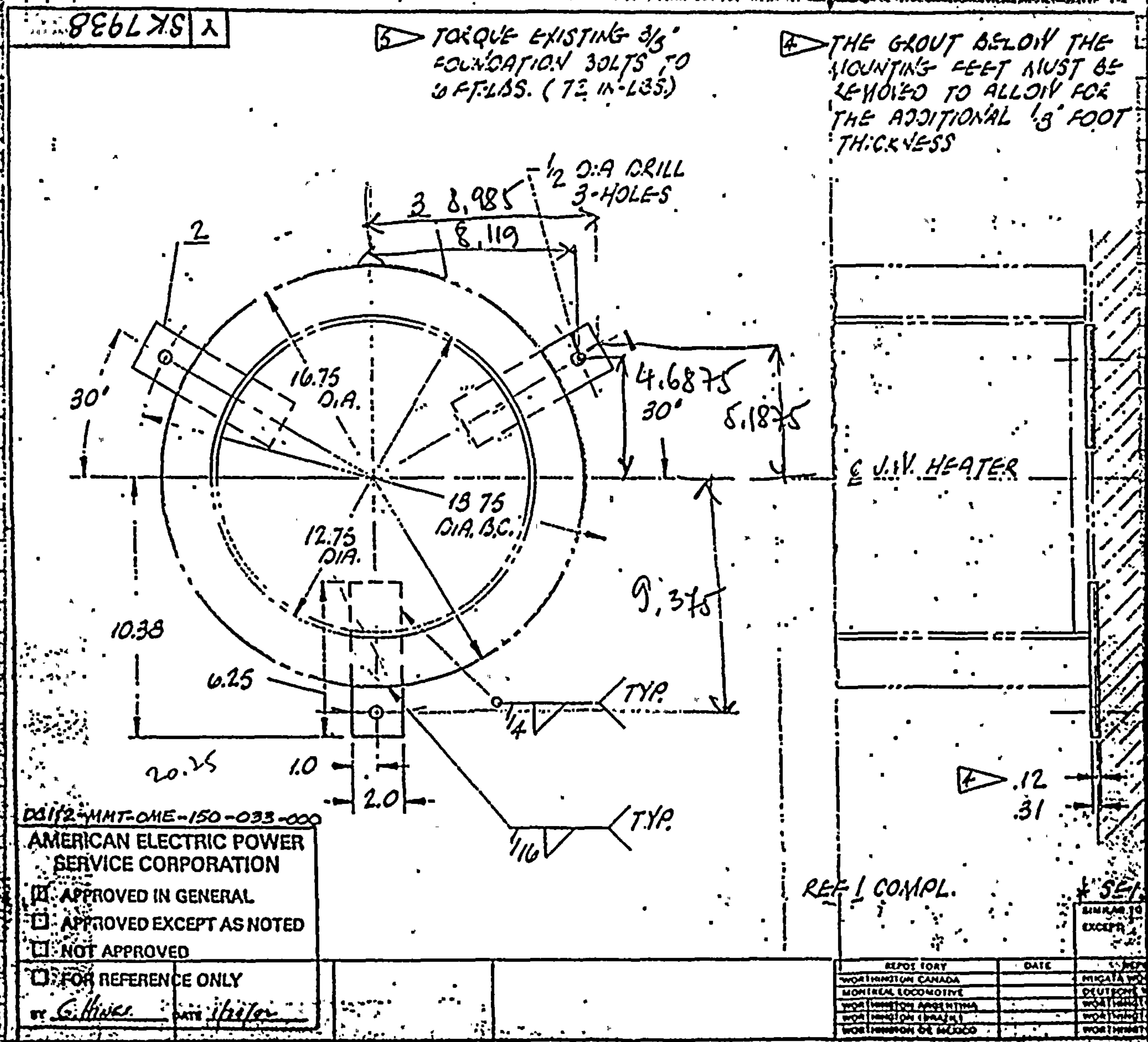
SUBJECT Seismic Evaluation
DC Cook Unit 2
Auxiliary Bldg. - CD Emergency
Diesel Auxiliary Jacket
2-QT-134 CD

REVISIONS
1 JMG 12/8/95
PRW 12/9/95

Verification of the Tank base plate thickness

The main concern for the tank base is the transfer of the axial bolt load through the base plate

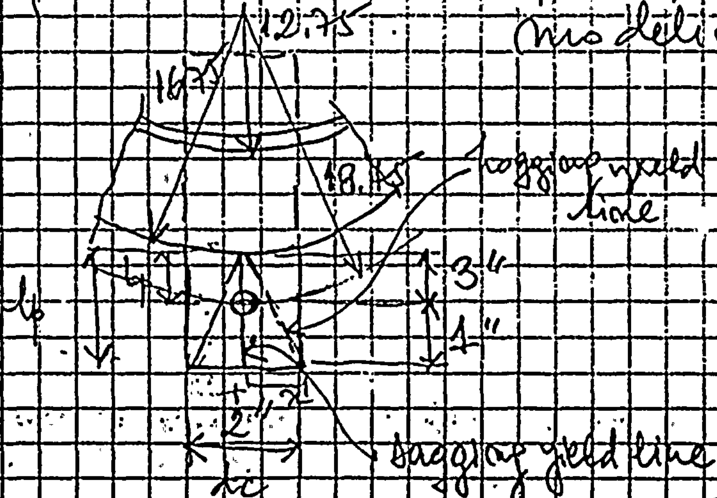
The tank base is described in the figure:



S&A Stevenson and Associates — A Structural-Mechanical Consulting Engineering Firm	CLIENT AEP — JOB No. 87C1570 — SHEET 2 OF 5
	SUBJECT Seismic Evaluation DC Cook Unit 2 Aux. Bldg - CD Emergency Diesel Auxiliary Jacket 2-QT-134-CD
	REVISIONS: 1 DMG 12/9/95 PRW 12/9/95

The ANCHOR analysis shown in the SEWS of item 2-QT-134-CD indicates a minimum anchor capacity to axial load of 2003 lb = 2.K. The axial anchor capacity is 3.74 larger than the demand (safety factor = 3.74) being equal to 536 lb (Conservative assumptions due to nonlinearity).

Herein the base plate is verified to the transfer of anchor axial capacity load using yield line modeling. For this, the "Analysis and Design of Structural Connections of reinforced concrete and steel" by Holmes and Martin, Ellis Harwood Engineering Science 1983, was used.



$l_p = 4"$ The work equation is:

$b_p = 3"$

$x = 2"$

$$F \cdot \frac{l_p}{l_p} \cdot \Delta = \left(4 l_p \frac{\Delta}{x/2} + 2 \frac{x}{2} \cdot \frac{\Delta}{l_p - ?}\right) M_{pl}$$

But, for our case it does not the "orientation of the yield line is arbitrary

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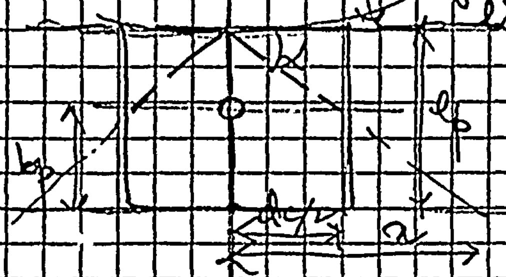
CLIENT AEP JOB No. 89C1570 SHEET 3 OF 5

SUBJECT Seismic Evaluation
DC Cook Unit 2
Aux. Bldg. - CD Emergency
Diesel Auxiliary Jacket
2-QT-134-CD

REVISIONS
1 BMG 12/9/95
PRW 12/9/95

critical yield line for yield lines oriented arbitrary with an angle α

the work equation is



$$F_b \cdot b_p \frac{\Delta}{\ell_p} = \left(4\Delta \frac{\ell_p (d_c/2)}{x^2} + 2 \frac{d_c/2}{\ell_p}\Delta \right) M_{pl}$$

The derivative is

$$\frac{dF_b}{dx} = -\frac{2}{x^3} 4 \ell_p \frac{d_c}{2} = 0$$

therefore the critical yield line for $x = \infty$, i.e. the yield line parallel to the edge ($\alpha = 0$). The maximum bolt force is

$$F_b \; b_p \frac{\cancel{\Delta}}{\cancel{\ell_p}} = M_{pl} \; d_c \cdot \frac{\cancel{\Delta}}{\cancel{\ell_p}}$$

$$F_b \, b_p = M_{pl} \, d_c \qquad M_{pl} = 864.0 \text{ lbs-in}$$

$$F_b = \frac{1}{3} \frac{0.31^2}{4} 36000 \cdot 2 = 576 \text{ lbs} > 536 \text{ lbs demand}$$

OK

This value is lower than the demand axial load in the bolt showing that base plate has safety factor of only 1.07. If we check the base plate with bending failure (ultimate state) the safety factor will be as follows on next page

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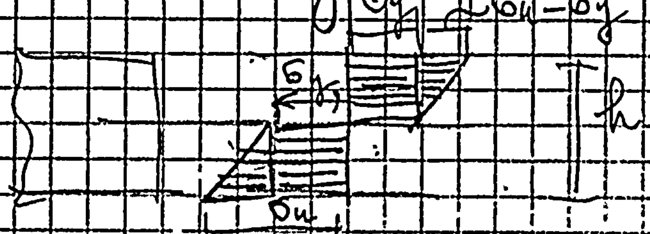
CLIENT: AEP   JOB No. 89C1570   SHEET 4 OF 5

SUBJECT: Seismic Evaluation
DC Cook Unit 2
Aux. Bldg — CD Emergency
Diesel Auxiliary Jacket
2-QT-134-CD

REVISIONS: DMG 12/9/95; PRW 12/9/95

The ultimate bending capacity may conservatively computed as:



$$M_{pl} = \sigma_y \frac{h^2}{4} + (\sigma_u - \sigma_y)\frac{h^2}{6} = \frac{h^2}{4}\left(\sigma_y + (\sigma_u - \sigma_y)\frac{2}{3}\right)$$

$$= \frac{0.31^2}{4}\left(36{,}000 + (58{,}000 - 36{,}000)\frac{2}{3}\right) = 1217 \text{ lb-in}$$

$$T_b = \frac{ac}{bp} M_{pl} = \frac{2}{3}\,1217 = 987.4 \text{ lb.} > 536 \text{ lb demand.}$$

OK

Therefore, the base plate does not fail in bending at the demand load. However, the base plate capacity is considerably lower than the bolt axial capacity, i.e. base plate is the weakest link of the Tank.

The safety factor is for the baseplate

$$F_S = \frac{987.4}{536} = 1.84$$

which is lower than that of 3.44 computed for the bolt by the ANCHOR analysis.

CLIENT AEP JOB No. 89C1570 SHEET 5 OF 5

SUBJECT Seismic Evaluation DC Cook Unit 2 Aux. Bldg - CD Emergency Diesel Auxiliary Jacket 2-QT-134-CD

REVISIONS 1 DWCF 12/9/95 PRW 12/9/95

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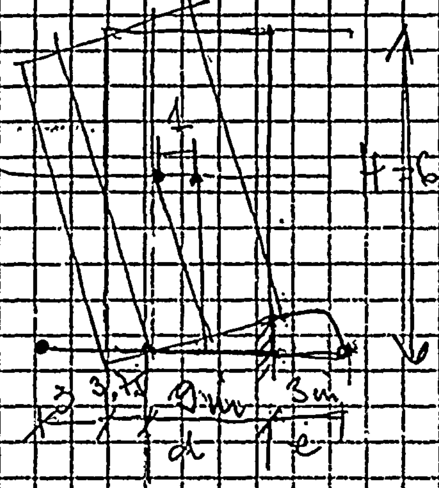
Frequency evaluation (for seismic load computation)

Consider a rotation of the tank under lateral load.



Vertical constraint at edge:

$$K_V = \frac{3EI}{e^3} = \frac{3 \times 29 \times 10^6 \times 4.97 \times 10^{-3}}{3^3} = 16000 \frac{lb}{in}$$

Horizontal translation of CG using kinematic displacements:

$$K_H = \frac{1}{H/2} \cdot d \cdot K_V = \frac{1}{32} (9) 16,000 = 4504 \frac{lb}{in}$$

conservative estimation

or

$$\delta_V = \frac{\delta_H}{H/2} \cdot d$$

$$M = \frac{550 lb}{386.4 in/s^2} = 1.42$$

$$I = \frac{0.31^3 \times 2}{12} = 0.00497 in^4 = 4.97 \times 10^{-3} in^4$$

$$E = 29E6 psi$$

$$f = \frac{1}{2\pi} \sqrt{\frac{K_H}{M}} = \frac{1}{2\pi} \sqrt{\frac{4504}{1.42}} = 8.96 Hz$$

Thus, the seismic load was evaluated for this calculation at a frequency of ± 8.96 Hz, and is 0.38g in horizontal direction and 0.25g in vertical direction.

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 9 of 14
ID : 2-QT-134-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,
Manufacturer, Model, Etc. : 75KW HEATER		

Earthquake :
Response Spectrum : User
Frequency : User - 8.96
Percent Damping : User - 0.00

Spectral Values :

Direction	Acceleration (g's)
North - South	0.38
East - West	0.38
Vertical	0.23

Angle (N-S Direction makes with the X Axis) : 0.00
Combination Criteria : SRSS

Weights :
Number of Weights : 1

No	Weight	X	Y	Z
1	550.00	6.875	0.000	32.000

Forces :
Number of External Forces : 0

Moments :
Number of External Moments : 0

Allowables :
Anchor :
Number of Anchor types : 1

No.	Dia	Manufact	Product	Ultimate Tension	Ultimate Shear	Tension Inter Coeff	Shear Inter Coeff	Saf Fact
1	1/2	Phillips	Wedge (N)	2290.00	2380.00	1.00	0.30	1.00

Concrete :
Ultimate Stress : 3500.00 psi..
Reduction Factor : 0.85

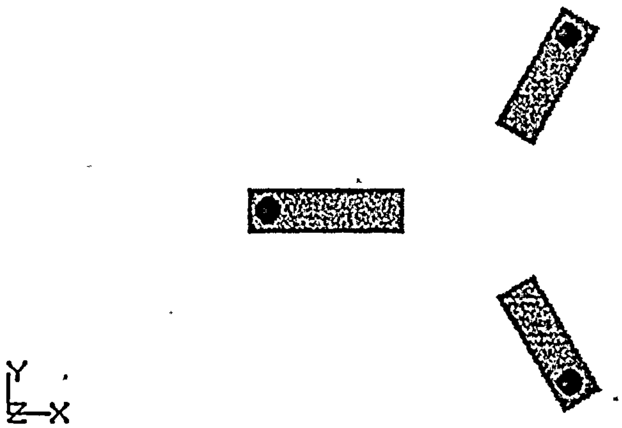
DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 10 of 14
ID : 2-QT-134-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,
Manufacturer, Model, Etc. : 75KW HEATER		

Weld :
Allowable Stress : 30600 psi.

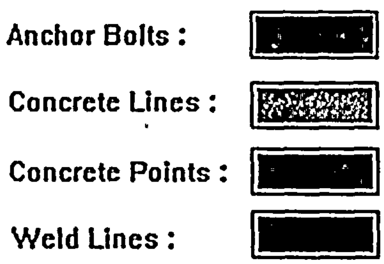
Surfaces :
Number of Surfaces : 1
Surface Orientation

	Direction	Direction	Direction
	Comp	Comp	Comp
No	Nx	Ny	Nz
1	0.000	0.000	1.000

Anchor Pattern for Surface # 1



Legend for Anchor Patterns



DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 11 of 14
ID : 2-QT-134-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,
Manufacturer, Model, Etc. : 75KW HEATER		

Geometry :

Anchor :

Number of Anchors : 3

No.	Anch Id	X Coord	Y Coord	Z Coord	Surf Id
1	1	0.000	0.000	0.000	1
2	1	14.063	-8.119	0.000	1
3	1	14.063	8.119	0.000	1

Concrete Lines :

# of elements per line : 1

Number of Concrete Lines : 3

No	Start X-Coord	Start Y-Coord	Start Z-Coord	End X-Coord	End Y-Coord	End Z-Coord	Sf Id	Line Width
1	-1.000	0.000	0.000	6.250	0.000	0.000	1	2.000
2	11.438	-3.572	0.000	14.563	-8.985	0.000	1	2.000
3	11.438	3.572	0.000	14.563	8.985	0.000	1	2.000

Concrete Points :

Number of Concrete Points : 0

Weld Lines :

# of elements per line : 4

Number of Weld Lines : 0

Determination of Reduction Factors :

Reduction Factor Input for Anchor # 1

Adequately Installed : Yes

Embedment Length : (2.13 in. Min Reqd. to achieve full capacity) := 2.13 in.

Gap at Threaded Anchor : 0.00 in.

Edge Distance - Edge 1 : 5.00 in.

Crack Size : 0.000 in. - Cracks Affect <= 50% Bolts

Essential Relays in Cabinet : No

Adequate Equipment Base Strength and Structural Load Path : Yes

Embedment Steel and Pads Adequately Installed : Yes

DC Cook Unit 2
SCREENING EVALUATION WORK SHEET (SEWS)

GIP Rev 2, Corrected, 2/14/92
Status: Yes

ID : 2-QT-134-CD (Rev. 0)

Class : 21 - Tanks and Heat Exchangers

Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)

Building : AUXILIARY

Floor El. : 587.00

Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,

Manufacturer, Model, Etc. : 75KW HEATER

Reduction Factor Input for Anchor # 2

Adequately Installed : Yes
Embedment Length : (2.13 in. Min Reqd. to achieve full capacity) := 2.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 5.00 in.
Crack Size : 0.000 in. - Cracks Affect <= 50% Bolts
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factor Input for Anchor # 3

Adequately Installed : Yes
Embedment Length : (2.13 in. Min Reqd. to achieve full capacity) := 2.13 in.
Gap at Threaded Anchor : 0.00 in.
Edge Distance - Edge 1 : 5.00 in.
Crack Size : 0.000 in. - Cracks Affect <= 50% Bolts
Essential Relays in Cabinet : No
Adequate Equipment Base Strength and Structural Load Path : Yes
Embedment Steel and Pads Adequately Installed : Yes

Reduction Factors Data Current : Yes

No	Anc Id	Pall/ Vall	Pallr/ Vallr	RT	RN	RL	RG	RS	RE	RF	RC	RR	RP	RB	RM
1	1	2003.75	N/A	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00
		2380.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1	2003.75	N/A	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00
		2380.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	1	2003.75	N/A	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00
		2380.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Legend :

N/A	= Not Applicable
Pall	= Allowable Pull without Reduced Inspection
Vall	= Allowable Shear without Reduced Inspection
Pallr	= Allowable Pull with Reduced Inspection
Vallr	= Allowable Shear with Reduced Inspection
*	= Outlier
X	= Reduction Factor Not Used
RT	= Reduction Factor for Type of Anchorage
RN	= Reduction Factor for Installation Adequacy
RL	= Reduction Factor for Embedment

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 13 of 14
ID : 2-QT-134-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,
Manufacturer, Model, Etc. : 75KW HEATER		

RG	= Reduction Factor for Gap at Anchors
RS	= Reduction Factor for Spacing
RE	= Reduction Factor for Edge Distance
RF	= Reduction Factor for Concrete Strength
RC	= Reduction Factor for Concrete Cracks
RR	= Reduction Factor for Essential Relays
RP	= Reduction Factor for Base Stiffness and Prying Action
RB	= Reduction Factor for Base Strength and Load Path
RM	= Reduction Factor for Embed. Steel and Pads

Analysis Results :

Analysis Performed : Yes

Type of Analysis : Regular

	Spectral Accelerations (G's)			
No	N-S	E-W	Vertical	Safety Factor
1	0.380	0.152	0.092	4.204
2	-0.380	-0.152	-0.092	4.704
3	-0.380	0.152	0.092	4.514
4	0.380	-0.152	-0.092	4.612
5	0.380	-0.152	0.092	4.204
6	-0.380	0.152	-0.092	4.704
7	0.380	0.152	-0.092	4.612
8	-0.380	-0.152	0.092	4.514
9	0.152	0.380	0.092	5.698
10	-0.152	-0.380	-0.092	3.859
11	0.152	-0.380	0.092	5.698
12	-0.152	0.380	-0.092	3.859
13	-0.152	0.380	0.092	3.740
14	0.152	-0.380	-0.092	6.064
15	0.152	0.380	-0.092	6.064
16	-0.152	-0.380	0.092	3.740
17	0.152	0.152	0.230	8.257
18	-0.152	-0.152	-0.230	7.950
19	0.152	0.152	-0.230	15.006
20	-0.152	-0.152	0.230	6.830
21	-0.152	0.152	0.230	6.830
22	0.152	-0.152	-0.230	15.006
23	0.152	-0.152	0.230	8.257
24	-0.152	0.152	-0.230	7.950

<table>
<tr><td colspan="2">DC Cook Unit 2
SCREENING EVALUATION WORK SHEET (SEWS)</td><td>GIP Rev 2, Corrected, 2/14/92
Status: Yes
Sheet 14 of 14</td></tr>
<tr><td>ID : 2-QT-134-CD (Rev. 0)</td><td colspan="2">Class : 21 - Tanks and Heat Exchangers</td></tr>
<tr><td colspan="3">Description : CD EMERGENCY DIESEL AUXILIARY JACKET WATER HEATER (TANK)</td></tr>
<tr><td>Building : AUXILIARY</td><td>Floor El. : 587.00</td><td>Room, Row/Col : CD EMER DSL GEN RM - IN THE NORTHEAST PART OF THE ROOM, 5 FEET NORTH OF CD EMERGENCY DIESEL JACKET WATER PUMP #2-QT-130-CD2,</td></tr>
<tr><td colspan="3">Manufacturer, Model, Etc. : 75KW HEATER</td></tr>
</table>

Minimum Safety Factor : 3.740

The Anchorage Capacity is 3.740 times greater than the Demand

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 2-QT-134-CD Class 21

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ___ (If yes, check items that apply.)

Anchor Type Anchor Diameter Anchor Spacing Anchor Number Anchor Embedment ✓ Anchor Edge Distance Anchor Gap Anchor Thread Engagement ✓ Anchor Grip Anchor Angularity Concrete Crack ✓	Remarks Crack is acceptable Anchor analysis reqd VK

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:
DIA OF ANCHOR IS BIGGER THAN THE DIA OF ANCHOR SHOWN IN DWG. 12-3468-13

Actions Taken:

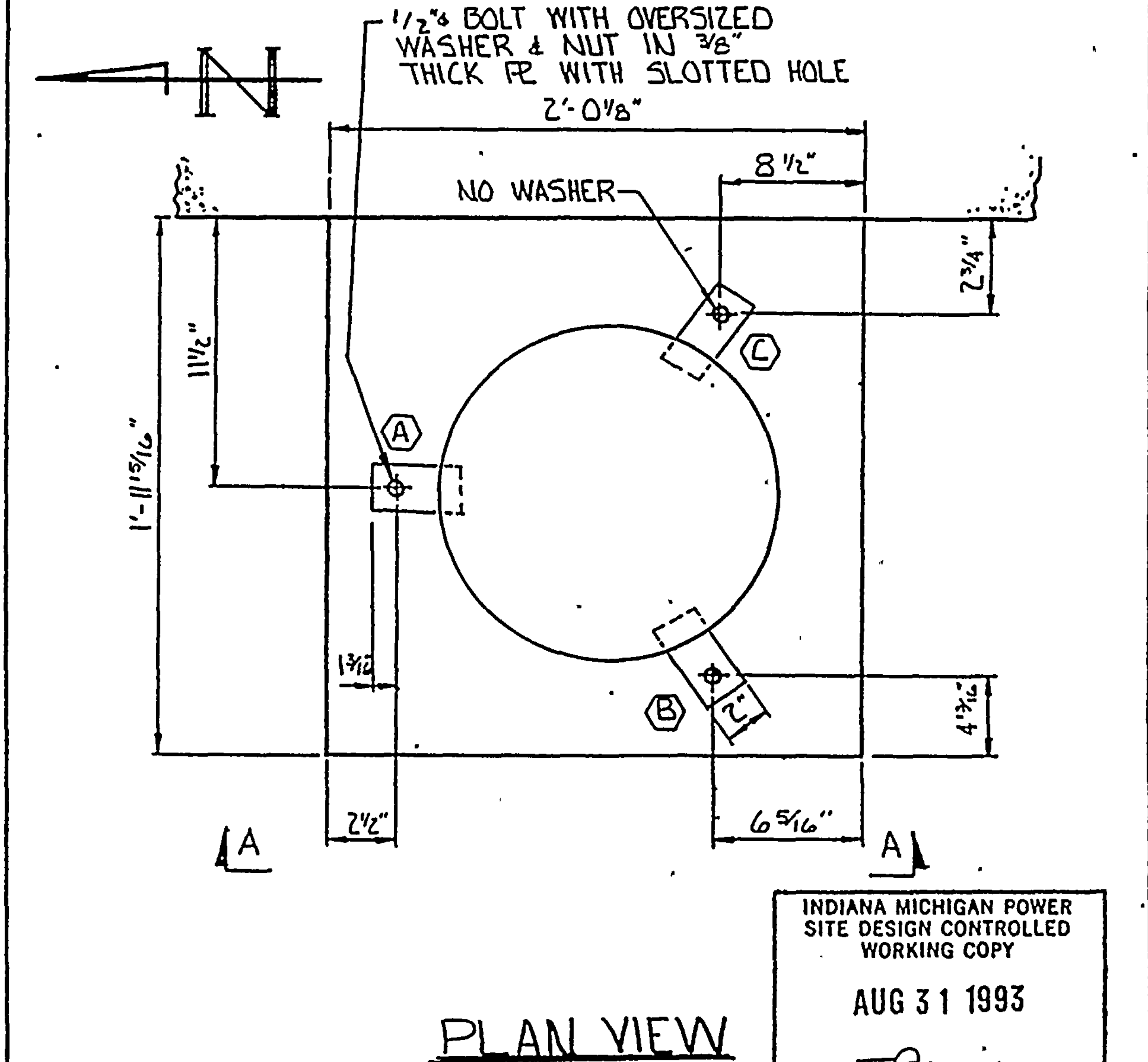
Prepared By T. [signature] Date 8-31-93

ANCHOR INSPECTION DATA SHEET

TWO	AUX "CD" DIESEL GEN. ROOM. 587'-0" EL.	NORTHEAST PORTION OF ROOM BY EAST WALL
Unit #	Bldg.	Location

12-3468-13	2-QT-134-CD
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
AUG 31 1993
CLERK. T. Dmuersonz

Drawn by: C. Ross Date: 6-7-93

Verified by: K. Whalan Date: 8-30-93
Qual./Cert. Inspector

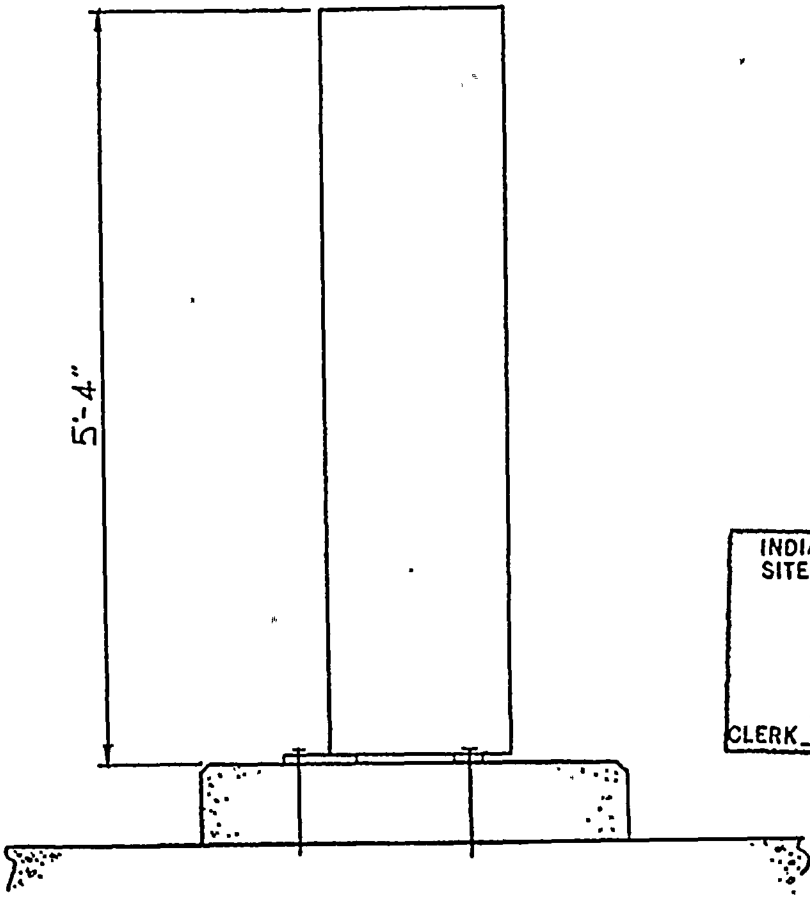
Reviewed by: T. Dmuersonz Date: 8-31-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

TWO	AUX "CD" DG Rm. 587'-0" EL.	NORTHEAST PORTION OF "CD" DG. Rm. BY EAST WALL
Unit #	Bldg.	Location

12-3468-13	2-QT-134-CD
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



SECTION "A-A"

INDIANA MICHIGAN POWER
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AUG 31 1993
CLERK T. Omanlasny

Drawn by: J. Rose Date: 6-7-93

Verified by: R.W. Trafton Date: 6-29-93
Qual./Cert. Inspector

Reviewed by: T. Omanlasny Date: 8-31-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-QT-134-CD   Dwg No.: 12-3468-13

Anchor type: COUPLING CONFIGURATION SEE SECT "D-9" DWG. 12-3468-13   Dia: 1/2"φ ▲   Dwg No.:

Tightness established by: ☐ "Snug Fit" ☒ Torque

Torque Wrench No.: CPM-438   Cal. Due Date: 22 AUG 1993

Tightness verified? ☒ Yes ☐ No S. Thakkar Construction ARE   Date: 6-28-93

Equipment base flexible? ☐ Yes ☒ No T. Omannson Construction ARE   Date: 6-28-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C						Comments
Gaps	0"	0"	0"						
Anchor length	5 1/2"	INACCESSABLE	5 1/2"						
Protruding length	5 5/16"	5 3/16"	4 3/4"						
Embedment	3/16" + ANCHOR ●	INACCESS-ABLE ●	3/4" + ANCHOR ●						
Bolt grip	4 7/8"	4 3/4"	4 3/8"						
Concrete condition	OK	CRACK 8 1/2" AWAY	ROUGH/ CRACK 2 3/4" AWAY						
Edge distance	11 1/2"	> 1'-0"	2 3/4"						
Anchor spacing	1'-4"	1'-4"	1'-4"						
Anchor angularity	OK	OK	OK						
Thread engagement	RECESSED 1/32"	RECESSED 1/16"	RECESSED 1/32"						7/16" THICK NUT

Comments: ▲ ACTUAL ROD DIAMETER OF 1/2" DOES NOT AGREE WITH 1/4"φ DIMENSION ON DWG 12-3468-13.
C ⊗ NO WASHER. ℞ ATTACHING GROUND WIRE IS BETWEEN MOUNTING PLATE AND NUT.
● ANCHOR LENGTH REFLECTS TOP PORTION OF THE COUPLING, PER DWG. 12-3468-13 AND PER SDS 88, THE BOTTOM PORTION (PHILLIPS RED HEAD WEDGE ANCHOR) ADDS AN ADDITIONAL 2" MIN. TO DEPTH OF EMBEDMENT.

Verified by: Tightness [signature] 8-30-93 / Dims. [signature] 8-30-93   Date:
Qual./Cert. Inspector

Reviewed by: T. Omannson   Date: 8-31-93
Construction ARE

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CLERK T. McNamara

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 6-1-93 REQUEST NO. N/A

IDENTIFICATION

Unit Two
Component 2-QT-134-CD
Item Anchors
Material C/S
Other Sqieg

TECHNIQUE

Test Unit/ S/N KBUSK-7S CQC-405
Freq./Diameter 5mhz .250"
Reference Standard QC-30
Couplant/Batch No. Ultragel II #7085

TEST DATA/REMARKS

Anchor	Length
A	5.5"
B	Inaccessable
C	5.5"

PERFORMED BY: [signature] LEVEL: II DATE: 6-1-93
REVIEWED BY: Stephen R. Vargo LEVEL: II DATE: 6/1/93

FORM NO. 12 SHP 5050 NDE.008-1

Page 1 of 1
Revision 0

Equip ID: 2-TK-76N Train: 2 Equip Class:21

Drawing No.: 2-5149

Function: HVAC

System: CONTROL ROOM AIR CONDITIONING CHILL WATER

Equip Desc: CONTROL ROOM AIR CONDITIONING NORTH CHILL WATER
EXPANSION TANK

Building: AUXILIARY Room: CONTROL ROOM AIR CONDITIONER ROOM

Elev: 650 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: STANDARD Min/Opt: MIN

Alias No: Power Train:

Comp Served:

MFR:

Model: 3 GAL.

Panel:

Elem. Drawing: NOT APPL

Wiring Drawing: NOT APPL

Power Source:

Walkdown: F Relay Eval : N

Comp Type: TANK.

Iso Drawing: 2-VW-529

Location: 4 FEET EAST OF THE ROOM'S ENTRANCE GATE, AT THE NORTH
WALL, 7 FEET ABOVE THE FLOOR

DC COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 2
ID : 2-TK-76N (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CONTROL ROOM AIR CONDITIONING NORTH CHILL WATER EXPANSION TANK		
Building : AUXILIARY	Floor El. : 650.00	Room, Row/Col : CTRL RM AIR CONDIT RM - 4 FEET EAST OF THE ROOM'S ENTRANCE GATE, AT THE NORTH WALL, 7 FEET ABOVE THE FLOOR
Manufacturer, Model, Etc. :		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Tom Huang and Kailash Mahajan on 11/3/93.

ANCHORAGE AND SUPPORT OF TANK ACCEPTABLE BY JUDGMENT BY THE SRT FOR THIS SMALL TANK.

Small tank 2' in length x 9 " in diameter on a 1" diameter piping system. Tank in-line with pipe, supported by a U-bolt on a cantelevered angle (2 1/2" x 2 1/2" x 3/8") about 1' - 6" long. Angle welded to a plate that is bolted to the reinforced block wall with 3 5/8" diameter through bolts (other side of wall inspected and bolts came through).

Glass site tube judged acceptable (no interactions).

Evaluated by: Date:

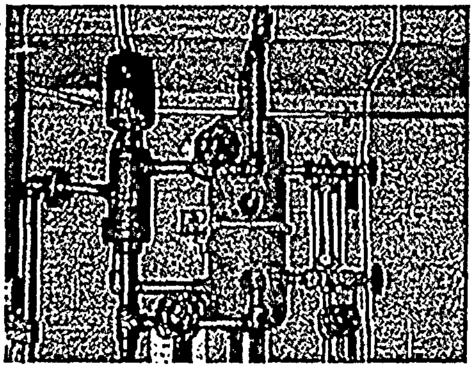
Gary D. Thomas 9/15/95

T Chen Huang 10-19-95

Attachment: Pictures

DC COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 2
ID : 2-TK-76N (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CONTROL ROOM AIR CONDITIONING NORTH CHILL WATER EXPANSION TANK		
Building : AUXILIARY	Floor El. : 650.00	Room, Row/Col : CTRL RM AIR CONDIT RM - 4 FEET EAST OF THE ROOM'S ENTRANCE GATE, AT THE NORTH WALL, 7 FEET ABOVE THE FLOOR
Manufacturer, Model, Etc. :		

PICTURES



CONTROL ROOM AIR CONDITIONING NORTH CHILL WATER EXPANSION TANK

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 2-TK-76N   Class 21

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ___ (If yes, check items that apply.)

Anchor Type	**Remarks**
Anchor Diameter	
Anchor Spacing	• crack in the block wall
Anchor Number	
Anchor Embedment	JUDGED TO BE INSIGNIFICANT.
Anchor Edge Distance	
Anchor Gap	
Anchor Thread Engagement	I. [signature] 11-3-93
Anchor Grip	
Anchor Angularity	B. [signature] 11-3-93
Concrete Crack ✓	

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

NONE

Actions Taken:

NONE

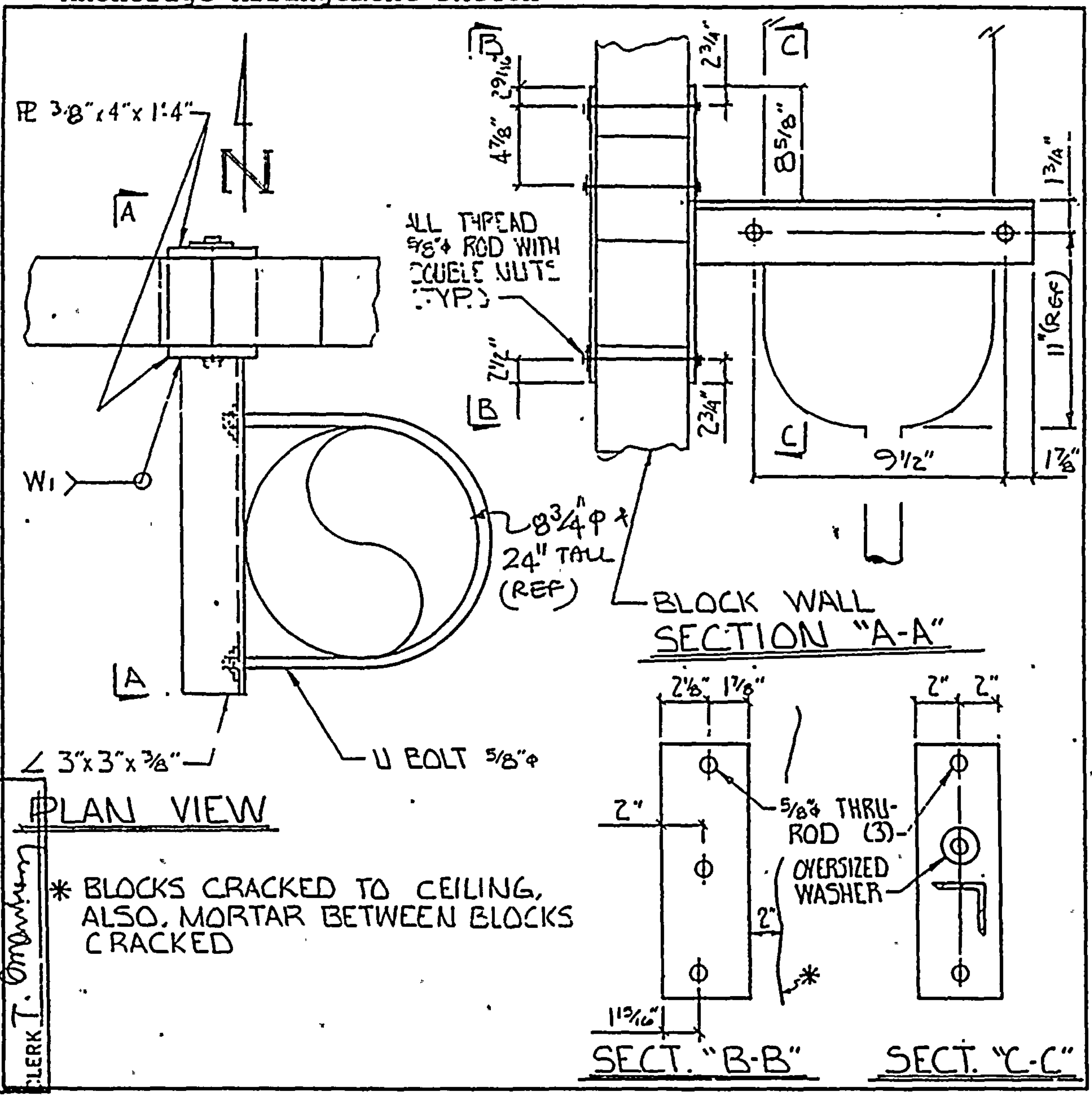
Prepared By T. [signature] Date 8-18-93

ANCHOR-INSPECTION DATA SHEET

Unit #	Bldg.	Location
TWO	AUX 650'-0"	NORTHWEST CORNER OF CONTROL ROOM AIR CONDITIONING ROOM ON BLOCK WALL 7'-0" ABOVE FLOOR.

Installation dwg. / Rev.	Equipment No.
	2-TK-76N

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
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AUG 18 1993
CLERK T. Omarison

Drawn by: [signature] Date: 6-1-93

Verified by: [signature] Date: 6-1-93
Qual./Cert. Inspector

Reviewed by: T. Omarison Date: 8-16-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-TK-76N Dwg No.: ____________

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W1							
Type	1						A	
Size	3/16"	N						
Length	●							
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

● INDICATES ALL AROUND WELD.
WELD IS UNDERCUT AND ENDS OF ANGLE HAS 1/8" WELDS.
1" OF THE TOP HORIZONTAL WELD IS COVERED BY OVERSIZED WASHER

WELD EXAMINED BY SRT AND FOUND TO BE MUCH MORE THAN ADEQUATE

I. Huey 11-3-93
[signature] 11-3-93

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
AUG 18 1993
CLERK T. Omanwamy

Equipment base flexible: ☐ Yes ☒ No S. Thakkar Construction Are Date: 5-7-93

Reviewed by: T. Omanwamy Construction Anchor Review Engineer Date: 8-16-93

Verified by: [signature] Qual./Cert. Inpsector Date: 6-1-93

ATTACHMENT 4 TO AEP:NRC:1040E

SAMPLE SEWS, ANCHORAGE CALCULATIONS, AND
ANCHORAGE INSPECTION DOCUMENTATION
FOR LARGE FLAT BOTTOM TANKS
RAI ITEM 6

This attachment includes sample SEWS, anchorage calculations and anchorage inspection documentation for the large flat bottom tank evaluations requested in RAI Question 6. Included in this attachment are the evaluations for 1-TK-33 (RWST) and 2-TK-32 (CST).

Equip ID: 1-TK-33 Train: 12 Equip Class: 21

Drawing No.: 1-5144

Function: DRI

System: REFUELING WATER STORAGE TANK SUPPLY

Equip Desc: REFUELING WATER STORAGE TANK

Building: GROUNDS Room: RWST AREA

Elev: 609 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd:

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train:

Comp Served: RWST

Mfr: GRAVER TANK AND MANUFACTURING CO

Model: 420,000 GALS

[illegible]l:

Elem. Drawing:

Wiring Drawing:

Power Source:

Walkdown: F Relay Eval : N

Comp Type: TANK

ISO Drawing:

Location: 25' NORTH OF UNIT 1 CONTAINMENT BUILDING.

ANCHOR INSPECTION DATA SHEET

1	GROUNDS	25' NORTH OF CONTAINMENT.
Unit #	Bldg.	Location

1-2-3048	1-TK-33
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch

RWST

TANK DIMENSION : 48' DIA x 32'-3" HIGH

25 ANCHOR STRAPS @ EQUAL SPACING ±6"
(SEE NEXT PAGE FOR STRAP DETAILS)

ONE STRAP IS BENT AROUND THE ℄ NEAR THE DOOR @ THE BOTTOM OF THE TANK / Also 9th one to left of Door is bent in.

ONE OF THE 3/8" CIRCULAR PLATES NEAR THE ENTRY DOOR IS TRIMED AS SHOWN IN NEXT PAGE.

WELDS ARE GROUND SMOOTH AND THEY VARY FROM 3/16" TO 1/4". (PART OF THE WELDS ARE INACCESSIBLE TO VERIFY BECAUSE OF THE HEATING STRIP AND INSULATION).

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
OCT 13 1993
CLERK T. [signature]

Drawn by: T. [signature] Date: 10-7-93

Verified by: [signature] Date: 10-12-93
Qual./Cert. Inspector

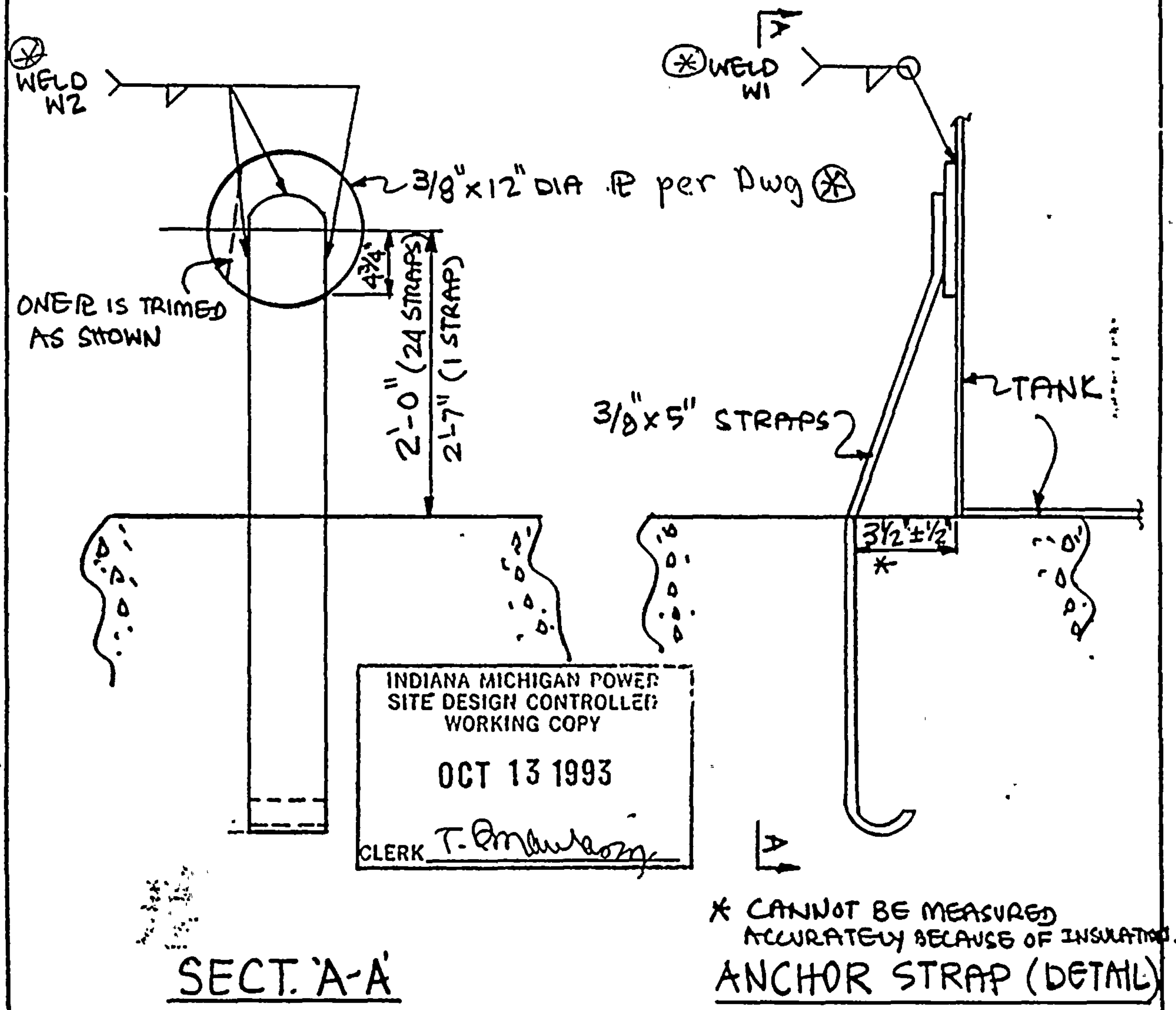
Reviewed by: T. [signature] Date: 10-13-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	GROUNDS	25' NORTH OF CONTAINMENT
Unit #	Bldg.	Location

1-2-3048	1-TK-33
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
OCT 13 1993
CLERK T. Emanuson

(*) Cannot be measured accurately due to insulation & 4" Heating strips.

Drawn by:	T. Emanuson	Date:	10-7-93
Verified by:	[signature] Qual./Cert. Inspector	Date:	10-12-93
Reviewed by:	T. Emanuson Construction Anchor Review Engineer	Date:	10-13-93

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 26
ID : 1-TK-33 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : REFUELING WATER STORAGE TANK		
Building : GROUNDS	Floor El. : 609.00	Room, Row/Col : RWST AREA, 25' N OF UNIT 1 CONT BUILDING.
Manufacturer, Model, Etc. : GRAVER TANK AND MANUFACTURING CO. 420,000 GALS		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	Yes
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT : George G. Thomas and Tom Huang on 10/5/93

Large flat bottom tank 48'-0" inside diameter 32'-3" height (31'-0" liquid tank). Tank manufactured by Graver Tank, made of ASTM A240 Type 304 Steel, 420,000 gallons and weighs 94,000 lbs. Anchored with 25 3/8" th x 5" w x 4' - 4" long strap that is embedded in the concrete 2' depth with a 2" radius hook at the end.

A detailed calculation was performed to the SQUG GIP criteria as part of the Stevenson & Associates report "Earthquake Analysis of D.C. Cook NPP Refueling Water Storage Tank Subjected to Nozzle Loadings to Original and Current Design Criteria", September 12, 1989.

The calculation for the RWST resulted in the conclusion that the weld to the tank and embedment in the concrete was sufficient to develop the full yield strength of the strap.

The calculation for the RWST using GIP methodology indicated an overall safety factor of 2.57 for overturning and 1.72 for shear. The calculation is included as a document of this SEWS.

The tank is founded on a concrete pad per drawing # 1-2-3048.

Although anchorage the straps were not rusted to the degree that the SRT judged there should be reduction in capacity. A finding of the walkdown was that these straps should be cleaned and painted to maintain their integrity.

Picture 2, Wk. 1, Tm 2, Disk 1 - Pipe at the Bottom of the RWST
Picture 1, Wk. 1, Tm 2, Disk 1 - Typical Rusted Strap
Picture 3, Wk. 1, Tm 2, Disk 1 - Buckled out Anchor Strap

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 26
ID : 1-TK-33 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : REFUELING WATER STORAGE TANK		
Building : GROUNDS	Floor El. : 609.00	Room, Row/Col : RWST AREA, 25' N OF UNIT 1 CONT BUILDING.
Manufacturer, Model, Etc. : GRAVER TANK AND MANUFACTURING CO. 420,000 GALS		

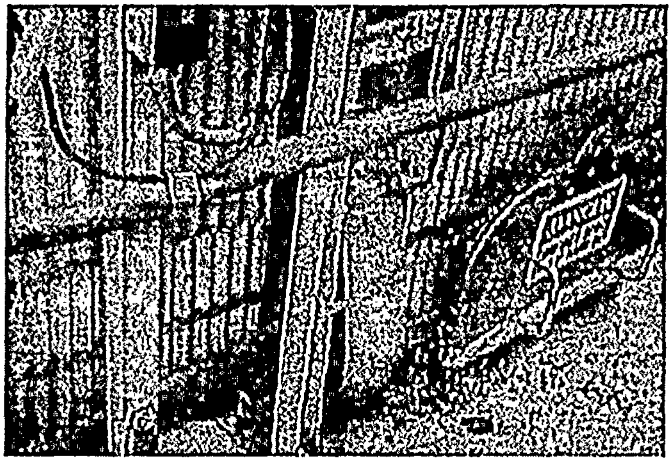
Evaluated by: George G. Thomas   Date: 10/4/95

Chen Huang   10-26-95

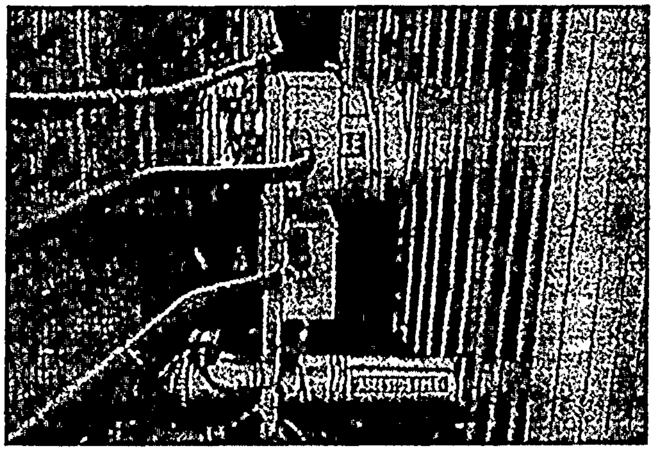
Attachment: Pictures
Attachment: Seismic Evaluation of The RWST

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 26
ID : 1-TK-33 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : REFUELING WATER STORAGE TANK		
Building : GROUNDS	Floor El. : 609.00	Room, Row/Col : RWST AREA, 25' N OF UNIT 1 CONT BUILDING.
Manufacturer, Model, Etc. : GRAVER TANK AND MANUFACTURING CO. 420,000 GALS		

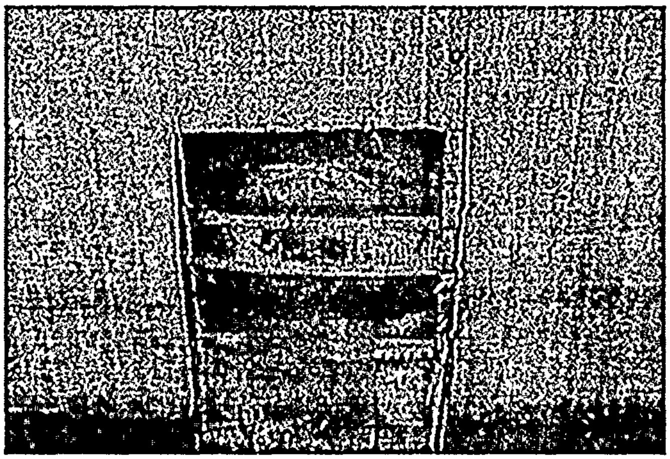
PICTURES



Buckled out Anchor Strap



Pipe at the Bottom of the RWST



Rusted Anchor Strap

I. Evaluation of Refueling Water Storage Tank to SQUG UST-A46 Criteria

The following evaluation is in accordance with Chapter 7 of the Generic Implementation Procedure by SQUG (GIP)

Chapter 7 includes a step by step procedure for evaluating flat bottom vertical tanks.

1) Step 1 (Pg 7-14 in GIP) Determine Input Data

Tank: R ~ Tank nominal radius ~ 288" 20'-4"

t_{AV} ~ Ave wall thickness over height of wall containing water

$= \left[(.3125")(96") + (.25")(96") + (.1875)(180")\right] / 372"$

$= .2359"$

t_{min} ~ Min. thickness anywhere = .1875"

t_s ~ Min. wall thickness in lowest 10% of height = .3125"

σ_y ~ Yield strength of tank ~ 30,000 psi

h_c ~ Height of compression zone (Assumed to top of plate connecting anchor strap) ~ 30"

Fluid: γ_l ~ Weight of fluid $= 62.4 \frac{LB}{FT^3} \times \frac{1 FT^3}{(12)^3 IN^3} = .036111 \frac{LB}{IN^3}$

H ~ Max. expected height of water ~ 372"

h_f ~ Height of fluid freeboard ~ 24"

Bolts: N ~ Number of anchor bolts ~ 25 straps

d ~ Diameter of bolt ~ A of strap = 5" x (3/8)" = 1.875 in² ~ $d = \sqrt{\frac{4 \cdot A}{\pi}} = \sqrt{\frac{4(1.875)}{\pi}} = 1.545"$

Effective diameter

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SUBJECT SEISMIC RE-ANALYSIS OF REFUELING WATER STORAGE TANK
AEPSC - D.C. COOK NPP

JOB No. 89C1557 SHEET B2 OF B22

REVISIONS: 0 — YDJ 3/25/89; PRW 9-5-89

F_b = ALLOWABLE TENSILE STRENGTH (1.7 x AISC ALLOW)
= 34,000 psi FOR A36 MATERIAL

h_b = EFFECTIVE LENGTH OF BOLT THAT CAN BE STRETCHED (ASSUMED DOWN TO BOTTOM OF HOOK)
1'-8 5/8" + 2'-0" = 44.625"

LOADING: GROUND SPECTRA @ 4% DAMPING
WILL BE DEVELOPED FROM 5% DAMPED SPECTRA
PROGRAM EDASP WILL BE USED FOR TRANSFORMATION

DESIGN BASIS E.Q. SPECTRA GIVEN IN FIG. 1.
FOR 5% DAMPING

5% DAMPED CURVE

FREQ (Hz)	ACCEL (g)	FREQ (Hz)	ACCEL (g)	FREQ (Hz)	ACCEL (g)
.1	.01	2.0	.26	25.	.20
.2	.036	3.0	.30	30.	.20
.3	.058	4.0	.33	35.	.20
.4	.075	5.0	.33	50.	.20
.5	.09	6.0	.30	100.	.20
.6	.12	7.0	.26		
.7	.132	8.0	.25		
.8	.143	9.0	.24		
.9	.152	10.0	.22		
1.0	.17	12.0	.21		
1.5	.23	15.0	.20		
		20.0	.20		

DIGITIZED VERSIONS OF THE RESPONSE SPECTRA ARE SHOWN ON PAGE 3 OF THIS CALCULATION. AS SHOWN BECAUSE OF THE CONSERVATISM OF EDASP IN CONVERTING A RESPONSE SPECTRA TO A POWER SPECTRAL DENSITY & BACK TO A RESPONSE SPECTRA THE HIGH FREQUENCY PORTION OF THE RESPONSE SPECTRA RIDES UP. THESE WERE ADJUSTED AS SHOWN BACK TO THE ZPGA LEVEL OF .2 g.

DDD 8/25/89
PRW 9-5-89

	FREQ	DAMP .050	DAMP .040
1.	0.10	9.872E-03	1.008E-02
2.	0.13	1.790E-02	1.846E-02
3.	0.16	2.700E-02	2.794E-02
4.	0.20	3.660E-02	3.798E-02
5.	0.25	4.832E-02	5.043E-02
6.	0.32	6.133E-02	6.432E-02
7.	0.40	7.518E-02	7.920E-02
8.	0.50	9.276E-02	9.817E-02
9.	0.63	1.219E-01	1.306E-01
10.	0.79	1.434E-01	1.540E-01
11.	1.00	1.702E-01	1.838E-01
12.	1.26	2.040E-01	2.217E-01
13.	1.58	2.357E-01	2.572E-01
14.	2.00	2.604E-01	2.849E-01
15.	2.51	2.834E-01	3.108E-01

1 / 3

	FREQ	DAMP .050	DAMP .040	
16.	3.16	3.066E-01	3.371E-01	
17.	3.98	3.290E-01	3.629E-01	
18.	5.01	3.292E-01	3.630E-01	
19.	6.31	2.937E-01	3.208E-01	6.22 Hz
20.	7.94	2.591E-01	2.809E-01	
21.	10.00	2.337E-01	2.514E-01	
22.	12.59	2.207E-01	2.367E-01	
23.	15.85	~~2.142E-01~~ .20	2.292E-01	
24.	19.95	~~2.138E-01~~	2.288E-01	
25.	25.12	~~2.144E-01~~	~~2.292E-01~~	.20
26.	31.62	~~2.151E-01~~	~~2.298E-01~~	
27.	39.81	~~2.160E-01~~	~~2.305E-01~~	
28.	50.12	~~2.170E-01~~	~~2.312E-01~~	
29.	63.10	~~2.180E-01~~	~~2.320E-01~~	
30.	79.43	~~2.200E-01~~	~~2.341E-01~~	

2 / 3

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SUBJECT Seismic Re-Evaluation of Refueling Water Storage Tank JOB No. 89C1557 SHEET B4 OF B22

AEPSC - D.C. Cook N.P.P.

REVISIONS: 0 DDD 8/25/89 PRW 9-5-89

2) Step 2 ~ (pg. 7-14 in GIP) Calculate the following ratios.

$H/R = 372/288 = 1.2917$

$t_s/R = .3125/288 = .001085$

$t_{ef} = (t_w + t_{min})/2 = (.2359 + .1875)/2 = .2117''$

$t_{ef}/R = .2117/288 = .0007351 < .001$

∴ Outside the charts for the method given in the GIP. Therefor, the methodology given in ASCE Standard 4-86, will also be used for the tank analysis. Will continue w/ SQUG methodology by extrapolating curves.

$A_b = 5'' \cdot 3/8'' = 1.875 \; in^2$

$t' = N A_b / 2\pi R = 25 (1.875)^{in^2} / 2\pi(288)'' = .0259041''$

$c' = (t'/t_s)(h_c/h_b) = \frac{.0259041''}{.3125''} \cdot \frac{30''}{44.625''} = .05573$

$W = \pi R^2 H \gamma_f = \pi (288)^2 \, in^2 \cdot 372'' (.036111)^{LB}/_{in^3}$

$= 3{,}500{,}400$ LB

3) Step 3 ~ Calculate F_f from Table

For $t_{ef}/R = .001$ $H/R = 1.0$ $R = 240$ $F_f = 11.7$ Hz

$t_{ef}/R = .001$ $H/R = 1.0$ $R = 300$ $F_f = 9.3$ Hz

$t_{ef}/R = .001$ $H/R = 1.5$ $R = 240$ $F_f = 8.0$ Hz

$t_{ef}/R = .001$ $H/R = 1.5$ $R = 300$ $F_f = 6.4$ Hz

INTERPOLATED

For $\frac{t_{eF}}{R} = .001$ $H/R = 1.0$ $R = 288''$ $f_f = 9.78$ Hz ✓

$\frac{t_{eF}}{R} = .001$ $H/R = 1.5$ $R = 288''$ $F_f = 6.72$ Hz ✓

For $\frac{t_{eF}}{R} = .001$ $H/R = 1.2917$ $R = 288''$ $F_f = 7.99$ Hz ✓

In order to adjust for the reduction in thickness $t_{ef}/R = .0007351$, it is assumed that the frequency will change by a factor of $\sim \sqrt{\frac{.0007351}{.001}}$.

$\therefore F_{f_{EST}} = \sqrt{\frac{.0007351}{.001}}(7.99) = 6.85$ Hz

4) Step 4 ~ Maximum spectral accel for 4% damping for:

$.8 F_f < F < 1.2 F_f$

$5.48^{Hz} < F < 8.22^{Hz}$

Max Accel .347 g ✓

5) Determine base shear load Q from Fig 7-2 (Step 5)

$\therefore$ Use $\frac{t_{eff}}{R} = .001$ conservatively $Q' = .675 = Q/(W S_{af})$ ✓

$\therefore Q = .675 (3,500,400)(.347) = 819,881$ LB ✓

6) Step 6 ~ Determine base overturning moment from Fig 7-3

Use $t_{eff}/R = .001$ conservatively $M' = .325 = M/W \cdot H \cdot S_{af}$ ✓

$M = M' \cdot W \cdot H \cdot S_{af}$

$M = .325 (3,500,400) 372'' (.347) = 1.4685 \times 10^8$ LB-IN. ✓

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SUBJECT Seismic Re-Evaluation of Refueling Water Storage Tank JOB No. 89C1557 SHEET B6 OF B22

AEPSC - D. C. Cook N.P.P

REVISIONS: 0 DDS 8/25/89; PRW 9-5-89

7) STEP 7 ~ DETERMINE THE FLUID PRESSURE FOR ELEPHANT FOOT BUCKLING OF TANK (Fig 7-4)

P_1' FOR $H/R = 1.0$ $P_1' = 1.36$

$H/R = 1.5$ $P_1' = 1.91$

FOR $H/R = 1.29$ $P_1' = 1.68$ ✓

$P_1 = P_1' \gamma_1 R = 1.68(.036111)(288'') = 17.472$ psi ✓

8) STEP 8 ~ DETERMINE ELEPHANT-FOOT BUCKLING STRESS CAPACITY FACTOR (Fig 7-6)

FROM Fig 7-6 $t_s/R = .001085$; $P_1 = 17.472$

FOR $t_s/R = .001$ $\sigma_{p1}/34000 = .275$

$t_s/R = .002$ $\sigma_{p1}/34000 = .50$

$t_s/R = .001085$ $\sigma_{p1}/34000 = .294$ ✓

CAN USE GRAPHS DIRECTLY SINCE $F_b = 34,000$ psi

9) STEP 9 ~ DETERMINE FLUID PRESSURE FOR DIAMOND-SHAPE BUCKLING (Fig. 7-7)

P_2' FOR $H/R = 1.0$ $P_2' = 1.17$

$H/R = 1.5$ $P_2' = 1.63$

$H/R = 1.29$ $P_2' = 1.44$ ✓

$P_2 = P_2' \gamma_1 R = 1.44(.036111)(288'') = 14.975$ psi ✓

10) STEP 10 ~ DETERMINE DIAMOND-SHAPE BUCKLING STRESS CAPACITY FACTOR (Fig 7-8)

FOR $t_s/R = .001$ $\sigma_{p2}/34,000$ psi $= .325$

$.002$ $\sigma_{p2}/34,000$ psi $= .585$

$\therefore$ FOR $t_s/R = .001085$ $\quad \sigma_{p2}/34000 = .347$

11) STEP 11 (LOWER VALUE FROM STEP 8 OR 10)

$\sigma_p/F_b = .294$ (STEP 8.) GOVERNS) ✓

$\left(\sigma_p/F_b\right)\cdot\left(h_c/h_b\right) = .294 \cdot \left(\frac{30''}{44.625''}\right) = .1976$ ✓

12) STEP 12 DETERMINE OVERTURNING MOMENT CAPACITY OF TANK (Fig 7-9)

$\sigma_p/F_b \; h_c/h_b = .1976 \quad C' = .05573$

FOR $C' = .05$ $\quad M'_{CAP} = .125$

$C' = .10 \quad M'_{CAP} = .18$

$\therefore C' = .05573 \quad M'_{CAP} = .131$ ✓

$M_{CAP} = (M'_{CAP})(2F_b)(R^2 t_s)(h_b/h_c)$

$= (.131)\,2\,(34{,}000)\,(288)^2\; 3.125 \left(\frac{44.625}{30}\right) =$

3.4346×10^8 LB-IN

13) STEP 13 COMPARISION OF CAPACITY TO DEMAND

$M_{CAP} = 3.4346 \times 10^8$ LB-IN (STEP 12)

$M = 1.4685 \times 10^8$ LB-IN (STEP 6)

SINCE $3.4346 \times 10^8 > 1.4685 \times 10^8$ OK ✓

14) STEP 14 - COMPUTE THE BASE SHEAR LOAD CAPACITY OF THE TANK

$Q_{CAP} = .55\,(1 - .21\,S_{aF})\,W$

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SUBJECT Seismic Re- JOB No. 89C1557 SHEET B8 OF B22
Evaluation of Refueling Water Storage Tank
AEPSC - D. C. Cook N.P.P.

REVISIONS: 0 JJS 8/25/89 PRW 9-5-89

$Q_{CAP} = .55(1 - .21(.347)) \cdot 3{,}500{,}400 = 1{,}789{,}929$ LB

15) STEP 15 - COMPARE Q (SHEAR) CAPACITY TO DEMAND

STEP 6

$\therefore$ 1,789,929 > 819,881 LB $\therefore$ OK

16) STEP 16 - DETERMINE SLOSH HEIGHT (TABLE 7-4)

$H/R = 1.2917$ $R = 288"$

For 1g ZPGA $h'_s = 109.1$ IN. (FROM INTERPOLATION)

$h_s = .2(109.1) = 21.8"$

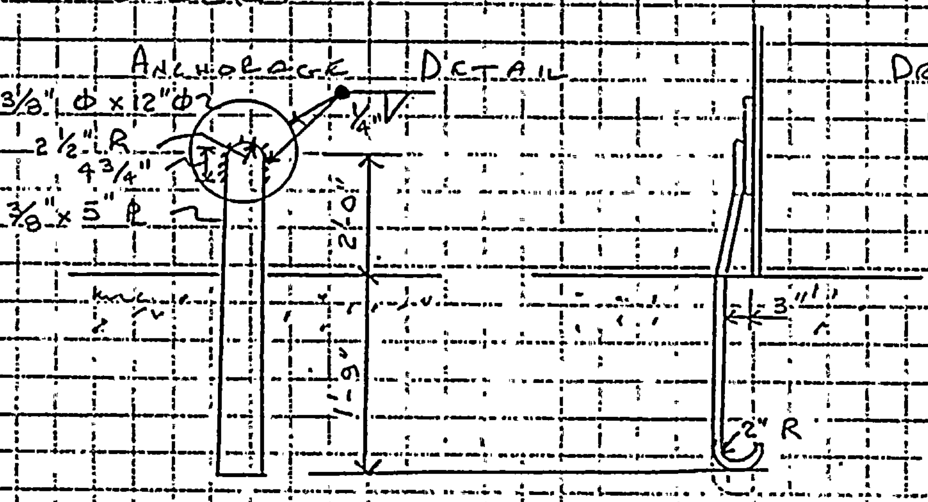
STEP 1

$h_f = 24" > 21.8"$ $\therefore$ OK

17) STEP 17-21 IN THE GIP ARE A CHECK OF WHETHER THE ANCHORAGE SYSTEM'S DETAILS ARE SUFFICIENT TO ENSURE THAT THE ANCHORAGE ULTIMATE CAPACITY WILL BE DEVELOPED. THE FOLLOWING CALCULATION IS TO SATISFY THIS CHECK:

ANCHORAGE DETAIL

DRAWING # L-24961 REV 1



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SUBJECT SEISMIC RE-EVALUATION OF REFUELING WATER STORAGE TANK JOB No. 89C1557 SHEET 89 OF 822

AEPSC - DC COOK N. P.P

REVISIONS: 0 DDS 8/25/89 PRW 9-5-89

a) CHECK DEVELOPMENT OF PLATE IN CONCRETE

CAPACITY OF PL = 5" x 3/8" x 34,000 psi = 63,750 LB ✓

BOND CAPACITY FOR PLANE BARS FROM ACI 318-63 JUNE 1963

CHAPTER 18 FOR BARS OTHER THAN TOP BARS & PLAIN BARS

$\sigma_b = .5 \cdot 9.5\sqrt{f_c'}$ $f_c' = 3500$ psi, DR 1-2-3048-4
BUT NO > 250 psi

$\therefore \sigma_b = .5 (9.5)\sqrt{3500} = 281.0$ psi USE 250 psi ✓

SURFACE AREA FOR PL = (5" + 3/8") 2 = 10.75 IN²/IN. DEPTH ✓

EMBEDMENT LENGTH REQUIRED TO DEVELOP STRENGTH OF PLATE

$l_e = 63,700$ LB / (250 LB/IN² · 10.75 IN²/IN) = 23.7"

LENGTH OF BAR INCLUDING HOOK

1'-7" + π (2") = 25.3" > 23.7" ∴ OK ✓

HOOK WILL ACTUALLY DEVELOP MORE THAN JUST IT'S LENGTH & THEREFOR EVALUATION ABOVE IS SOMEWHAT CONSERVATIVE. ✓

ALSO HOOK GOES AROUND A #8 DEFORMED BAR INCREASING IT'S CAPACITY.

b) CHECK OF WELD OF PLATE TO 12" Φ PAD

FOR E-70 ELECTRODE

WELD LENGTH = 2 (4.75) + π (2.5") = 17.35" ✓

WELD CAP = .25 (.707) · .3 (70 KSI) · 1.7 (17.35") = 109.5 K
(1/4" WELD, THROAT, E70 ELECTRODE, FOR ULTIMATE LOAD)

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SUBJECT Seismic Re- JOB No. 89C1557 SHEET 810 OF 822

Evaluation of Refueling Water Storage Tank

AEPSC D.C. Cook N.P.P.

REVISIONS: 0 [initials] 8/25/89 PRW 9-5-89

$109.5^k > 63.75^k$ OK ✓

c) Weld of 12" Pad

Length of weld = $\pi(12)" = 37.7"$ ✓

For 1/4" fillet OK by inspection ✓

∴ System's anchorage details are sufficient to develop the full strength of the bolts and to justify assumptions made in the procedure.

18. Conclusions

D.C. Cook Refueling Water Storage Tank meets all of the SQUG USI-A46 requirements of the GIP. The tank will still have to be inspected during the walkdown to determine if all anchorage is present, condition of the concrete and interaction issues.

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SUBJECT Seismic Re-Evaluation of Refueling Water Storage Tank
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JOB No. 8961557 SHEET B11 OF B22

REVISIONS: 0 JJJ 8/25/89; BRW 9-5-89

II Evaluation of Refueling Water Storage Tank to ASCE Standard 4-86

Above ground tanks are discussed on pgs 85 to 88 of the standard in Section 3.5.4.

1) Section 3.5.4.2.1 Define Terms

W_t ~ Total Fluid Wt ~ $\frac{\pi (48')^2 (31')}{4} (62.4\ ^{LB}/_{FT^3})$ (Diameter, Height)

= 3.5004×10^6 LBS ✓

D ~ Tank Diameter = 48' ✓

H ~ Height of Fluid = 31' ✓

$D/H = 48/31 = 1.548$ ∴ Eqns C3500-1 & C3500-2 Applicable

$$\frac{W_1}{W_t} = \frac{\tanh(.866)(1.548)}{(.866)(1.548)} = \frac{\tanh 1.340568}{1.340568}$$

$$= \frac{.872}{1.340568} = .650$$ ✓

$$\frac{X_1}{H} = .375$$ ✓

$W_1 = .650 (3.5004 \times 10^6) = 2.2753 \times 10^6$ LBS. ✓

$X_1 = .375 (31') = 11.625$ FT ✓

2) Calculation of Fundamental Natural Frequency of Tank

ASCE Standard 4-86 refers to the following paper for calculation of tank horizontal fundamental frequency: "Dynamics of Fixed-Base Liquid-Storage Tanks" by Veletsos & Yang @ US-Japan Seminar for Earthquake Engineering, Tokyo, 1976.

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SUBJECT Seismic Re-Evaluation of Refueling Water Storage Tank JOB No. 89C1557 SHEET 812 OF 822

AEPSC - D.C. Cook N.P.P.

REVISIONS: 0 JJJ 8/25/89 PRW 9-5-89

FROM THIS PAPER THE FOLLOWING EQUATION IS GIVEN FOR NATURAL FREQUENCY

$$(\omega_1^*)_0 = \frac{2.486}{\sqrt{1+\frac{1}{2}\frac{\rho}{\rho_s}\frac{a}{h}}} \cdot \frac{a}{H^2}\sqrt{\frac{E}{\rho_s}}$$

WHERE $(\omega_1^*)_0$ FUNDAMENTAL CIRCULAR NATURAL FREQUENCY OF TANK FILLED W/ LIQUID, COMPUTED ON THE BASIS THAT THE TANK BEHAVES AS A CANTILEVER FLEXURAL BEAM

ρ ~ MASS DENSITY OF WATER

ρ_s ~ MASS DENSITY OF SHELL

a ~ RADIUS OF TANK

h ~ THICKNESS OF TANK WALL

H ~ HEIGHT OF LIQUID IN TANK

E ~ ELASTIC MODULUS OF TANK

$$\rho = 62.4 \frac{LB}{FT^3} \times \frac{1\ FT^3}{(12)^3 IN^3} \times \frac{1}{32.2\ \frac{FT}{S^2} \cdot 12 \frac{IN}{FT}} = 9.3955 \times 10^{-5} \frac{LB-S^2}{IN^4}$$ ✓

$$\rho_s = \frac{490 \frac{LB}{FT^3}}{62.4 \frac{LB}{FT^3}} \cdot 9.3455 \times 10^{-5} = 7.3386 \times 10^{-4} \frac{LB-S^2}{IN^4}$$ ✓

$a = 24' \times 12'' = 288''$ ✓

h = THICKNESS OF TANK WALL (GOING TO USE WEIGHTED AVE. OVER HEIGHT CONTAINING WATER

$$\left[.3125(96'') + .25''(96'') + .1875''(180'')\right] / 372''$$

$= .2359''$ ✓

$H \sim 372''$ ✓ $E = 28 \times 10^6 \frac{LB}{IN^2}$ (STAINLESS STEEL)

$$(\omega_1^*)_o = \frac{2.486}{\sqrt{1+\frac{1}{2}\,\frac{9.3455\times10^{-5}}{7.3386\times10^{-4}}\cdot\frac{288''}{.2359''}}}\cdot\frac{288}{(372)^2}\,\frac{1}{IN}\sqrt{\frac{28\times10^6\ LB/IN^2}{7.3386\times10^{-4}\ LB\text{-}s^2/IN^4}}$$

$$(\omega_1^*)_o = 113.89\ \text{rads}/s$$

$$\frac{\omega_A}{(\omega_1^*)_o} = \frac{.4023}{\sqrt{1-\nu^2}}\,\frac{H^2}{a^2} \qquad \nu = .3 \qquad (\text{EQN } 42)$$

$$\frac{\omega_A}{(\omega_1^*)_o} = \frac{.4023}{\sqrt{1-(.3)^2}}\left(\frac{372}{288}\right)^2 = .703607 \qquad (\text{EQN } 42)$$

$$\frac{(\omega_1)_s}{(\omega_1^*)_o} = \frac{.3159}{\sqrt{1+\nu}}\cdot\left(\frac{H}{a}\right) \qquad (\text{EQN } 43)$$

$$\frac{(\omega_1)_s}{(\omega_1^*)_o} = \frac{.3159}{\sqrt{1.3}}\left(\frac{372}{288}\right) = .357873 \qquad \text{EQN } 43$$

$\omega_1^*{}_o$ IS FUNDAMENTAL FREQUENCY COMPUTED ON ASSUMPTION THAT TANK BEHAVES AS A CANTILEVER FLEXURAL BEAM.

ω_A IS FREQUENCY OF OVALLING MOTION OF A RING OF UNIT WIDTH WHICH HAS THE CROSS SECTIONAL DIMENSIONS OF THE TANK.

ω_s IS FREQUENCY VALUE COMPUTED BY ASSUMING THE TANK BEHAVES AS A CANTILEVER SHEAR BEAM.

$$\omega_A = .703607\,(113.89) = 80.134\ \text{rads}/s$$

$$\omega_s = .357873\,(113.89) = 40.758\ \text{rads}/s$$

USING DUNKERLEY'S APPROXIMATION FOR THE FIRST NATURAL FREQUENCY OF THE TANK.

$$\frac{1}{\omega_1^2} = \frac{1}{(\omega_1)_o^2} + \frac{1}{(\omega_1)_s^2} + \frac{1}{(\omega_A)^2} \quad \text{(EQN 44)}$$

$$\frac{1}{\omega_1^2} = \frac{1}{(113.89)^2} + \frac{1}{(80.134)^2} + \frac{1}{(40.758)^2}$$

$\omega_1 = 34.6111 \ \frac{rads}{s}$ ∴ $f_1 = \frac{34.6111}{2\pi} = 5.5085$ Hz

3) Calculate S_a ~ Going to use 4% damping spectra in accordance w/GIP (pg 3 of this calc.)

To account for uncertainties in this calculation going to shift frequency -15%

∴ $\omega_1 = 5.5085 - (.15)(5.5085) = 4.68$ Hz

S_{a_1} ~ Spectral accel $4.68 \le \omega_1 \le 5.5085$ for 4% damping $= .363$ g (peak of response spectra)

4) ① Overturning moment @ base impulsive mode (3.5.4.2.3 in standard, pg 86)

$M_1 = [W_1 X_1 + W_s X_s] S_a$

∴ W_s & X_s are weight & height of shell.

A sketch of the shell is given on pg 15 of this calculation

$M_1 = [(2.2764 \times 10^6)(1.625')(12''/ft) + (48.026')\pi \cdot 8' \cdot (.026042)' \cdot 490 \ lb/ft^3 \cdot 48'' + (48.020833)\pi \cdot 8' (.020833) \cdot 490 \cdot (144)'' + 48.15625\pi \cdot (16.25') \cdot (.015625) 490 \cdot (289.5'') + \pi (26)^2 \cdot (.020833) \cdot 490 \cdot (435'')] .363$

∴ $M_1 = (3.1756 \times 10^8 + 1.7393 \times 10^7)) .363 = 1.2159 \times 10^8$ LB-IN.

$V = [\underbrace{2.2753 \times 10^6}_{water} + \underbrace{68,224}_{tank}] .363 = 8.507 \times 10^5$ LB

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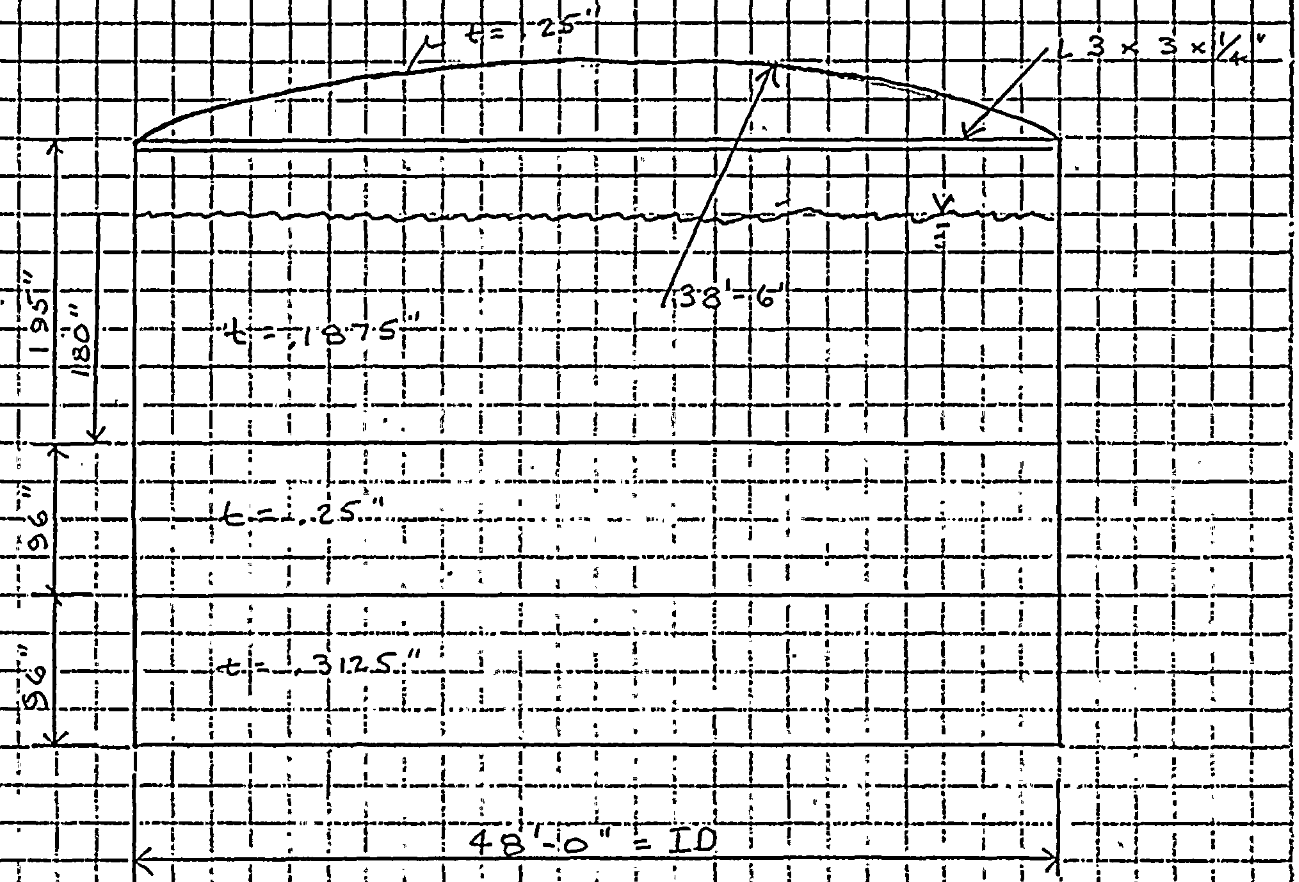
SUBJECT SEISMIC RE-EVALUATION OF REFUELING WATER STORAGE TANK

AEPSC - D. C. COOK N. P. P.

JOB No. 89C1557 SHEET B15 OF B22

REVISIONS
0 DDS PRW 9-5-89



SKETCH OF D.C. COOK REFUELING WATER STORAGE TANK.

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SUBJECT Seismic Re-Evaluation of Refueling Water Storage Tank
AEPSC - D. C. Cook N.P.P

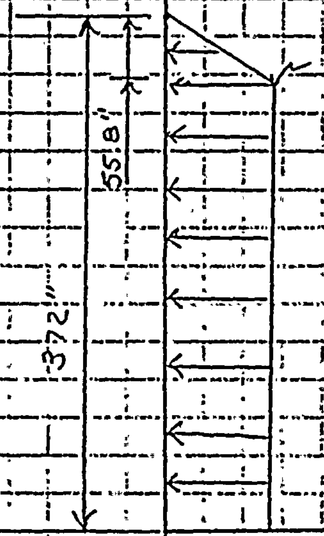
JOB No. 89C1557 SHEET B16 OF B22

REVISIONS: 0 JDS 8/25/89; PRW 9-5-89

5) Hydrodynamic Pressure on Tank Shell due to Impulse Mode (3.5.4.2.4 in Standard pg 86) Eqn. (C3500-6)

$$P_1 = \frac{W_1 \cdot X_1 \cdot Sa_1}{.68\, D\, H^2} = \frac{2.2753\times10^6\,LB \cdot (11.625)' \cdot 12''/_{FT} \cdot .363}{.68\,(48' \times 12'') \cdot (372)^2}$$

$= 2.2257$ LB/IN² @ $y \geq .15H$



Pressure Distribution:

6) (3.5.4.3 pg 86 of Standard) Sloshing Mode

Rigid Tank Model does not introduce unacceptable error, TID-7024 Procedure is used

$$\frac{W_2}{W_1} = .230\,\frac{D}{H}\tanh\left(\frac{3.67}{D/H}\right) \qquad (C3500-7)$$

$$\frac{X_2}{H} = 1.0 - \frac{\cosh\left(\frac{3.67}{D/H}\right) - 1}{\frac{3.67}{D/H}\sinh\left(\frac{3.67}{D/H}\right)} \qquad (C3500-8)$$

Where: W_2 ~ Effective Fluid Weight

X_2 ~ Height from Bottom of Cylindrical Shell

$$\frac{W_2}{W_T} = .230\,(1.548)\tanh\left(\frac{3.67}{1.548}\right) = .350$$

$$\frac{X_2}{H} = 1.0 - \frac{\left[\cosh\left(\frac{3.67}{1.548}\right) - 1\right]}{\frac{3.67}{1.548}\sinh\left(\frac{3.67}{1.548}\right)} = .650$$

$\therefore\ W_2 = .350\,(3.5004 \times 10^6) = 1.224205 \times 10^6$ LB

$X_2 = .65\,(372'') = 241.8''$

10) SLOSHING MODE NATURAL FREQUENCY

(3.5.4.3.2 OF STANDARD PG 87)

$$\omega_2^2 = \frac{3.67\,g}{D}\tanh\left(\frac{3.67\,H}{D}\right) \quad (\text{EQN } C3500\text{-}9)$$

$$\omega_2^2 = \frac{3.67\,(32.2\ \text{FT}/\text{S}^2)}{48\ \text{FT}}\tanh\left(\frac{3.67\,(31')}{48'}\right) = 2.419$$

$\omega = 1.555$ rad/s $\quad f = \frac{1.555}{2\pi} = .248$ HZ

S_{a_2} FOR .5% DAMPING FOR SLOSHING MODE

ASSUME 15% SHIFT IN FREQ.

$f = .248\,(1.15) = .285$ HZ

S_{a_2} @ .285 HZ = .087 g

11) OVERTURNING MOMENT @ BASE OF TANK - SLOSHING MODE (3.5.4.3.3

$M_2 = (1.224205 \times 10^6)^{LB}\,(241.8)''\cdot .087 = 2.57531 \times 10^7$ LB-

$V_s = (1.224205 \times 10^6)^{LB}\cdot .087 = 1.0651 \times 10^5$ LB

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REVISIONS: 0 — JJDS 8/25/89; PRW 9-5-89.

12) Fluid Slosh Height (Sloshing Mode)
(3.5.4.3.5 of Standard pg. 37)

$d = .42 \cdot D \left(\frac{S_{a2}}{g}\right)$ for C3500-12

$d = .42\,(576")\,(.087) = 21.047" < 24"$ FREEBOARD
SO OK

13) Hydrodynamic Pressure on Tank Shell - Sloshing Mode
(3.5.4.3.4 of Standard pg. 37)

$$P_2 = \frac{.533\, W_T S_{a2}}{D\,H} \cdot \frac{\cosh\left(3.68 \frac{H-Y}{D}\right)}{\cosh\left(3.68 \frac{H}{D}\right)}$$

Where Y is depth from the top

$$P_2 = \frac{.533\,(3.5004 \times 10^6)^{LB}\,.087}{576"\,(372")} \cdot \frac{\cosh\left(3.68 \cdot \frac{372-Y}{576}\right)}{\cosh\left(3.68 \cdot \frac{372}{576}\right)}$$

$$P_2 = .758 \cdot \frac{\cosh\left[3.68 \frac{(372-Y)}{576}\right]}{5.431}$$

P_2 @ Y = 0"	.758 psi	Y = 216"	.215 psi
@ Y = 12"	.703 psi	Y = 240"	.192 psi
@ Y = 24"	.652 psi	Y = 264"	.174 psi
@ Y = 36"	.605 psi	Y = 288"	.160 psi
@ Y = 48"	.562 psi	Y = 312"	.150 psi
@ Y = 60"	.522 psi	Y = 336"	.143 psi
@ Y = 72"	.485 psi	Y = 360"	.140 psi
@ Y = 84"	.450 psi	Y = 372"	.140 psi
@ Y = 96"	.419 psi		
@ Y = 108"	.390 psi		
@ Y = 120"	.363 psi		
@ Y = 132"	.338 psi		
@ Y = 144"	.316 psi		
@ Y = 156"	.295 psi		
@ Y = 168"	.276 psi		
@ Y = 192"	.242 psi		

S&A STEVENSON & ASSOCIATES a structural-mechanical consulting engineering firm

SUBJECT Seismic Re-Analysis of Refueling Water Storage Tank — AEPSC - D.C. Cook NPP.

JOB No. 89C1557 SHEET B19 OF B22

REVISIONS: 0 — [illegible] 8/25/89; PRW 9-5-89

14) VERTICAL FLUID RESPONSE MODE (3.5.4.4 IN STD, PG 87)

VERTICAL NATURAL FREQUENCY

$$\omega_v = \frac{\pi}{2H}\left[\rho\left(\frac{D}{tE} + \frac{1}{K}\right)\right]^{-1/2}$$

WHERE ρ IS FLUID MASS DENSITY $= 9.3455 \times 10^{-5}$ $\frac{LB\text{-}S^2}{IN^4}$

K IS FLUID BULK MODULUS

t IS thickness & WILL TAKE AVG OVER HEIGHT OF WATER $= .2359''$

K = 320,000 PSI FOR WATER @ 70°F ATMOSPHERIC PRESSURE

FROM ESHBACH "HANDBOOK OF ENGINEERING FUNDAMENTALS" THIRD EDITION.

$E = 28 \times 10^6$ LB/IN²

$$\omega_v = \frac{\pi}{2(372'')}\left[9.3455 \times 10^{-5} \frac{LB\text{-}S^2}{IN^4}\left(\frac{576}{28 \times 10^6 \frac{LB}{IN^2}(.2359)} + \frac{1}{320{,}000 \frac{LB}{IN^2}}\right)\right]^{-1/2}$$

$$\omega_v = \frac{\pi}{2(372'')}\left[8.442 \times 10^{-9} \frac{S^2}{IN^2}\right]^{-1/2}$$

$\omega_v = 45.954 \frac{RADS}{S}$ $f = 7.314$ Hz ✓

15) CHECK OF V CAPACITY OF TANK

ASSUME TANK V LOAD RESISTED BY FRICTION

MAX VERTICAL ACCEL. 2/3 HOR @ NATURAL FREQ. (15% PEAK SHIFT)

ACCEL @ .85 (7.314 Hz) = 6.2169 Hz ✓

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SUBJECT SEISMIC RE-ANALYSIS OF REFUELING WATER STORAGE TANK

AEPSC - D.C. COOK NPP

JOB No. 89C1557 SHEET 520 OF 822

REVISIONS: 0 JDS 8/25/89 PRW 9-5-89

$S_a = \frac{2}{3}(.35)g = .233g$ FOR 4% DAMPING

ASSUME .55 FRICTION COEF. VERY CONSERVATIVE - NEGLECT WT OF SHELL

$V_{CAP} = .55(1-.233) \cdot 3,500,400^{LB} = 1,476,644^{LB}$

TOTAL V SRSS OF IMPULSIVE & SLOSHING MODES

$V = \sqrt{(8.507 \times 10^5)^2 + (1.0651 \times 10^5)^2} = 857,340^{LB}$

1,476,644 > 857,340 OK

1(e) CALCULATE COMPRESSION FORCE IN TANK WALL 3.5.4.5 IN ASCE STANDARD 4-86 pg 87

$C = \sqrt{(F_v)^2 + \left(\frac{1.273 M_B}{D^2}\right)^2}$ (C.500-14)

F_v MAXIMUM VERTICAL RESPONSE FOR EMPTY TANK SHELL

$F_v = .233g \cdot \frac{68,224^{LB}}{\pi(576)''} = 8.785^{LB}$ (SHELL WT)

M_B TOTAL IMPULSIVE + SLOSHING

$M_B = \sqrt{(1.2159 \times 10^8)^2 + (2.57531 \times 10^7)^2} = 1.2429 \times 10^8$ LB-IN

$\therefore C = \sqrt{(8.785)^2 + \left[\frac{(1.2429 \times 10^8)(1.273)}{(576)^2}\right]^2} = 477.0$ LB/IN

$\sigma = C/t = \frac{477.0}{.3125''} = 1,526$ psi (.3125" @ BOTTOM)

FROM SIXTH EDITION OF ROARKS FORMULAS FOR STRESS & STRAIN BY WARREN C. YOUNG

FROM TESTS $\sigma' \approx .3 E t/r = .3(28 \times 10^6)\frac{.3125''}{288''} = 9,115$

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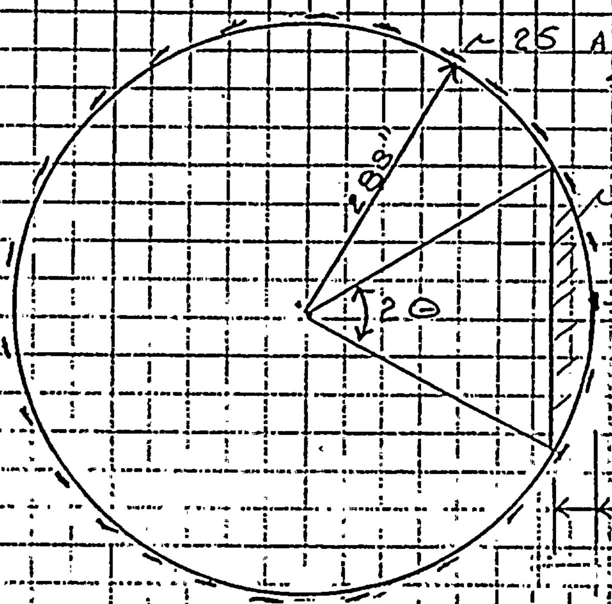
SUBJECT: SEISMIC RE ANALYSIS OF REFUELING WATER STORAGE TANK — AEPSC – D.C. COOK N.P.P

JOB No. 89C1557 SHEET B21 OF B22

REVISIONS: 0 — DDJ 8/25/89 — PRW 9-5-89

9115 psi >> 1578 psi OK ✓

17) CALCULATION OF FOUNDATION MOMENT CAPACITY BASED ON CONCRETE BEAM THEORY



FOR A NEUTRAL AXIS OF 28.8" THERE ARE 22 STRAPS IN TENSION. GOING TO LIMIT THE FURTHEST STRAP TO YIELD & ASSUME A RIGID BASE ∴ TENSION IN STRAP IS PROPORTIONAL TO IT'S DISTANCE FROM NEUTRAL AXIS / FURTHEST STRAP

DISTANCE FROM NEUTRAL AXIS OF FURTHEST STRAP

288" + (cos 7.2°) 288" − 28.8" = 544.93" ~ 2 STRAPS

SUBSEQUENT STRAP DISTANCE FROM N.A.

288" + cos (21.6°) 288" − 28.8" = 526.98" ~ 2 STRAPS

288" + cos (36.0°) 288" − 28.8" = 492.20" ~ "

288" + cos (50.4°) 288" − 28.8" = 442.78" ~ "

288" + cos (64.8°) 288" − 28.8" = 381.82" ~ "

288" + cos (79.2°) 288" − 28.8" = 313.17" ~ "

STEVENSON & ASSOCIATES a structural-mechanical consulting engineering firm	SUBJECT SEISMIC RE-ANALYSIS OF REFUELING WATER STORAGE TANK AEPSC - D.C. COOK N.P.P. JOB No. 89C1557 SHEET B22 OF B22 REVISIONS 0 DDS 8/25/89 ORW 9-5-89

$288'' - \cos(86.4°) \cdot 288'' - 28.8'' = 241.12''$ ~2 STRAPS

1.6 $288'' - \cos(72°) \cdot 288'' - 28.8'' = 170.20''$ ~2 STRAPS

$288'' - \cos(57.6°) \cdot 288'' - 28.8'' = 104.88''$ ~ "

$288'' - \cos(43.2°) \cdot 288'' - 28.8'' = 49.26''$ ~ "

$288'' - \cos(28.8°) \cdot 288'' - 28.8'' = 6.82''$ ~ "

MAXIMUM STRESS ALLOWABLE ~ 1.7 × NORMAL AISC ALLOW.
= 34,000 psi

$$T = 2(34{,}000\,psi)\left[1 + \frac{526.98 + 492.2 + 442.78 + 381.82 + 313.17 + 241.12}{544.93} + \frac{170.20 + 104.88 + 49.26 + 6.82}{544.93}\right] 1.875\,in^2 = 766{,}071.6\ ^{LB}$$

$$\cos\theta = \frac{(288 - 28.8)}{288} \Rightarrow \theta = \cos^{-1} .9 = 25.842°$$

$$\text{COMPRESSION AREA} = \pi(288)^2\left(\frac{57.6°}{360°}\right) - .9(288'') \cdot \sin 28.8° \cdot 288'' = 41{,}692.2'' - 35{,}962.7 = 5729.5\ in^2$$

$C = T$ ∴ EXTREME FIBER STRESS FOR CONCRETE COMPRESSION

$$\sigma_c = 2 \cdot \frac{766071.61}{5729.5} = 227.4\ psi \quad OK$$

$$M_{CAP} = 2(34{,}000)\,1.875^{in^2}\left[544.93 + \frac{(526.98)^2 + (492.2)^2 + (442.78)^2 + (381.82)^2}{544.93} + \frac{(313.17)^2 + (241.12)^2 + (170.20)^2 + (104.88)^2 + (49.26)^2 + (6.82)^2}{544.93}\right]$$

$+ 766{,}071.6\,(14.4'') = 3.2863 \times 10^8 > 1.285 \times 10^8$ OK SF = 2.557

Equip Id: 2-TK-32 Train: 12 Equip Class: 21

Drawing No.: 2-5106A

Function: D___

System: CONDENSATE STORAGE TANK SUPPLY

Equip Desc: CONDENSATE STORAGE TANK

Building: GROUNDS Room: INNER PLANT GROUNDS

Elev: 609 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: STANDARD Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: CONDENSATE STORAGE TANK

MFR: GRAVER TANK & MFG. CO., INC.

Model: 500,000 GALS.

Panel:

Elem. Drawing: NOT APPL

Wiring Drawing: NOT APPL

Power Source:

Walkdown: F Relay Eval: N

Comp Type: TANK

Iso Drawing:

Location: 50 FEET SOUTH OF THE UNIT 2 CONTAINMENT DOME

<table>
<tr><td colspan="2">DC Cook Unit 2
SCREENING EVALUATION WORK SHEET (SEWS)</td><td>GIP Rev 2, Corrected, 2/14/92
Status: Yes
Sheet 1 of 3</td></tr>
<tr><td>ID : 2-TK-32 (Rev. 0)</td><td colspan="2">Class : 21 - Tanks and Heat Exchangers</td></tr>
<tr><td colspan="3">Description : CONDENSATE STORAGE TANK</td></tr>
<tr><td>Building : GROUNDS</td><td>Floor El. : 609.00</td><td>Room, Row/Col : INNER PLANT GROUNDS - 50 FEET SOUTH OF THE UNIT 2 CONTAINMENT DOME</td></tr>
<tr><td colspan="3">Manufacturer, Model, Etc. : GRAVER TANK & MFG. CO., INC. 500,000 GALS.</td></tr>
</table>

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	Yes
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	Yes

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT : George G. Thomas and Tom Huang on 10/5/93

Large flat bottom tank 52'-0" inside diameter 34'-5 1/2" height. Tank manufactured by Graver Tank , made of ASTM A240 Type 304 Steel, 500,000 gallons and weighs 128,700 lbs. Anchored with 30 3/8" th x 5" w x 4' - 4" long strap that is embedded in the concrete 2' depth with a 2" radius hook at the end.

The strap detail is identical to the strap for the Unit 1 and 2 refueling Water Storage Tanks (RWST) 1-TK-33 and 2-TK-33. The calculation for the RWST resulted in the conclusion that the weld to the tank and embedment in the concrete was sufficient to develop the full yield strength of the strap.

The RWST has a very similar configuration as this CST. The calculation for the RWST using GIP methodology indicated an overall safety factor of 2.57 for overturning and 1.72 for shear. Calculation is attached to the SEWS of 1-TK-33.

Comparison of significant attributes of the tanks is shown below:

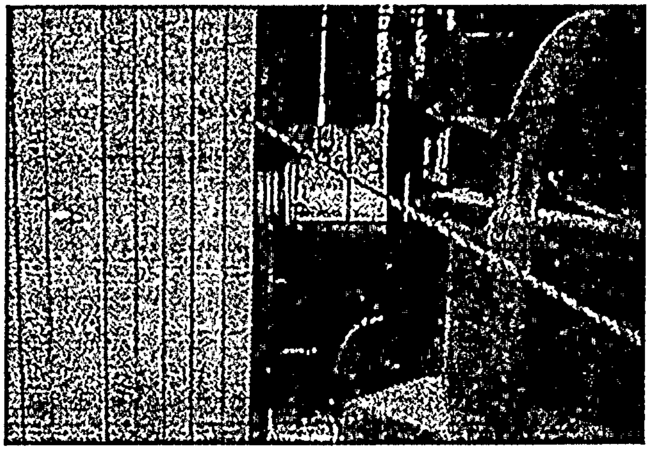
RWST	CST
48' Diameter	52' Diameter
31' Liquid Height	31'-7" Liquid Height
25' Strap Anchors	30' Strap Anchors

For shear the tanks are essentially identical since the demand and capacity are both proportional to the area under the base.

DC Cook Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 3
ID : 2-TK-32 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CONDENSATE STORAGE TANK		
Building : GROUNDS	Floor El. : 609.00	Room, Row/Col : INNER PLANT GROUNDS - 50 FEET SOUTH OF THE UNIT 2 CONTAINMENT DOME
Manufacturer, Model, Etc. : GRAVER TANK & MFG. CO., INC. 500,000 GALS.		

PICTURES

Buckled Out Anchor Strap



Pipes at the Bottom of the RWST

ANCHOR INSPECTION DATA SHEET

2	GROUNDS	CONDENSATE STORAGE TANK AREA
Unit #	Bldg.	Location

1-2-3048	2-TK-32
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch

CONDENSATE STORAGE TANK

DIMENSION:- 52' DIA X 34'-5½" HIGH

30 ANCHOR STRAPS. (ONE STRAP IS INACCESSIBLE)

SIZE OF THE WELDS VARY BETWEEN 3/16" TO 1/4". PART OF THE WELDS WERE INACCESSIBLE BECAUSE OF THE INSULATION.

MOST OF THE STRAPS HAVE RUST.

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
OCT 13 1993
CLERK T. Omurray

Drawn by: T. Omurray Date: 10-7-93

Verified by: R W Graham Date: 10-12-93
Qual./Cert. Inspector

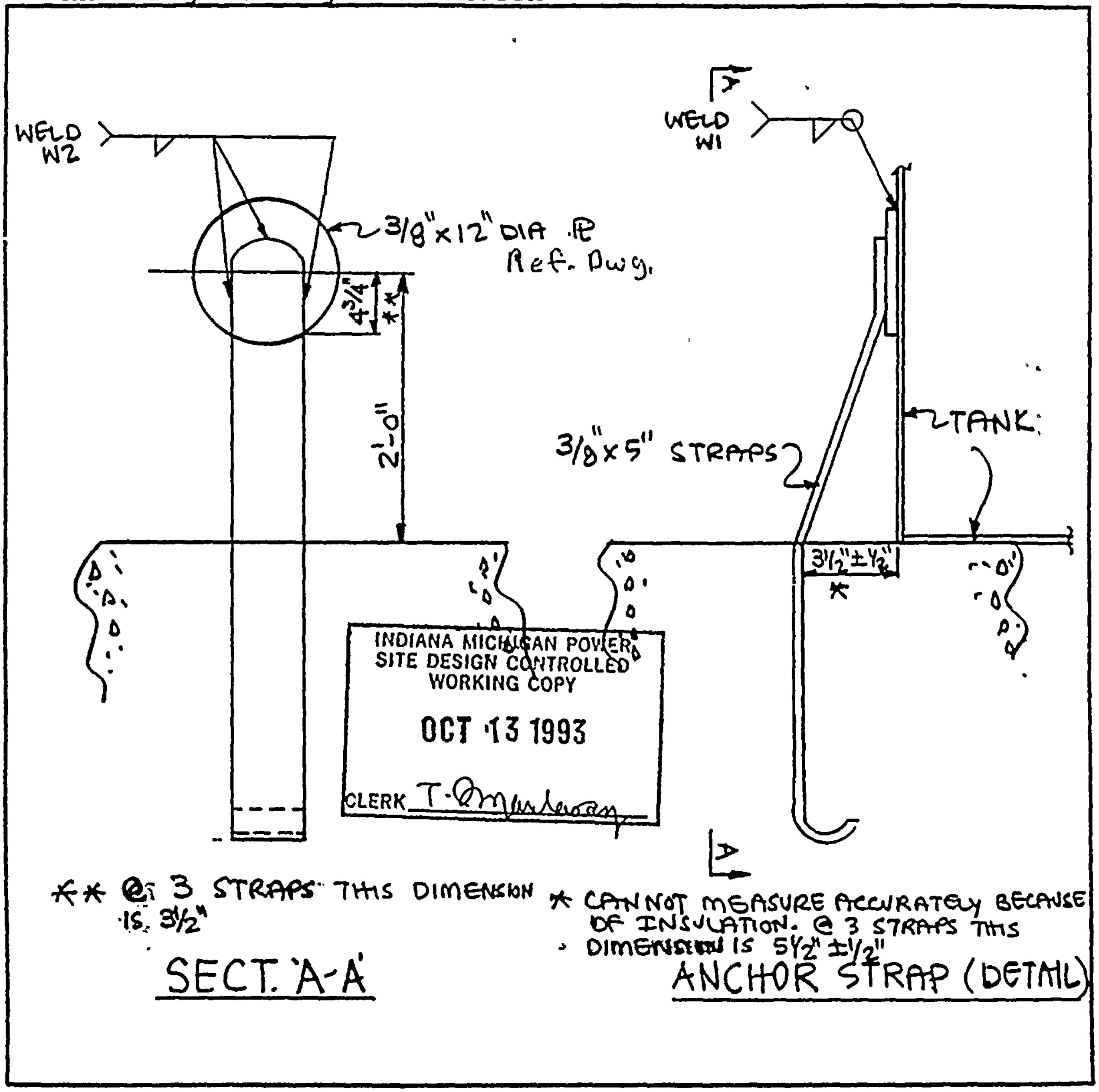
Reviewed by: T. Omurray Date: 10-13-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

2	GROUNDS	CONDENSATE STORAGE TANK AREA.
Unit #	Bldg.	Location

1-2-3048	2-TK-32
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: T. Omanlaesy Date: 10-7-93

Verified by: [signature] Date: 10-12-93
Qual./Cert. Inspector

Reviewed by: T. Omanlaesy Date: 10-13-93
Construction Anchor Review Engineer

ATTACHMENT 5 TO AEP:NRC:1040E

SAMPLE SEWS, ANCHORAGE CALCULATIONS, AND
ANCHORAGE INSPECTION DOCUMENTATION
FOR HORIZONTAL TANKS AND HEAT EXCHANGERS
RAI ITEM 7

This attachment includes sample SEWS, anchorage calculations and anchorage inspection documentation for the horizontal tank and heat exchanger evaluations requested in RAI Question 7. Included in this attachment are the evaluations for 1-HE-14, 2-HE-15E, 12-HE-16N, 1-QT-107-AB, 2-QT-115-CD, 1-HE-15E and 1-QT-107-CD.

SAFE SHUTDOWN EQUIPMENT LIST (SSELWP)

FUNCTION: CCW

Equipment Class: 21 Train: 12

Equipment ID: 1-HE-14 Drawing Number: 1-5135

System: CVCS

Equip Description: LETDOWN HEAT EXCHANGER

Building: AUXILIARY Room: LETDOWN HEAT EXCHANGER ROOM Elevation: 633

Normal state: Desired state: Power Required: N Sort: W,_ Notes:

Supporting System Drawing Number:

Required Interconnections and Supporting Components:

fety Related Status: NUCLEAR SR Min/Opt: MIN

ADDITIONAL INFORMATION

Alias Number: Power Train: NA

Component Served: LETDOWN HEAT EXCHANGER

Manufacturer: ATLAS INDUSTRAIAL MANUFACTURING CO Model: 1000 GPM

Panel:

Elem Drawing: N/A Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Only: N

Component Type: HE (ONE PER UNIT)
ISO Drawings:

Detailed Location:

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 3
ID : 1-HE-14 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : LETDOWN HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : LETDOWN HEAT EXCHANG,
Manufacturer, Model, Etc. : ATLAS INDUSTRAIAL MANUFACTURING CO, 1000 GPM		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

<u>IS EQUIPMENT SEISMICALLY ADEQUATE?</u> <u>Yes</u>

<u>COMMENTS</u>

SRT: Gary Thomas, and Tom Huang on 11/3/93.

ANCHORAGE ADEQUACY ACCEPTABLE TO SRT BASED ON BACK OF ENVELOPE CALCULATION SHOWN BELOW.

Nozzle loads on heat exchanger are small (on the order of 600 lbs. and 600 ft.-lbs.).

Anchored with 2 - 7/8" diameter J-bolts on 11-3/8" spacing. Vertical distance from the base of exchanger to the C.G. of exchanger is 13". Vertical distance from the base of the exchanger to the top nozzle is 29".

Supports for saddle dowled into base concrete. Saddle supports are adequately reinforced to transfer loads to bolts.

SRT judged that the Heat Exchanger is rigid.

Back of the envelope calculation:

0.24g (DBE ZPA at floor) x 1.25 (for realistic spectra) x 3320 lbs. (wt. of HX) x 13" (to C.G.) / [2 (bolts) x (11.375")] + 700 lbs x 29" (Nozzle loads)/ [2 x 11.375"] + 700 (ft. -lbs.) x 12 in./ft / (2 x 11.375") = 1830 lbs. tension / bolt - 3320 (.76g)/4 (dead wt. - vertical earthquake)) = 1199 lbs. tension/bolt

.24 x 1.25 x 3320 / 4 (bolts) + 700/4 = 424 lbs. shear/ bolt

Embedment for the 7/8" diameter J-bolts is 19.5" or 19.5/.875 = 22.3 bolt diameters into concrete. RLp for embedment (90 degree hook) = [19.5+8(7/8)]/(62.5 x .875)=0.49. Allowable for tension = 20.44 x 0.49 = 9.8 k > 1.2 k. For shear = 10.22 k > 0.424 k. OK.

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 3
ID : 1-HE-14 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : LETDOWN HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : LETDOWN HEAT EXCHANG,
Manufacturer, Model, Etc. : ATLAS INDUSTRAIAL MANUFACTURING CO, 1000 GPM		

Evaluated by: Date:

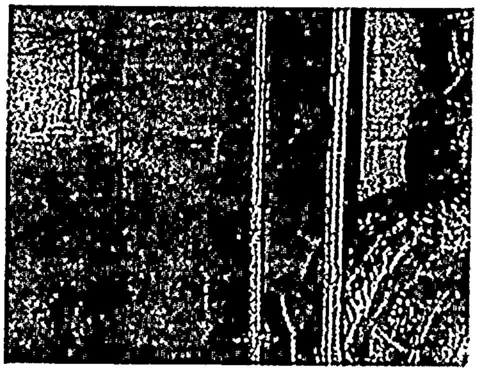
Geory D. [signature] 9/15/95

J. Chen Huang 12-15-95

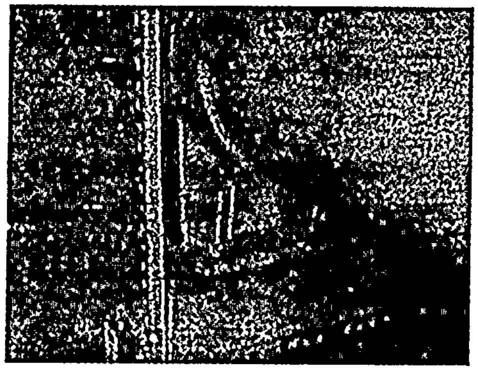
Attachment: Pictures

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 3
ID : 1-HE-14 (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : LETDOWN HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 633.00	Room, Row/Col : LETDOWN HEAT EXCHANG,
Manufacturer, Model, Etc. : ATLAS INDUSTRAIAL MANUFACTURING CO, 1000 GPM		

PICTURES



Overall Exchanger



Saddle Support

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 1-HE-14 Class 12

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ___ (If yes, check items that apply.)

	Remarks
Anchor Type	
Anchor Diameter	
Anchor Spacing	
Anchor Number	
Anchor Embedment ✓	WILL BE ACCOUNTED FOR PER GIP,
Anchor Edge Distance	
Anchor Gap ✓	1/8" GAP, NOT A CONCERN,
Anchor Thread Engagement	
Anchor Grip	
Anchor Angularity	
Concrete Crack	

Others (describe briefly)
NO WASHERS. — WASHER NOT NECESSARY

I. [signature] 11-3-93
D. [signature] 11-3-93

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

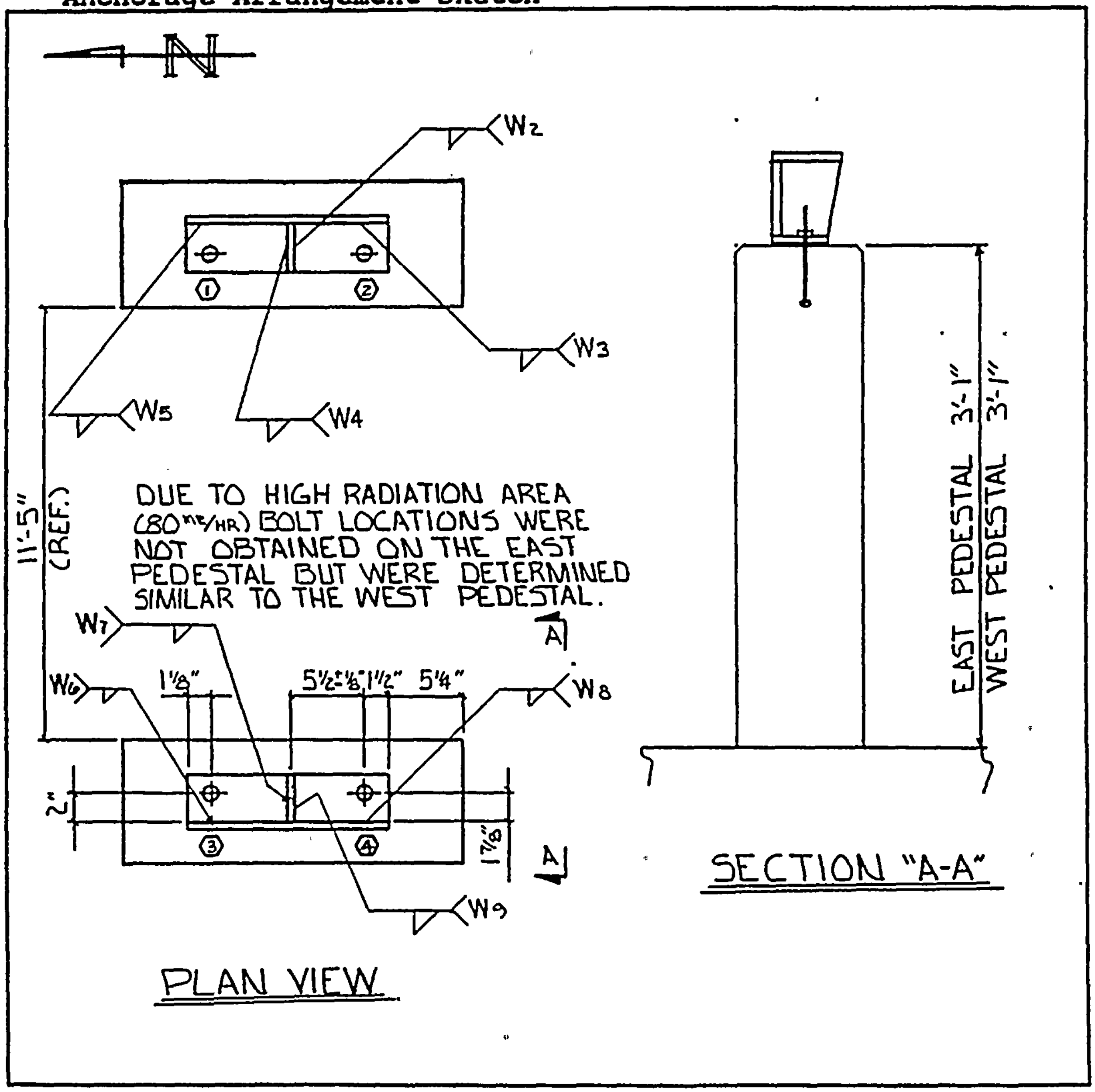
Actions Taken:
NONE (HIGH RADIATION AREA)

Prepared By T. [signature] Date 6-29-93.

ANCHOR INSPECTION DATA SHEET

ONE	AUX 633'-0" EL.	LETDOWN HEAT EXCHANGER ROOM
Unit #	Bldg.	Location
12-3321-22 12-3323-9		1-HE-14
Installation dwg. / Rev.		Equipment No.

Anchorage Arrangement Sketch



Drawn by: Judy Rose Date: 4-20-93

Verified by: [signature] Date: 6-1-93
Qual./Cert. Inspector

Reviewed by: T. Omaraqqy Date: 6-29-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-HE-14 Dwg No.: 12-3321-22 & 12-3323.

Anchor type: J- BOLT TYPE 2 Dia: 7/8"φ Dwg No.: 12-3079-20

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date: ______

Tightness verified? ☐ Yes ☐ No NA Date: ______
Construction ARE

Equipment base flexible? ☐ Yes ☒ No T. Omarkany Date: 4-21-93
Construction ARE

PHYSICAL CHARACTERISTICS

Bolt ID	1	2	3	4					Comments
Gaps	1/8" GAP BETWEEN PL & NUT	1/8" GAP BETWEEN PL & NUT	0"	0"					
Anchor length	2'-1½"	2'-1½"	2'-1½"	2'-1½"					
Protruding length	41½" ● -35½ / 6"	41¼" ● -35½ / 5¾"	41½" ● -35½ / 6"	41½" ● -35½ / 6"					
Embedment	1'-7½"	1'-7¾"	1'-7½"	1'-7½"					
Bolt grip	38¼" ● -35½" / 2¾"	38" ● -35½" / 2½"	37⅞" ● -35½" / 2⅜"	37½ ● -35½ / 2"					
Concrete condition	▲	▲	OK	CRACK IN CONCRETE ON BOTH SIDES					
Edge distance	▲	▲	4¼"	4¼"					
Anchor spacing	▲	▲	11⅜"	11⅜"					
Anchor angularity	< 10°	<10°	<10°	<10°					
Thread engagement	OK	OK	OK	OK					

Comments: ▲ DUE TO HIGH RADIATION AREA (80 mr/hr) BOLT LOCATIONS WERE NOT OBTAINED ON THE EAST PEDESTAL BUT WERE DETERMINED SIMILAR TO THE WEST PEDESTAL BY ENGINEERING VISUAL INSPECTION.
● DIMENSIONS WERE TAKEN FROM FLOOR SLAB. REINFORCED PEDESTAL IS 2'-11½" ABOVE FL. EL. PER DRAWING 12-3364-9.
BOLTS DID NOT HAVE WASHERS.

Verified by: R W Traham Date: 6-1-93
Qual./Cert. Inspector

Reviewed by: T. Omarkany Date: 6-29-93
Construction ARE

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-HE-14 Dwg No.: NA

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID		W2	W3	W4	W5	W6	W7	W8
Type		1	1	1	1	1	1	1
Size		1/8"	1/8"	1/8"	1/8"	1/8"	1/8"	1/8"
Length		3 1/2 ± 1/4	6 3/4" ± 1/4"	3 1/2" ± 1/4	6 3/4" ± 1/4	6 3/4" ± 1/4"	3 1/2" ± 1/4"	6 3/4" ± 1/4"
Cracks	Yes No	~~Yes~~ No	~~Yes~~ No	~~Yes~~ No	~~Yes~~ No	~~Yes~~ No	~~Yes~~ No	~~Yes~~ No
Lack of Penetration	Yes No	~~Yes~~ No	Yes No	~~Yes~~ No	~~Yes~~ No	~~Yes~~ No	~~Yes~~ No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	~~Yes~~ No	~~Yes~~ No	~~Yes~~ No	Yes No

Weld Type Codes

1 = Fillet

2 = Plug/Slot

3 = Groove

Equipment base flexible: ☐ Yes ☒ No T. Manlamy Construction Are Date: 4-21-93

Reviewed by: T. Manlamy Construction Anchor Review Engineer Date: 6-29-93

Verified by: Tolerances are not per procedure [signature] Qual./Cert. Inpsector Date: 6-1-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-HE-14 Dwg No.: NA

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W9							
Type	1							
Size	1/8"							
Length	3 1/4" ± 1/4"							
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes

1 = Fillet

2 = Plug/Slot

3 = Groove

Equipment base flexible: ☐ Yes ☒ No T. [illegible] Date: 4-21-93

Construction Are

Reviewed by: T. [illegible] Date: 6-29-93

Construction Anchor Review Engineer

Verified by: Tolerances not per procedure [illegible] Date: 6-1-93

Qual./Cert. Inpsector

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 3/3/93 REQUEST NO. N/A

IDENTIFICATION

Unit ONE
Component 1-HE-14
Item ANCHORS
Material C/S
Other SQUG PROGRAM

TECHNIQUE

Test Unit/ S/N KB USK7/CQC 405
Freq./Diameter 5MHZ / .250
Reference Standard QC# 30
Couplant/Batch No. ULTRAGE! I 9088

TEST DATA/REMARKS

ANCHOR	LENGTH
1	*
2	*
3	*
4	*

* NOTE: A BACK REFLECTION INDICATING ANCHOR LENGTH WAS NOT OBTAINED DURING THIS EXAM. THIS WOULD BE INDISATIVE OF A J-BOLT TYPE ANCHOR

PERFORMED BY: JWWodaus LEVEL: II DATE: 3/3/93
REVIEWED BY: Stephen R. Vargo LEVEL: II DATE: 3/3/93

FORM NO. 12 SHP 5050 NDE.008-1

Page 1 of 1
Revision 0

Equip ID: 2-HE-15E Train: 2 Equip Class:21

Drawing No.: 2-5135A 2-5113

Function: CCW

System: COMPONENT COOLING WATER

Equip Desc: EAST COMPONENT COOLING WATER HEAT EXCHANGER

Building: AUXILIARY Room: 609 HALLWAY

Elev: 609 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: EAST COMPONENT COOLING WATER HEAT EXCHANGER

MFR: M.L.W. INDUSTRIES

Model:

Panel:

Elem. Drawing: NOT APPL

Wiring Drawing: NOT APPL

Power Source: NOT APPL

Walkdown: F Relay Eval : N

Comp Type: HE

Iso Drawing: 2-CCW-41, 2-CCW-42

Location: 30 FEET EAST OF THE #2 MONITOR TANK

DC COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 2
ID : 2-HE-15E (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EAST COMPONENT COOLING WATER HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 609 HALLWAY - 30 FEET EAST OF THE #2 MONITOR TANK
Manufacturer, Model, Etc. : M.L.W. INDUSTRIES (HORIZONTAL)		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Tom Huang, and Kailash Mahajan on 11/2/93.

Component Cooling Water Heat Exchanger on two reinforced saddles. Anchorage is two 7/8" diameter J bolts. There are 4 1" wedge expansion anchors in one pedestal in the horizontal direction.

C.G. of exchanger from the top of the saddle pedestal about 3'.

Pedestal concrete is cracked. AEPSC tracking the problem through a condition report. SRT has reviewed the resolution of this problem and determined that it is resolved.

This unit is the same as 1-HE-15E except there are no horizontal anchors on 1-HE-15E. The anchorage for this exchanger is more robust. The calculations of 1-HE-15E show that the anchors are adequate and the saddles are safe.

Evaluated by: Date:

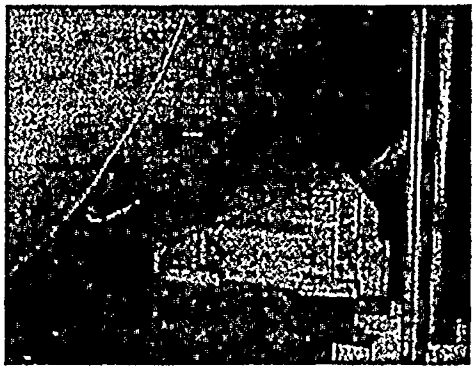
George [illegible] 9/15/95

[illegible] Huang 10-18-95

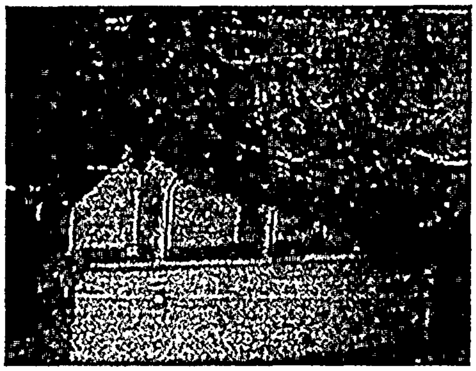
Attachment: Pictures

DC COOK Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 2
ID : 2-HE-15E (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EAST COMPONENT COOLING WATER HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : 609 HALLWAY - 30 FEET EAST OF THE #2 MONITOR TANK
Manufacturer, Model, Etc: : M.L.W. INDUSTRIES (HORIZONTAL)		

PICTURES



ONE SADDLE WITH 4 HORIZONTAL BOLTS



OTHER SADDLE SUPPORT

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 2-HE-15E Class 21

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ✓ No ___ (If yes, check items that apply.)

	Remarks
Anchor Type	
Anchor Diameter	
Anchor Spacing	
Anchor Number	
Anchor Embedment ✓	
Anchor Edge Distance ✓	
Anchor Gap ✓	
Anchor Thread Engagement	
Anchor Grip	
Anchor Angularity	
Concrete Crack ✓	

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:
NONE

Actions Taken:
NONE

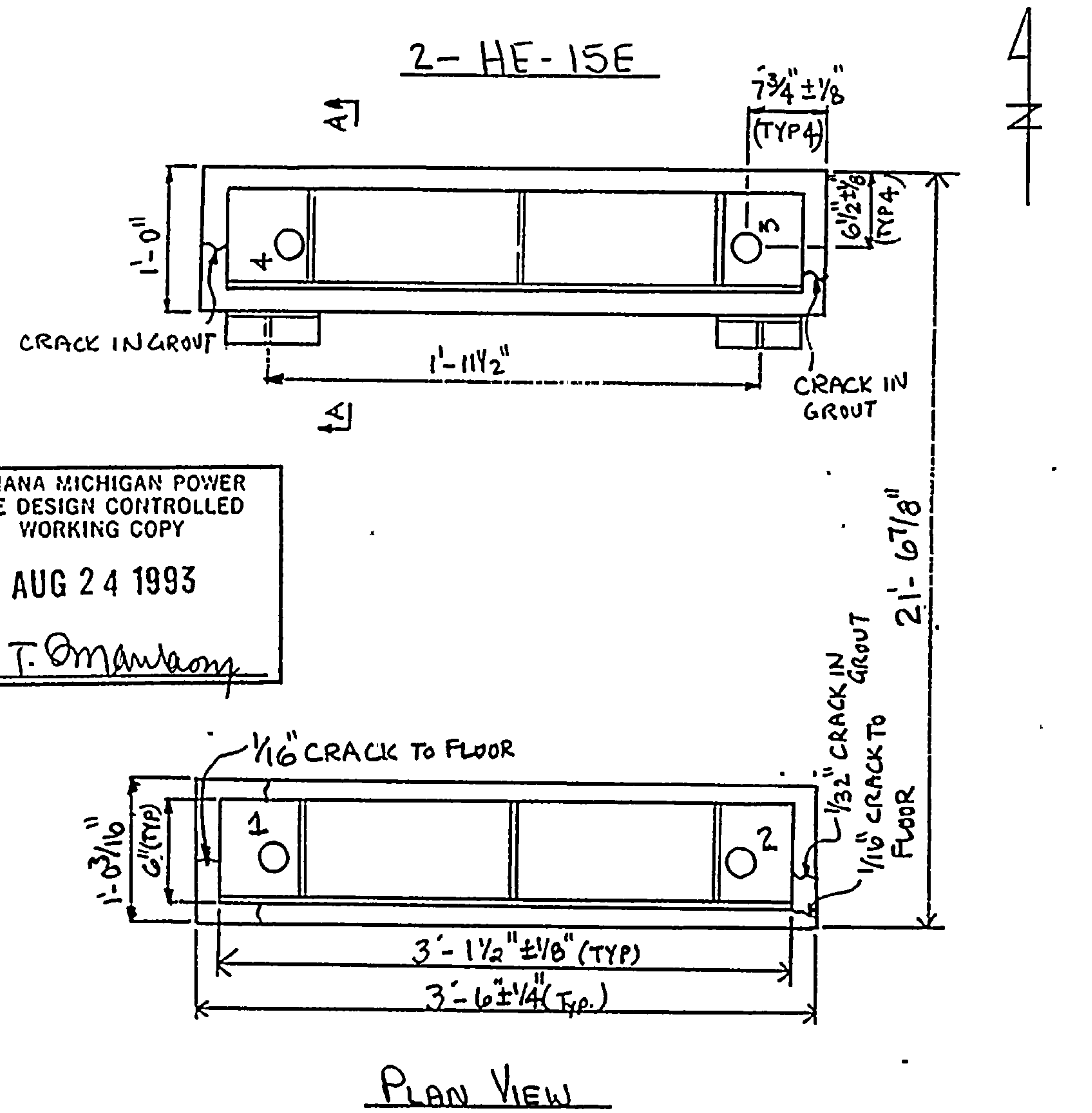
Prepared By T-Omantany Date 8-24-93

ANCHOR INSPECTION DATA SHEET

2	AUX. EL. 609'-0"	NORTH SOUTH HALLWAY
Unit #	Bldg.	Location

12-3285-23, 12-3288-4	2-HE-15E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
AUG 24 1993
CLERK T. Omanlaom

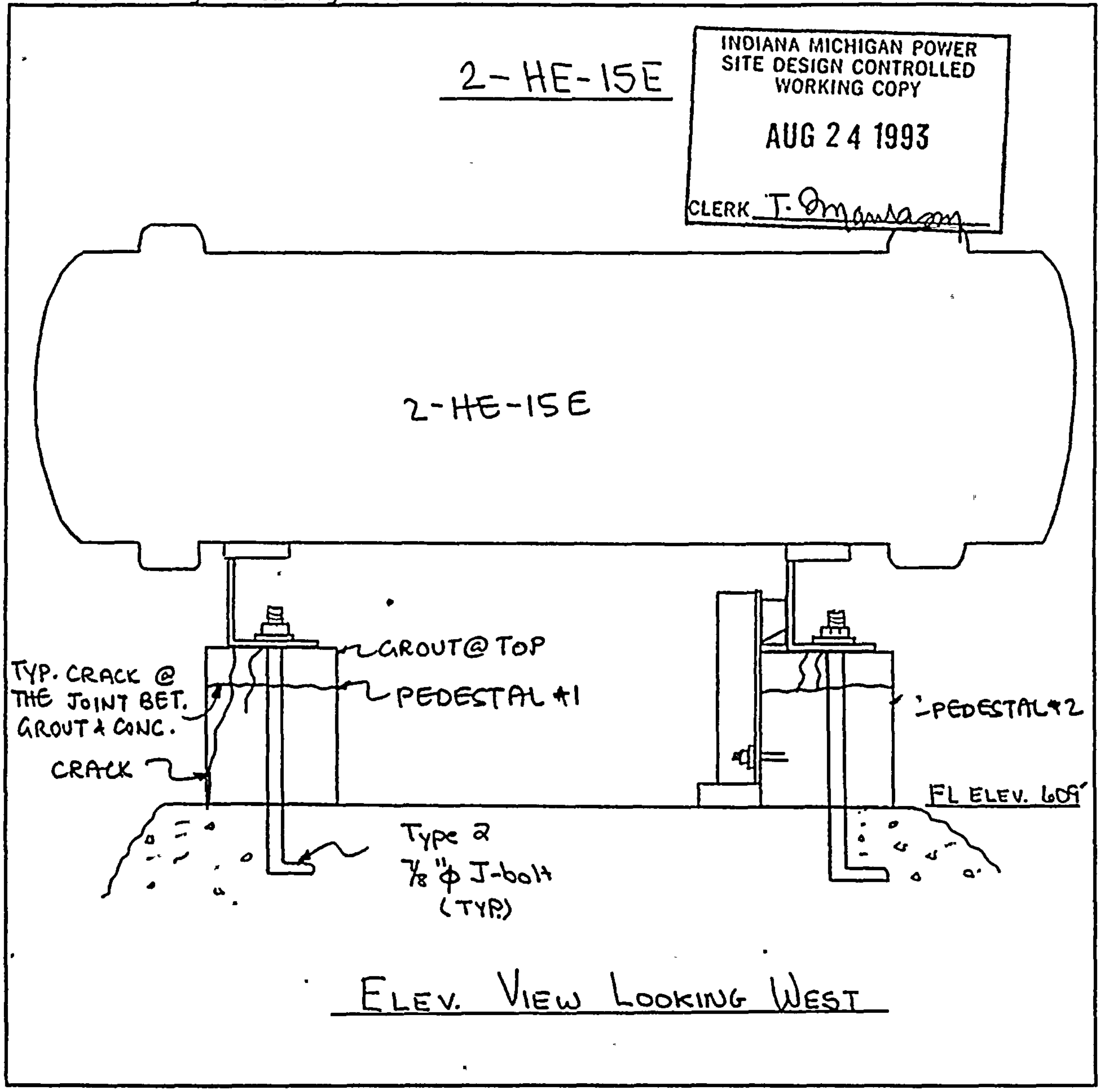
Drawn by:	T. Omanlaom	Date:	4-23-93
Verified by:	RWTraber Qual./Cert. Inspector	Date:	6-1-93
Reviewed by:	T. Omanlaom Construction Anchor Review Engineer	Date:	8-24-93

ANCHOR INSPECTION DATA SHEET

2	AUX EL. 609'-0"	NORTH SOUTH HALLWAY
Unit #	Bldg.	Location

12-3285-23, 12-3288-4	2-HE-15E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by: T. Omanson Date: 4-23-93

Verified by: [signature] Date: 6-1-93
Qual./Cert. Inspector

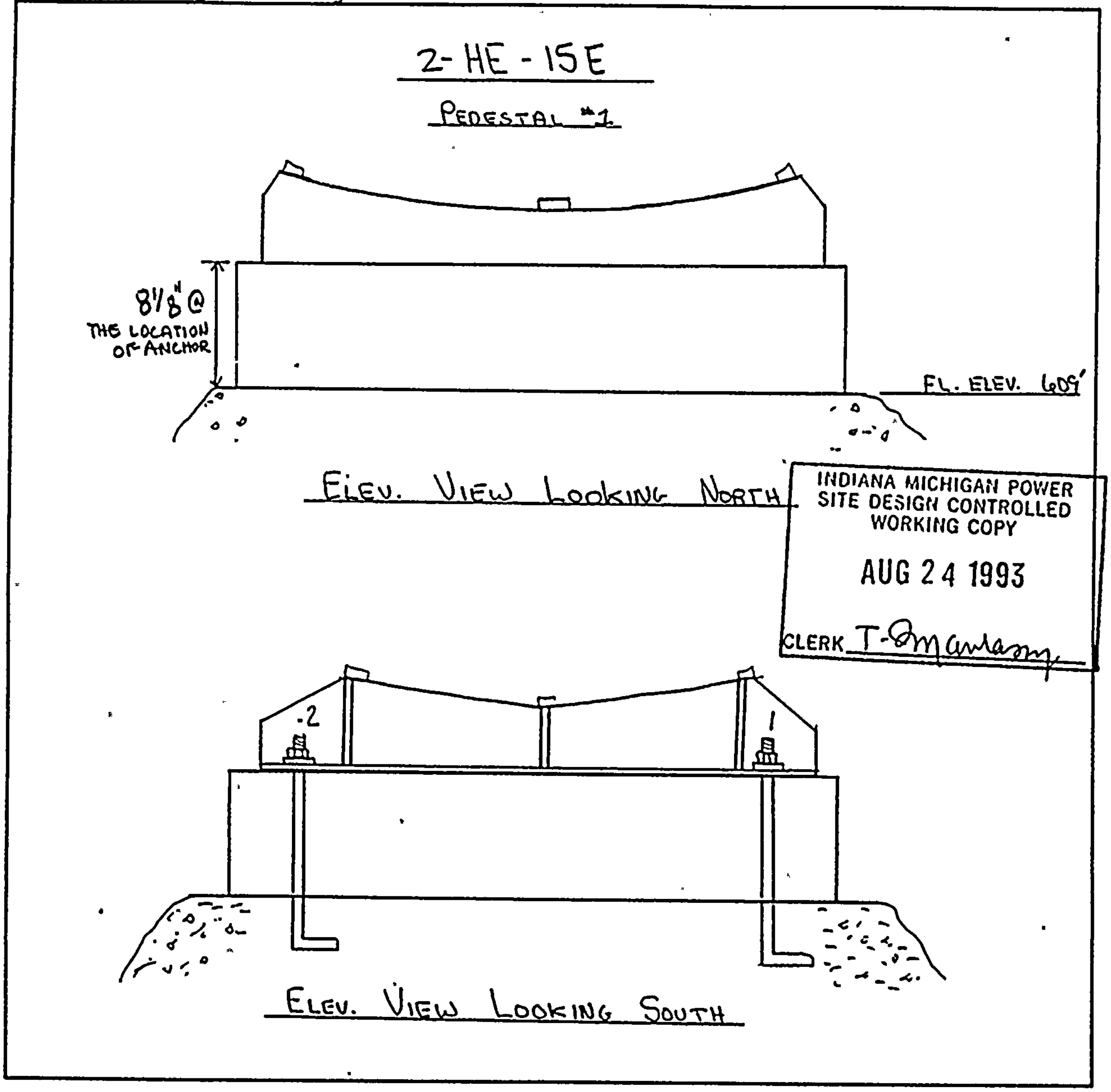
Reviewed by: T. Omanson Date: 8-24-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

2	AUX EL. 609'-0"	NORTH SOUTH HALLWAY
Unit #	Bldg.	Location

12-3285-23, 12-3288-4	2-HE-15E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



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CLERK T. Omanlaorn

Drawn by: T. Omanlaorn Date: 4-23-93

Verified by: [signature] Date: 6-1-93
Qual./Cert. Inspector

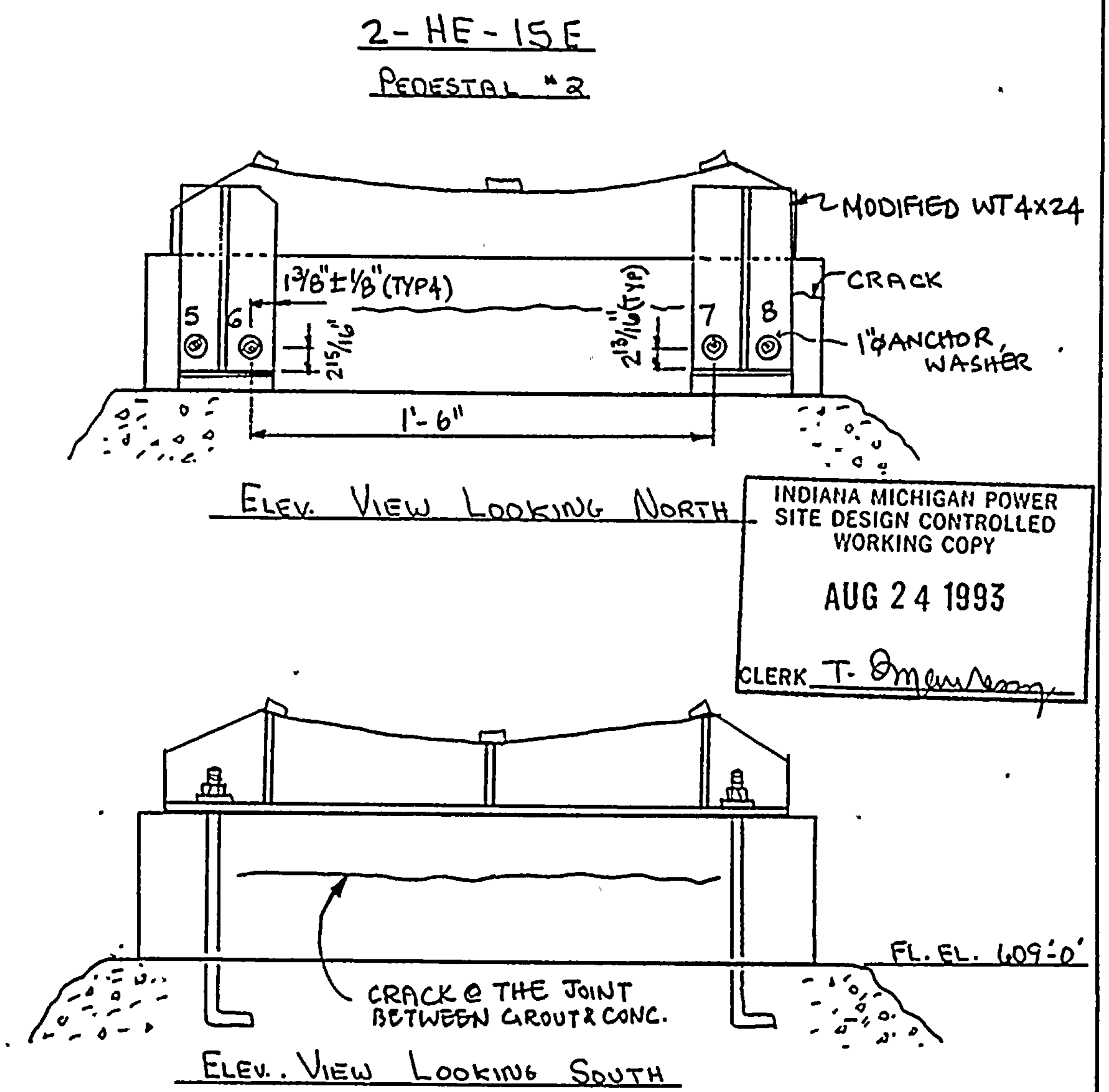
Reviewed by: T. Omanlaorn Date: 8-24-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

2	AUX EL. 609'-0"	NORTH SOUTH HALLWAY
Unit #	Bldg.	Location

12-3285-23, 12-3288-4	2-HE-15E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



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WORKING COPY
AUG 24 1993
CLERK T. Omanason

Drawn by:	T. Omanason	Date:	4-23-93
Verified by:	(signature) Qual./Cert. Inspector	Date:	6-1-93
Reviewed by:	T. Omanason Construction Anchor Review Engineer	Date:	8-24-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-HE-15E　　Dwg No.: 12-3288-4

Anchor type: J BOLT　　Dia: 7/8"φ　　Dwg No.: ______

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA　　Cal. Due Date: ______

Tightness verified? ☐ Yes ☒ No　NA Construction ARE　Date: ______

Equipment base flexible? ☐ Yes ☒ No　T. Omanhann Construction ARE　Date: 4-23-93

PHYSICAL CHARACTERISTICS

Bolt ID	1	2	3	4					Comments
Gaps	*	0	0	0					
Anchor length	2'-6 3/4"	2'-6 3/4"	2'-6 3/4"	2'-6 3/4"					FROM DWG 12-3073B-2
Protruding length	4 3/4"	4 15/16"	~~3 3/4~~ 5"	~~3 7/8~~ ~~4 1/4~~ "3 7/8"					TOLERANCE ±3/8". SEE BELOW
Embedment	2'-2"	2'-1 13/16"	~~2'-3"~~ 2'-1 3/4	2'-2 7/8"					
Bolt grip	3 3/8"	3 9/16"	2 1/2"	2 9/16"					TOLERANCE ±3/8" SEE NOTE BELOW.
Concrete condition	CRACK	CRACK	CRACK	CRACK		N	A		SEE SKETCH
Edge distance	6"	6"	6"	6"					TOLERANCE ±1/2"
Anchor spacing	2'-2 1/2"	2'-2 1/2"	2'-2 1/2"	2'-2 1/2"					TOLERANCE ± 1/4"
Anchor angularity	0	0	0	0					
Thread engagement	OK	OK	OK	OK					

Comments: * 1/16" GAP BETWEEN NUT & WASHER, 1/16" GAP BETWEEN WASHER & STEEL. ALL ANCHORS HAVE A WASHER. PROTRUDING LENGTH & BOLT GRIP ARE MEASURED FROM THE JOINT OF GROUT & CONCRETE PAD. DEPTH OF GROUT VARIES FROM 1 3/4" TO 3". HENCE PROTRUDING LENGTH & BOLT GRIP CANNOT BE MEASURED ACCURATELY. EDGE DISTANCE IS APPLICABLE ONLY TO THE PEDESTAL.

Verified by: [signature] Qual./Cert. Inspector　　Date: 4-27-93

Reviewed by: T. Omanhann Construction ARE　　Date: 8-24-93

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SITE DESIGN CONTROLLED
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AUG 24 1993
CLERK T. Omanhann

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-HE-15E   Dwg No.: 12-3288-4

Anchor type: WEDGE ANCHOR   Dia: 1"φ   Dwg No.: 12-3073A, 12-3073B

Tightness established by: ☐ "Snug Fit" ☒ Torque

Torque Wrench No.: CPM 511   Cal. Due Date: 4 Sept.'93

Tightness verified? ☒ Yes ☐ No   S. Thakkar   Date: 4.23.93
Construction ARE

Equipment base flexible? ☐ Yes ☒ No   T. Swanson   Date: 4-23-93
Construction ARE

PHYSICAL CHARACTERISTICS

Bolt ID	5	6	7	8					Comments
Gaps	0	0	0	0					
Anchor length	7 3/4"	9"	9"	9"					
Protruding length	2 1/2"	2"	1 15/16"	1 7/8"					
Embedment	5 1/4"	7"	7 1/16"	7 1/8"					
Bolt grip	13/16"	7/8	13/16"	7/8"	N		A		
Concrete condition	CRACK	CRACK	CRACK	CRACK					
Edge distance	4 3/16"	4 3/16"	4"	4"					TO TOP OF GROUT
	1 3/4"	1 3/4"	2"	2"					TO TOP OF CONCRETE
Anchor spacing	5 3/8"	5 3/8"	5 5/16"	5 5/16"					
Anchor angularity	0	0	0	0					
Thread engagement	OK	OK	OK	OK					

Comments:

Tightness Verified by: [signature] 6-1-93 / Dims. [signature]   Date: 6-1-93
Qual./Cert. Inspector

Reviewed by: T. Swanson   Date: 8-24-93
Construction ARE

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
AUG 24 1993
CLERK

ANCHOR INSPECTION DATA SHEET

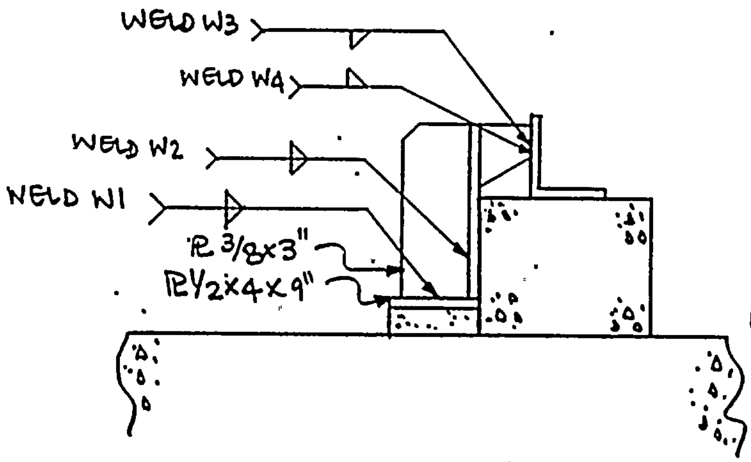
Equipment No.: 1-HE-~~18E~~ 15 E Rvl 6-1-93 Dwg No.: 12-3288-4

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W1	W2	W3	W4				
Type	1	1	1	1	N		A	
Size	3/16	3/16	-	1/4"				
Length	5"	28"	5"	5"				
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove



SECT. 'A-A'

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
AUG 24 1993
CLERK T. Omanlam

WELD W3 - TOO MUCH SLAG. CANNOT VERIFY ANYTHING EXCEPT THE LENGTH

Equipment base flexible: ☐ Yes ☒ No T. Omanlam Construction Are Date: 4-23-93

Reviewed by: T. Omanlam Construction Anchor Review Engineer Date: 8-24-93

Verified by: RW Graham Qual./Cert. Inpsector Date: 6-1-93

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A   REPORT DATE: 4-13-93   REQUEST NO. N/A

IDENTIFICATION

Unit Two
Component 2-HE-15E
Item Anchors
Material C/S
Other Sqeg

TECHNIQUE

Test Unit/ S/N KBUSK-7S CQC-405
Freq./Diameter 5mhz .250"
Reference Standard QC-8
Couplant/Batch No. Ultragel II #9088

TEST DATA/REMARKS

Anchors 1 thru 4
A back reflection indicating anchor bolt length was not obtained during this exam. This would be indicative of a J-bolt type Anchor.

* Anchors 5, 6, 7, 8

Anchor	Length
5	7 3/4"
6	9"
7	9"
8	9"

PERFORMED BY: [signature]   LEVEL: II   DATE: 4-13-93
REVIEWED BY: Stephen R. Vaye   LEVEL: II   DATE: 4/14/93

FORM NO. 12 SHP 5050 NDE.008-1

Page 1 of 1
Revision 0

Database: K:SSEL1B.DBF

Equip ID: 12-HE-16N Train: 12 Equip Class:21

Drawing No.: 12-5136, 1-5135

Function: SFP COOLING AND CCW

System: SPENT FUEL PIT COOLING & CCW

Equip Desc: NORTH SPENT FUEL PIT HEAT EXCHANGER

Building: U-1 AUXILIARY Room: SPENT FUEL PIT HE ROOM

Elev: 609 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: STANDARD Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: OAT, JOSEPH, CORP

MFR:

N[illegible]:

Panel:

Elem. Drawing:

Wiring Drawing:

Power Source:

Walkdown: F Relay Eval : N

Comp Type: HE

Iso Drawing: 12-SF-5, 7, 1-CCW-1, 7

Location: NW AREA OF RM

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 9
ID : 12-HE-16N (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : NORTH SPENT FUEL PIT HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : SPENT FUEL PIT HEAT XCHGR RM, NW AREA OF RM
Manufacturer, Model, Etc. : OAT, JOSEPH, CORP.		

BASIS : Horizontal TANK analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Tom Huang and Kailash Mahajan on 11/3/93.

3' - 2" diameter horizontal heat exchanger about 22' long on two saddles supported by piers.Total weight full given as 26,200 lbs.

Exchanger bolted into pier with 4 7/8" diameter bolts per saddle. Piers are dowled into floor.

The results of tank analysis show that the tank anchorage is adequate and also the saddles are safe.

Evaluated by: Date:

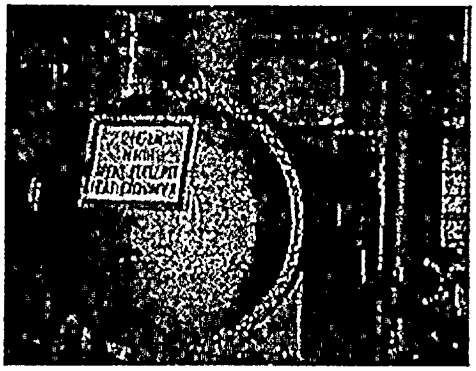
Georg G. [signature] 10/4/95

[signature] 10-26-95

Attachment: Pictures
Attachment: TANK Analysis Results
Attachment: Check of Stresses in Saddles

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 9
ID : 12-HE-16N (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : NORTH SPENT FUEL PIT HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : SPENT FUEL PIT HEAT XCHGR RM, NW AREA OF RM
Manufacturer, Model, Etc. : OAT, JOSEPH, CORP.		

PICTURES



NORTH SPENT FUEL PIT HEAT EXCHANGER

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 9
ID : 12-HE-16N (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : NORTH SPENT FUEL PIT HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : SPENT FUEL PIT HEAT XCHGR RM, NW AREA OF RM
Manufacturer, Model, Etc. : OAT, JOSEPH, CORP.		

TANK Analysis Results

Step 1 -- Input Data

a) Assumptions

1. Tank is cylindrical, horizontally oriented and supported on saddles.	Yes
2. Tank and saddles are made of carbon steel.	Yes
3. Saddles are uniformly spaced.	Yes
4. Saddles overhang is less than spacing / 2.	Yes
5. Base plates have slotted anchor bolt holes for thermal growth except for the base plate under the fixed saddle.	Yes
6. Imposed nozzle loads are not significant.	Yes
7. The tank foundation is adequate.	Yes
8. Anchor bolts are cast in place or expansion type.	Yes

b) Materials

Weight of Tank + Fluid	26.2 kips
Weight Density of Tank + Fluid	151 lbs/ft^3
Saddle Elastic Modulus	30000.0 ksi
Saddle Shear Modulus	11500.0 ksi
Base Plate Yield Strength	30000.0 ksi
Anchor Type	7/8 in 90 deg. J-Bolts

c) Dimensions

Tank Diameter, D	3.17 ft
Tank Length, L	22.0 ft
Tank Thickness, t	0.44 in
Height of Tank + Fluid C.G., Hcg	2.16 ft
Number of Saddles	2
Saddle Spacing, S	13.0 ft
Saddle Height, h	4.9 in
Saddle Shear cross-sectional area	23.63 in^2
Saddle Weak Axis Moment of Interia	24.36 in^4
Number of Bolt Locations / Saddle	2
Number of Bolts / Bolting Location	2
Extreme Bolt Spacing, D'	1.83 ft
Anchor Bolt Eccentricity, e	3.0 in
Weld Thickness	0.188 in
Base Plate Thickness	0.5 in

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 9
ID : 12-HE-16N (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : NORTH SPENT FUEL PIT HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : SPENT FUEL PIT HEAT XCHGR RM, NW AREA OF RM
Manufacturer, Model, Etc. : OAT, JOSEPH, CORP.		

d) Anchor Bolts

Type = 90 Deg J-Bolt	Diameter = 7/8 in
Manufacturer =	Product Name =

	Pullout	Shear
Nominal Capacity	20.44 kips	10.22 kips

Concrete Compression Strength, fc' = 3500.0 psi

Reduction Parameters

Label	Check	Condition	Capacity Reduction Factor	
			Pullout	Shear
1. Type of Anchorage	Yes		1.0	1.0
2. Installation Adequacy	Yes	Installation is adequate	1.0	1.0
3. Embedment Length	Yes	Embedment Length = 18.75 in	0.47	1.0
4. Gap at Threaded Anchors	Yes	Gap size = 0.0 in	1.0	1.0
5. Spacing between Anchorages	Yes		1.0	1.0
6. Edge Distance	Yes	Edge Distance = 6.75 in	0.75	0.78
7. Concrete Strength and Condition	Yes		1.0	1.0
8. Concrete Crack Location and Size	Yes	Crack Size = 0.0 in	1.0	1.0
9. Essential Relays in Cabinets	No			
10. Base Stiffness and Prying Action	Yes		1.0	1.0
11. Equipment Base Strength and Structural Load Path	Yes	Base strength and load path are O.K.	1.0	1.0
12. Embedment Steel and Pads	Yes	Installation is O.K.	1.0	1.0

Does the tank satisfy all the assumptions and is within the applicable range of parameters? Yes

Step 2 -- The allowable bolt loads

Allowable Tension Load, Pu'	7.211 kips
Allowable Shear Load, Vu'	7.967 kips

Step 3 -- Determine base plate bending strength reduction factor

RB	346.7068

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 9
ID : 12-HE-16N (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : NORTH SPENT FUEL PIT HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : SPENT FUEL PIT HEAT XCHGR RM, NW AREA OF RM
Manufacturer, Model, Etc. : OAT, JOSEPH, CORP.		

Step 4 -- Determine base plate weld strength reduction factor

RW	3.3848

Step 5 -- Determine the anchorage tension and shear allowable loads

Allowable Anchorage Tension Load, Pu	7.211 kips
Allowable Anchorage Shear Load, Vu	7.967 kips

Step 6 -- Calculate the ratios and values

alpha (Pu/Vu)	0.91
Wb	3.28 kips/bolt
Vu / Wb	2.43
Hcg / D'	1.18
Hcg / S	0.166
F1	2.236
F2	2.475

Step 7 -- Determine the acceleration capacity of the tank anchorage

lambda_1	1.088 G
lambda_u	0.772 G
Anchor Acceleration capacity, lambda	0.772 G

Step 8 -- Determine the maximum saddle spacing for transverse and vertical rigid frequency response

Maximum Saddle Spacing, Sc	13.45 ft

Step 9 -- Compute the resonant frequency of the tank in the longitudinal direction

Saddle Stiffness, Ks	13948.206 kips/in
Resonant Frequency of Tank in Longitudinal Direction	72.15 Hz

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 9
ID : 12-HE-16N (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : NORTH SPENT FUEL PIT HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : SPENT FUEL PIT HEAT XCHGR RM, NW AREA OF RM
Manufacturer, Model, Etc. : OAT, JOSEPH, CORP.		

Step 10 -- Determine the seismic demand acceleration

ZPA	0.275 G

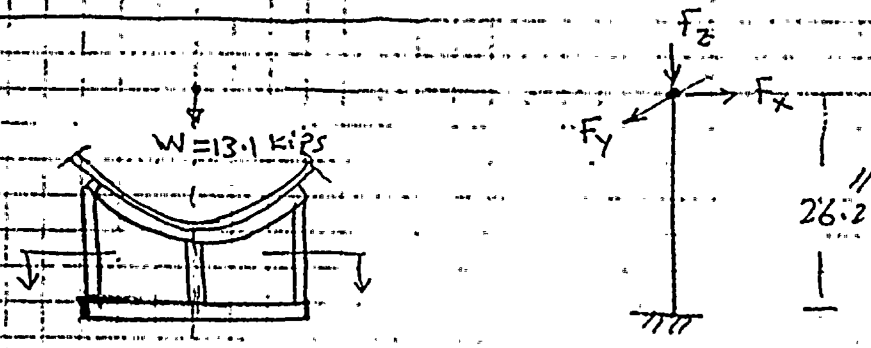
Tank is rigid in all three directions.
Tank anchorage is adequate because anchorage acceleration capacity is greater than ZPA

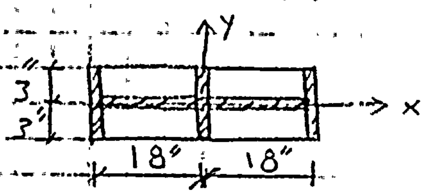
Step 11 -- Check the saddle stresses

The program does not check the saddle stresses
Check the saddle stresses by an independent calculation

S&A Stevenson and Associates — A Structural-Mechanical Consulting Engineering Firm	CLIENT: AEP — JOB No. [illegible] — SHEET 1 OF 2
SUBJECT: North Spent Fuel Pit Heat Exchanger (12-HE-16N) DC Cook	REVISIONS: B. Mahmoud 5/2/95; [illegible] 5/20/95

• check saddle stresses





• weight/support (W) = 13.1 kips

• Anch. Acc. capacity $\lambda = 0.60$ g (From Gipper)

• ZPA = .275 g. horizontal

• prop. of Area

$A = 27.0\ in^2$

$I_{xx} = 27.85\ in^4$, $I_{yy} = 3888.0\ in^4$

• Compression + Bending

$N = W \pm \lambda \cdot W = 13.1 \pm \frac{2}{3}\overset{SV}{0.60}(13.1) = 13.10 \pm 5.24$ kips

$M_x = (0.60)(13.1)(26.2) = 243.7$ kip.in

$M_y = M_x$

Stevenson and Associates
A Structural-Mechanical Consulting Engineering Firm

CLIENT [illegible] JOB No. [illegible] SHEET 2 OF 2

SUBJECT [illegible]

REVISIONS

UC Code

For three component earthquake the maximum (negative) normal stress is determined using SRSS superposition rule

$$\sigma^{\ominus}_{max} = \frac{W}{A} + \sqrt{\left(\frac{\delta V}{A}\right)^2 + \left(\frac{M_x}{S_x}\right)^2 + \left(\frac{M_y}{S_y}\right)^2}$$

Where $S_x = I_x / y_{max} = 27.85\ in^4 / 3 = 9.28\ in^3$

$S_y = I_y / x_{max} = 3888\ in^4 / 18 = 216\ in^3$

$$\sigma^{\ominus}_{max} = \frac{13,100}{27} + \sqrt{\Big(\underbrace{\frac{5,246}{27}}_{194}\Big)^2 + \Big(\underbrace{\frac{243,700}{216}}_{1128}\Big)^2 + \Big(\underbrace{\frac{243,700}{9.28}}_{26,260}\Big)^2} =$$

$\sigma^{\ominus}_{max} = 485 + 26,285 = \underline{26,770\ psi}$

$\sigma_{all} = 30,000\ psi$ (A285 Gr C)

$\boxed{F_S = \frac{30,000}{26,770}} = \underline{1.12}$

Thus,

The saddle has a larger capacity than the tank anchorage - O.K.

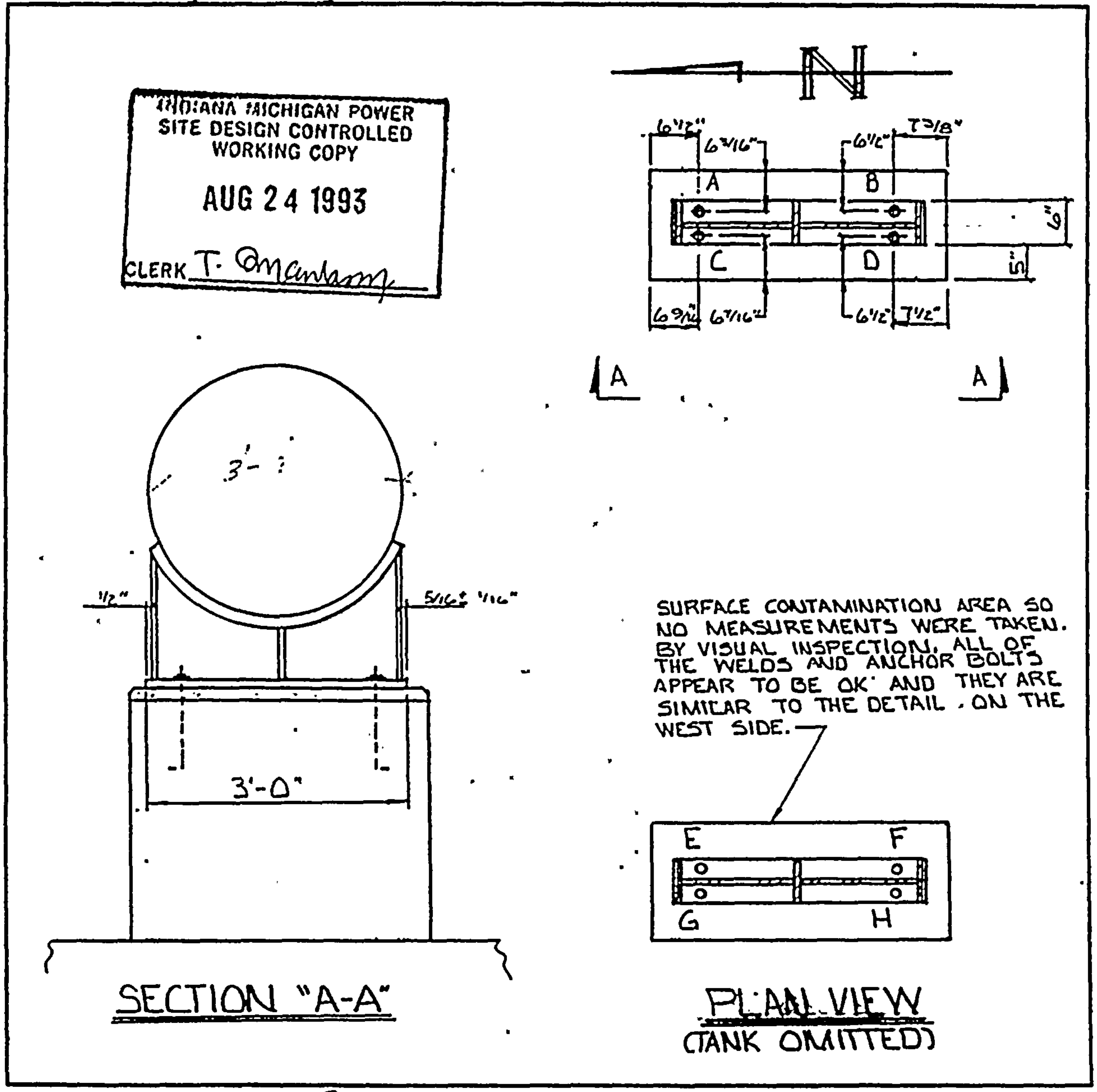
ANCHOR INSPECTION DATA SHEET

ONE — Unit #
AUX 609'-0" EL. — Bldg.
SPENT FUEL PIT HEAT EXCHANGER ROOM — Location

12-3297A-14 — Installation dwg. / Rev.
12-HE-16N — Equipment No.

Anchorage Arrangement Sketch

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
AUG 24 1993
CLERK T. Omantom



Drawn by: J. Rose — Date: 8-10-93

Verified by: R.W. [illegible] — Date: 8-16-93
Qual./Cert. Inspector

Reviewed by: T. Omantom — Date: 8-23-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HE-16N Dwg No.: 12-3297A-14

Anchor type: #2 J. BOLT Dia: 7/8" Dwg No.: 12-3073B-2

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date:

Tightness verified? ☐ Yes ☒ No T. Omanlasom Construction ARE Date: 8-10-93

Equipment base flexible? ☐ Yes ☒ No T. Omanlasom Construction ARE Date: 8-10-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D	E	F	G	H	Comments
Gaps	0	0	0	0	0	0	0	0	
Anchor length	1'-11"	1'-11"	1'-11"	1'-11"	1'-11"	1'-11"	1'-11"	1'-11"	FROM DWG 12-3073-B
Protruding length	4 1/8" ●	4" ●	4 1/8" ●	4 1/8" ●	▲	▲	▲	▲	
Embedment	1'-6 7/8"	1'-7"	1'-6 7/8"	1'-6 7/8"	▲	▲	▲	▲	
Bolt grip	2 1/4" ●	2" ●	2 1/4" ●	2 1/4" ●	▲	▲	▲	▲	
Concrete condition	OK	OK	OK	OK	OK	OK	OK	OK	
Edge distance	6 3/16"	6 1/2"	6 7/16"	6 1/2"	▲	▲	▲	▲	
Anchor spacing	3 7/8"	3 1/2"	3 7/8"	3 1/2"	▲	▲	▲	▲	
Anchor angularity	0	0	2°	2°	▲	▲	▲	▲	
Thread engagement	OK	OK	OK	OK	OK	OK	OK	OK	

Comments: ▲ SURFACE CONTAMINATION AREA SO NO MEASUREMENTS WERE TAKEN. BY VISUAL INSPECTION, ALL OF THE WELDS AND ANCHOR BOLTS APPEAR TO BE OK AND ARE SIMILAR TO THE DETAIL ON THE WEST SIDE.
● DIMENSION INCLUDES 1½" GROUT PER DRAWING 12-3298A-7.

Verified by: RWGraham Qual./Cert. Inspector Date: 8-16-93

Reviewed by: T. Omanlasom Construction ARE Date: 8-23-93

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SITE DESIGN CONTROLLED
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ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HE-16N　　　Dwg No.: ______

Embedded Steel Dwg. No.: NA

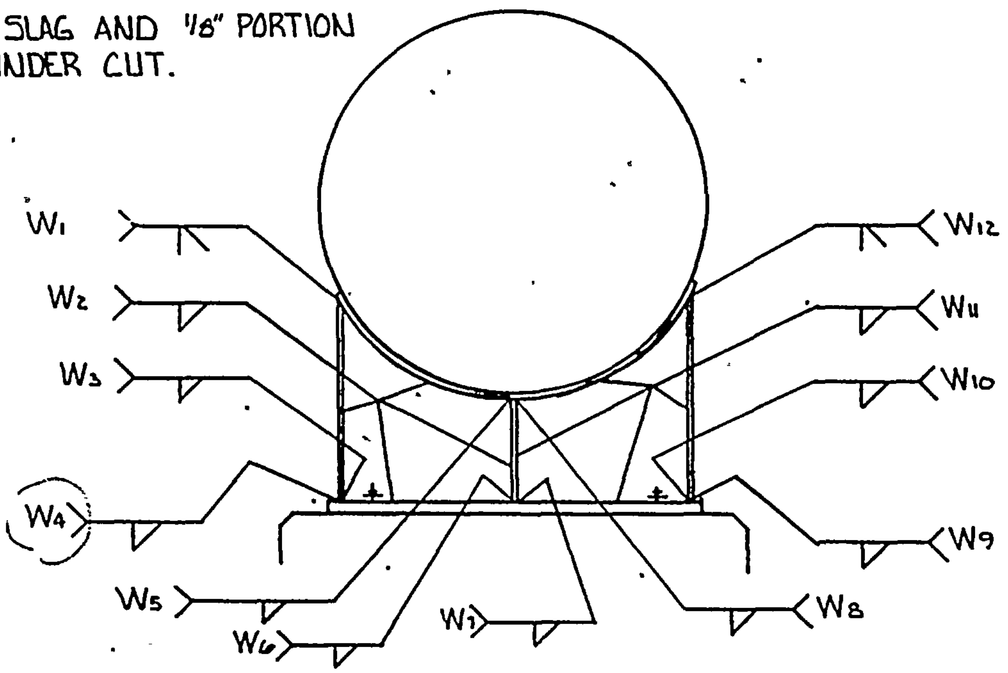
PHYSICAL CHARACTERISTICS

Weld ID	W1	W2	W3	W4	W5	W6	W7	W8
Type	3	1	1	1	1	1	1	1
Size	3/16	3/16	3/16	1/4"	1/8	3/16	3/16	3/16
Length	5 3/16"	44 1/2"	2 3/8"	5 1/8"	2"	2 3/8"	2 3/8"	2 1/4"
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

QUALITY CONTROL TECHNICIAN ONLY VERIFIED WELDS W3, W4, W9, & W10 PER CONSTRUCTION ANCHOR REVIEW ENGINEER'S REQUEST.

W4 HAS SLAG AND 1/8" PORTION IS UNDER CUT.



ELEV. LKG. WEST

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CLERK T. Omaraom

PAGE 1 OF 3

Equipment base flexible: ☐ Yes ☒ No　T. Omaraom　Date: 8-10-93
Construction Are

Reviewed by: T. Omaraom　Date: 8-23-93
Construction Anchor Review Engineer

Verified by: RWbalam　Date: 8-16-93
Qual./Cert. Inpsector

ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HE-16N Dwg No.:

Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W9	W10	W11	W12				
Type	1	1	1	3				
Size	3/16	3/16	3/16	3/16				
Length	5 3/4"	2 3/8"	4 4 1/2"	5 1/4				
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

W9 3/8" PORTION OF WELD IS UNDERCUT.

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CLERK T. Omanhaen

PAGE 2 OF 3

Equipment base flexible: ☐ Yes ☒ No T. Omanhaen Construction Are Date: 8-10-93

Reviewed by: T. Omanhaen Construction Anchor Review Engineer Date: 8-23-93

Verified by: [signature] Qual./Cert. Inpsector Date: 8-16-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 12-HE-16N

Dwg No.:

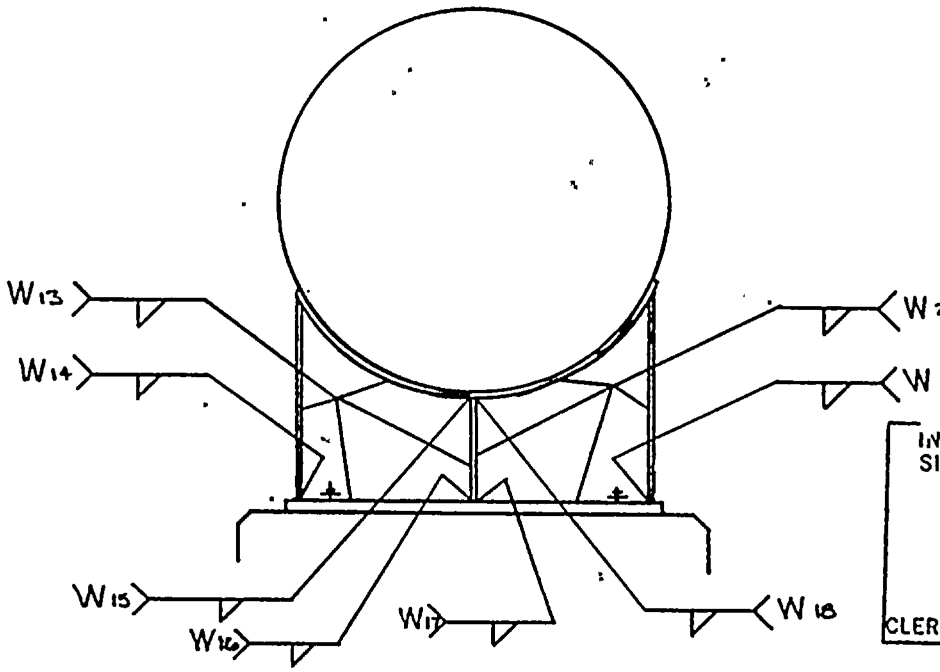
Embedded Steel Dwg. No.: NA

PHYSICAL CHARACTERISTICS

Weld ID	W13	W14	W15	W16	W17	W18	W19	W20
Type	1	1	1	1	1	1	1	1
Size	3/16	3/16	1/8	3/16	3/16	1/8	3/16	3/16
Length	44 1/2"	2 1/8"	2 1/2"	2 1/8"	2 1/8"	2 1/2"	2 1/8"	44 1/2"
Cracks	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Lack of Penetration	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Porosity	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No

Weld Type Codes
1 = Fillet
2 = Plug/Slot
3 = Groove

WELDS ON THIS PAGE WERE NOT VERIFIED BY Q.C. TECHNICIAN.



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SITE DESIGN CONTROLLED
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AUG 24 1993
CLERK T. Smanlaong

PAGE 3 OF 3

Equipment base flexible: ☐ Yes ☒ No — T. Smanlaong, Construction Are — Date: 8-10-93

Reviewed by: T. Smanlaong — Construction Anchor Review Engineer — Date: 8-23-93

Verified by: NA — Qual./Cert. Inpsector — Date:

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 2/24/93 REQUEST NO. N/A

IDENTIFICATION

Unit ONE / TWO
Component 12·HE·16N
Item ANCHORS
Material C/S
Other SQUG PROGRAM

TECHNIQUE

Test Unit/ S/N KB USK7 / CQC 405
Freq./Diameter 5MHZ / .250
Reference Standard QC 30°
Couplant/Batch No. ULTRAGEL II 9083

TEST DATA/REMARKS

ANCHOR	LENGTH
A	NOT OBTAINABLE (SURFACE CUT)
B	NOT OBTAINABLE (SURFACE CUT)
C	NOT OBTAINABLE (SURFACE CUT)
D	NOT OBTAINABLE (SURFACE CUT)

A BACK REFLECTION INDICATING ANCHOR LENGTH WAS NOT OBTAINED DURING THIS EXAM. THE ANCHOR SURFACE HAS BEEN CUT

PERFORMED BY: [signature] LEVEL: II DATE: 2/24/93
REVIEWED BY: [signature] LEVEL: II DATE: 2/24/93

FORM NO. 12 SHP 5050 NDE.008-1

NLMH

Equip ID: 1-QT-107-AB Train: 1 Equip Class:21

Drawing No.: 1-5151A

Function: EMERG DIESEL

System: DIESEL FUEL OIL

Equip Desc: AB EMERG DIESEL FUEL OIL DAY TANK

Building: AUXILIARY Room: AB EMERG DIESEL GENERATOR ROOM

Elev: 587 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: AB FUEL OIL DAY TANK

MFR:

Model: 36" D x 108" L, 465 GAL.

Panel:

Elem. Drawing: N/A

Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Eval : N

Comp Type: TANK (CAPACITY- 2HRS FULL LOAD OPERATION)

Iso Drawing:

Location: IN THE SW REGION OF THE ROOM INSIDE THE AB EMERGENCY DIESEL FUEL OIL DAY TANK ENCLOSURE, AT 599 EL.

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 2
ID : 1-QT-107-AB (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : AB EMERG DIESEL FUEL OIL DAY TANK		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : AB EDG RM,
Manufacturer, Model, Etc. : 36 D x 108 L, 465 GAL.		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: George G. Thomas (S&A) and Tom Huang (AEP), 10/7/93.

Same as 1-QT-107-CD, except that the grout is in much better condition for 1-QT-107-AB.

Evaluated by: Date:

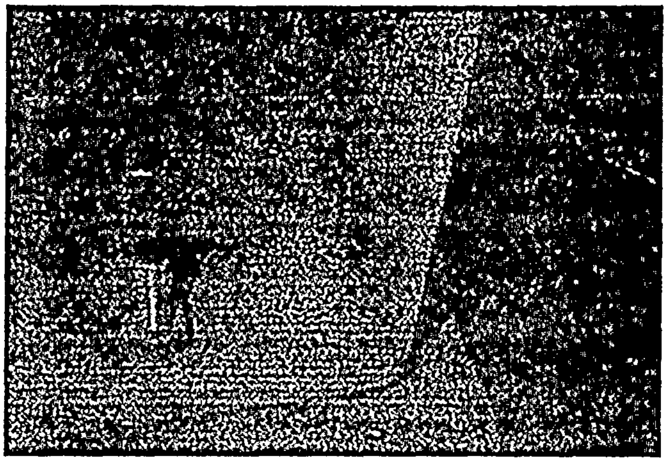
George G. Thomas 11/19/95

T. Chen Huang 11-27-95

Attachment: Pictures

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)			GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 2
ID : 1-QT-107-AB (Rev. 0)		Class : 21 - Tanks and Heat Exchangers	
Description : AB EMERG DIESEL FUEL OIL DAY TANK			
Building : AUXILIARY	Floor El. : 587.00		Room, Row/Col : AB EDG RM,
Manufacturer, Model, Etc. : 36 D x 108 L, 465 GAL.			

PICTURES



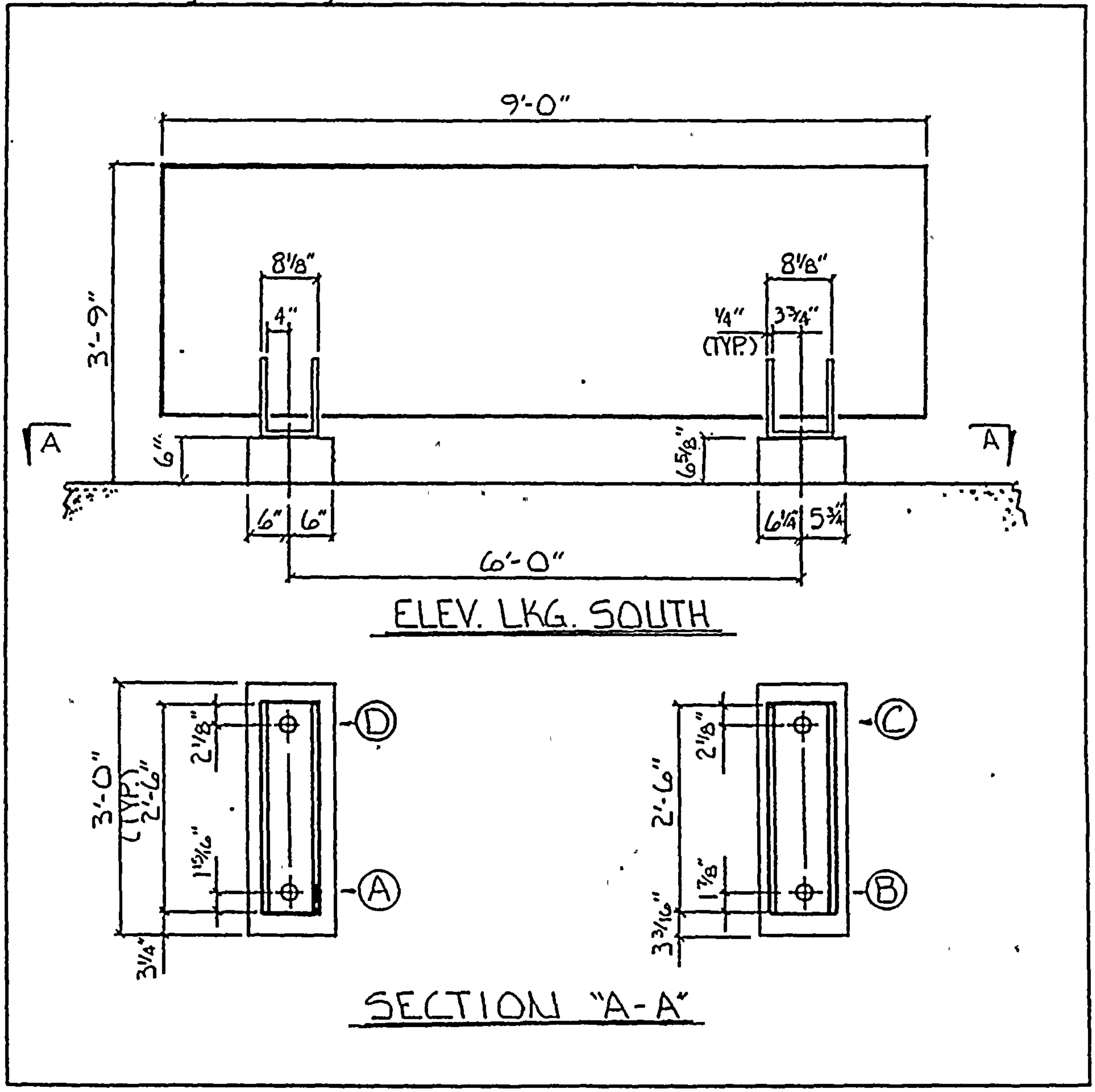
AB Emerg. Diesel Fuel Oil Day Tank 1-QT-107-AB

ANCHOR INSPECTION DATA SHEET

ONE	AUX 599'-0"	SOUTHWEST SIDE OF AB D.G RM UP INSIDE AB EMERGENCY DIESEL FUEL OIL DAY TANK FL
Unit #	Bldg.	Location

12-3890-2	1-QT-107-AB
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



Drawn by:	J. ROSE	Date:	1-27-93
Verified by:	[signature] Qual./Cert. Inspector	Date:	2-19-93
Reviewed by:	T. Omadaony Construction Anchor Review Engineer	Date:	2-26-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-QT-107-AB Dwg No.: 12-3890

Anchor type: STUD Dia: 5/8"Φ Dwg No.: ______

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date: NA

Tightness verified? ☐ Yes ☐ No NA Date: ______
Construction ARE

Equipment base flexible? ☐ Yes ☒ No T. Omardeary Date: 2-17-93
Construction ARE

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	SEE COMMENTS	0	SEE COMMENTS	SEE COMMENTS					
Anchor length	11 3/4"	11 3/4"	11 3/4"	11 3/4"					SEE DWG. 12-3073C & 12-3073A
Protruding length	3 1/4"	2 15/16"	3 3/16"	2 3/4"					
Embedment	8 1/2"	8 13/16"	8 3/4"	9 3/16"					
Bolt grip	9/16"	3/8"	9/16"	1/2"					
Concrete condition	GOOD	GOOD	GOOD	GOOD					
Edge distance	N/A	N/A	N/A	N/A					
Anchor spacing	2'-1 15/16"	2'-2"	2'-2"	2'-1 15/16"					
Anchor angularity	0°	0°	0°	0°					
Thread engagement	OK	OK	OK	OK					

Comments: BOLT "A" 1/16" GAP BETWEEN WASHER & COMPONENT. 1/16" GAP BETWEEN NUT & WASHER
1/8" GAP BETWEEN BRACKET & PAD.
BOLT "C" 1/8" GAP BETWEEN COMPONENT AND CONCRETE. FLAME CUT HOLE EXTENDS OUT PAST WASHER.
BOLT "D" OVERSIZED BOLT HOLE IN COMPONENT BASE STICKS OUT 1/8" PAST WASHER. NUT IS BOTTOMED OUT ON BOLT SHANK. 1/16" GAP BETWEEN NUT AND WASHER.

Verified by: Brian [signature] Date: 2-19-93
Qual./Cert. Inspector

Reviewed by: T. Omardeary Date: 2-26-93
Construction ARE

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

.. SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 1/29/93 REQUEST NO. N/A

IDENTIFICATION

Unit ONE
Component 1-QT-107-AB
Item ANCHORS
Material C.S.
Other SQUG PROGRAM

TECHNIQUE

Test Unit/ S/N KB USK7 / QC-405
Freq./Diameter 5 MHZ / .250
Reference Standard QC-30
Couplant/Batch No. ULTRAGEL II 9088

TEST DATA/REMARKS

ANCHOR	LENGTH
A	11.75"
B	11.75"
C	11.75"
D	11.75"

PERFORMED BY: Stephen R. Vargo LEVEL: II DATE: 1/29/93
REVIEWED BY: [signature] LEVEL: II DATE: 2/1/93

IN	2
SS	21
D	2-QT-115-CD
SYSTEM	DIESEL LUBE OIL
DESCRIPT	CD EMERGENCY DIESEL LUBE OIL SUMP TANK
DRAWINGNO	2-5151C
BUILDING	AUXILIARY
NORMSTATE	
DESIRSTATE	
POWERREQD	N
ALIASNO	
POWERTRAIN	NA
COMPSERVED	CD LUBE OIL SUMP TANK
MANUFACTUR	
MODEL	775GALS
PANEL	
ELEMDWG	NOT APPL
WIRINGDWG	NOT APPL
PWRSOURCE	NOT APPL
QUALIF	NUCLEAR SR
WALKDOWN	F
PFDOPT	MIN
SUPPSYSDWG	
REQSUPP	
EVAL_TYPE	Seismic Only
NOTES	
FUNCTION.	EDG
E VATION	579.00
ATION	CD EMER DSL LUBE OIL PIT
AY	N
P_TYPE	TANK
ISO_DWGS	
DETAIL_LOC	IN THE WEST PART OF THE PIT, NEAR THE WEST WALL, 3 FEET ABOVE THE FLOOR
FLOW_PATH	S
REV	0
REV_LOCK	N
LOCK_DATE	/ /
SHOW_INDEX	Y
TAG	N
SIGNATURES	
REV_NOTES	

Donald C. Cook Nuclear Plant, Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 7
ID : 2-QT-115-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL LUBE OIL SUMP TANK		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : CD EMER DSL LUBE OIL PIT - IN THE WEST PART OF THE PIT, NEAR THE WEST WALL, 3 FEET ABOVE THE FLOOR
Manufacturer, Model, Etc. : 775GALS		

BASIS : Horizontal TANK analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	N/A
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: W. Djordjevic and TR Satyan Sharma. 10/6/93.

REF: 1. Anchor Inspection Data Sheets: Anchorage Arrangement Sketches and Physical Characteristics Data Sheet, Certified 10/1/93.
2. Worthington Dwg # 700003BY.
3. Worthington Co.Lube Oil Sump Tank Calculation, 8/22/74.

Anchorage:
The tank sits on 3 saddles, 2 plates per saddle, 1/4" thick. There are two 3/4" anchors per saddle. There are 4 anchors in total for the tank because the middle saddle has no anchorage on it.

Horizontal Tank Analysis:
Saddle Weak Axis Moment of Inertia = 2I + 2(ad^2) = 2((36"x0.25in^3)/12) + 2(18in^2 x (5^2)in^2") = 900in^4.

Saddle stresses analyzed in Ref. 3.

Nozzle loads judged not significant by SRT.

Evaluated by: Date: 9/20/95

N Satyan Sharma 9/30/95

<table>
<tr><td colspan="2">Donald C. Cook Nuclear Plant, Unit 2
SCREENING EVALUATION WORK SHEET (SEWS)</td><td>GIP Rev 2, Corrected, 2/14/92
Status: Yes
Sheet 2 of 7</td></tr>
<tr><td colspan="2">ID : 2-QT-115-CD (Rev. 0)</td><td>Class : 21 - Tanks and Heat Exchangers</td></tr>
<tr><td colspan="3">Description : CD EMERGENCY DIESEL LUBE OIL SUMP TANK</td></tr>
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<tr><td colspan="3">Manufacturer, Model, Etc. : 775GALS</td></tr>
</table>

Attachment: Pictures
Attachment: TANK Analysis Results

Donald C. Cook Nuclear Plant, Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 7
ID : 2-QT-115-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
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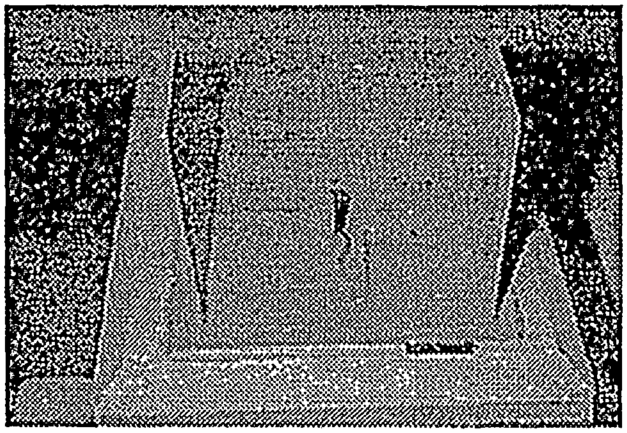
Manufacturer, Model, Etc. : 775GALS		

PICTURES



2-QT-115-CD

Donald C. Cook Nuclear Plant, Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 7
ID : 2-QT-115-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL LUBE OIL SUMP TANK		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : CD EMER DSL LUBE OIL PIT - IN THE WEST PART OF THE PIT, NEAR THE WEST WALL, 3 FEET ABOVE THE FLOOR
Manufacturer, Model, Etc. : 775GALS		

TANK Analysis Results

Step 1 – Input Data

a) Assumptions

1. Tank is cylindrical, horizontally oriented and supported on saddles.	Yes
2. Tank and saddles are made of carbon steel.	Yes
3. Saddles are uniformly spaced.	Yes
4. Saddles overhang is less than spacing / 2.	Yes
5. Base plates have slotted anchor bolt holes for thermal growth except for the base plate under the fixed saddle.	Yes
6. Imposed nozzle loads are not significant.	Yes
7. The tank foundation is adequate.	Yes
8. Anchor bolts are cast in place or expansion type.	Yes

b) Materials

Weight of Tank + Fluid	6.83 kips
Weight Density of Tank + Fluid	60 lbs/ft^3
Saddle Elastic Modulus	29000.0 ksi
Saddle Shear Modulus	1150.0 ksi
Base Plate Yield Strength	36.0 ksi
Anchor Type	3/4 in 90 deg. J-Bolts

c) Dimensions

Tank Diameter, D	3.8 ft
Tank Length, L	10.0 ft
Tank Thickness, t	0.19 in
Height of Tank + Fluid C.G., Hcg	2.08 ft
Number of Saddles	2
Saddle Spacing, S	7.67 ft
Saddle Height, h	2.0 in
Saddle Shear cross-sectional area	18.0 in^2
Saddle Weak Axis Moment of Interia	900.0 in^4
Number of Bolt Locations / Saddle	2
Number of Bolts / Bolting Location	1
Extreme Bolt Spacing, D'	2.67 ft
Anchor Bolt Eccentricity, e	0.02 in
Weld Thickness	0.19 in
Base Plate Thickness	0.25 in

Donald C. Cook Nuclear Plant, Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)	GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 7

ID : 2-QT-115-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers
Description : CD EMERGENCY DIESEL LUBE OIL SUMP TANK	

Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : CD EMER DSL LUBE OIL PI'. - IN THE WEST PART OF THE PIT, NEAR THE WEST WALL, 3 FEET ABOVE THE FLOOR
Manufacturer, Model, Etc. : 775GALS		

d) Anchor Bolts

Type = 90 Deg J-Bolt	Diameter = 3/4 in
Manufacturer =	Product Name =

	Pullout	Shear
Nominal Capacity	15.03 kips	7.51 kips

Concrete Compression Strength, fc' = 4000.0 psi

Reduction Parameters

Label	Check	Condition	Capacity Reduction Factor Pullout	Capacity Reduction Factor Shear
1. Type of Anchorage	Yes		1.0	1.0
2. Installation Adequacy	Yes	Installation is adequate	1.0	1.0
3. Embedment Length	Yes	Embedment Length = 27.0 in	0.7	1.0
4. Gap at Threaded Anchors	Yes	Gap size = 0.0 in	1.0	1.0
5. Spacing between Anchorages	Yes		1.0	1.0
6. Edge Distance	Yes	Edge Distance = 6.0 in Another Edge Distance = 4 in	0.41	0.31
7. Concrete Strength and Condition	Yes		1.0	1.0
8. Concrete Crack Location and Size	Yes	Crack Size = 0.0 in	1.0	1.0
9. Essential Relays in Cabinets	Yes	Essential relays are not present	1.0	1.0
10. Base Stiffness and Prying Action	Yes		1.0	1.0
11. Equipment Base Strength and Structural Load Path	Yes	Base strength and load path are O.K.	1.0	1.0
12. Embedment Steel and Pads	Yes	Installation is O.K.	1.0	1.0

Does the tank satisfy all the assumptions and is within the applicable range of parameters? Yes

Step 2 – The allowable bolt loads

Allowable Tension Load, Pu'	4.344 kips
Allowable Shear Load, Vu'	2.346 kips

Step 3 – Determine base plate bending strength reduction factor

RB	0.1726

Donald C. Cook Nuclear Plant, Unit 2 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 7
ID : 2-QT-115-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERGENCY DIESEL LUBE OIL SUMP TANK		
Building : AUXILIARY	Floor El. : 579.00	Room, Row/Col : CD EMER DSL LUBE OIL PIT - IN THE WEST PART OF THE PIT, NEAR THE WEST WALL, 3 FEET ABOVE THE FLOOR
Manufacturer, Model, Etc. : 775GALS		

Step 4 – Determine base plate weld strength reduction factor

RW	0.0379

Step 5 – Determine the anchorage tension and shear allowable loads

Allowable Anchorage Tension Load, Pu	0.164 kips
Allowable Anchorage Shear Load, Vu	2.346 kips

Step 6 – Calculate the ratios and values

alpha (Pu/Vu)	0.07
Wb	1.71 kips/bolt
Vu / Wb	1.37
Hcg / D'	0.779
Hcg / S	0.271
F1	2.236
F2	1.779

Step 7 – Determine the acceleration capacity of the tank anchorage

lambda_1	0.614 G
lambda_u	0.568 G
Anchor Acceleration capacity, lambda	0.568 G

Step 8 – Determine the maximum saddle spacing for transverse and vertical rigid frequency response

Maximum Saddle Spacing, Sc	14.2 ft

Step 9 – Compute the resonant frequency of the tank in the longitudinal direction

<table>
<tr><td colspan="2">Donald C. Cook Nuclear Plant, Unit 2
SCREENING EVALUATION WORK SHEET (SEWS)</td><td>GIP Rev 2, Corrected, 2/14/92
Status: Yes
Sheet 7 of 7</td></tr>
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<tr><td colspan="3">Manufacturer, Model, Etc. : 775GALS</td></tr>
</table>

Saddle Stiffness, Ks	10339.067 kips/in
Resonant Frequency of Tank in Longitudinal Direction	121.66 Hz

Step 10 – Determine the seismic demand acceleration

ZPA	0.25 G

Tank is rigid in all three directions.
Tank anchorage is adequate because anchorage acceleration capacity is greater than ZPA

Step 11 – Check the saddle stresses

The program does not check the saddle stresses
Check the saddle stresses by an independent calculation

<u>Summary</u>

<u>IS EQUIPMENT SEISMICALLY ADEQUATE?</u>

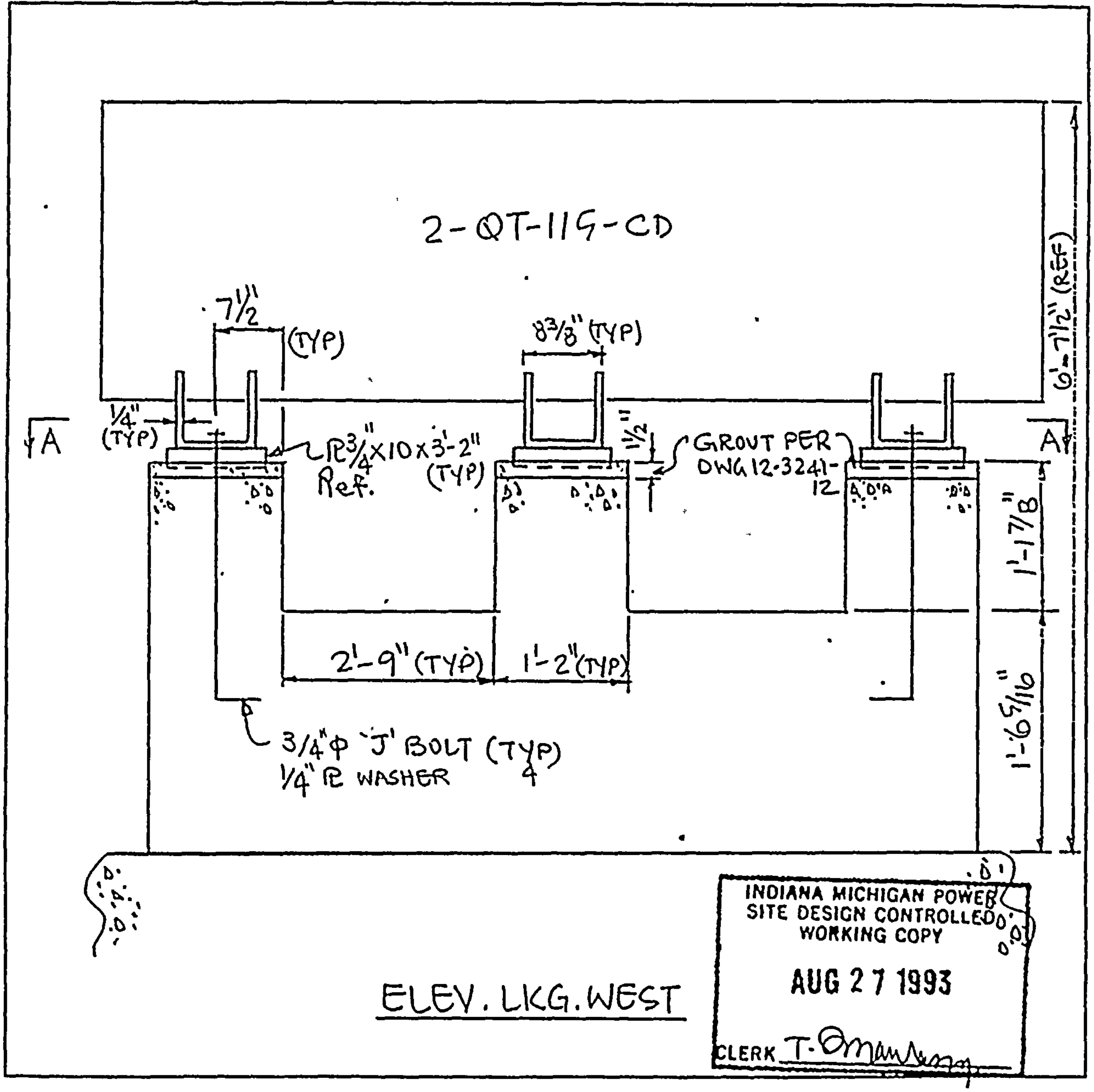
The tank anchorage is adequate.

ANCHOR INSPECTION DATA SHEET

2	AUX./D.G.CD	PIT
Unit #	Bldg.	Location

12-3241 / 12	2-QT-115-CD
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
AUG 27 1993
CLERK T. Omanson

Drawn by: T. Omanson Date: 8-10-93

Verified by: [signature] Date: 8-16-93
Qual./Cert. Inspector

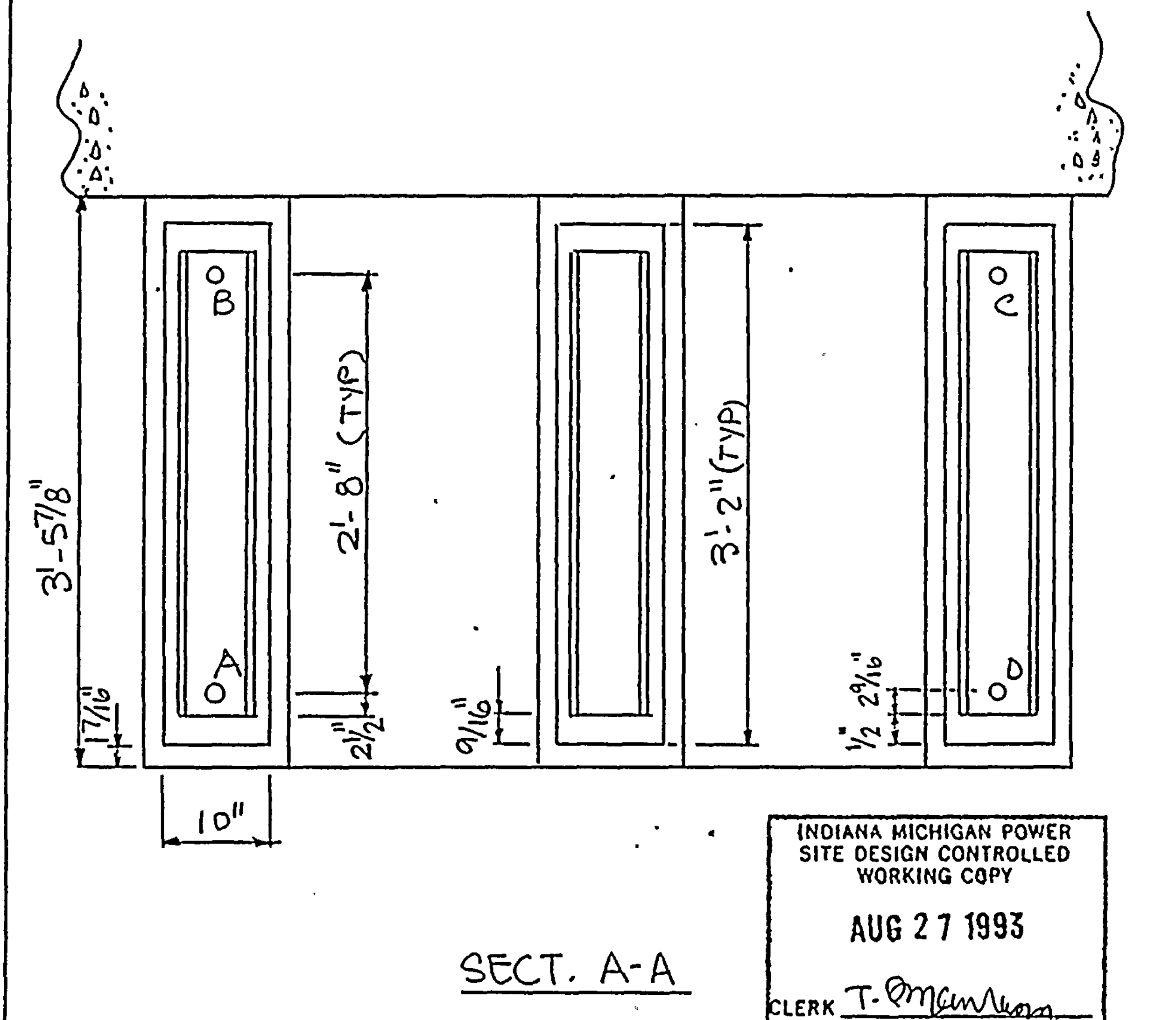
Reviewed by: T. Omanson Date: 8-27-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

2	AUX / D.G CD	PIT
Unit #	Bldg.	Location

12-3241 / 12	2-QT-115-CD
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



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Verified by: [signature] Date: 8-16-93
Qual./Cert. Inspector

Reviewed by: T. Omanson Date: 8-27-93
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 2-QT-115-CD Dwg No.: 12-3241

Anchor type: 'J' BOLT Dia: 3/4" Dwg No.: 12-3073B

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA Cal. Due Date:

Tightness verified? ☐ Yes ☐ No NA T. Omanson Construction ARE Date: 8-10-93

Equipment base flexible? ☐ Yes ☑ No T. Omanson Construction ARE Date: 8-10-93

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	—	*	*	—					
Anchor length	2'-8"	2'-8"	2'-8"	2'-8"					12-3073B
Protruding length	3 1/4"+1 1/2"	*	*	3 7/16"+1 1/2"					SEE NOTES
Embedment	2'-3 1/4"	*	*	2'-3 1/16"					
Bolt grip	11/16"+1 1/2"	*	*	7/8"+1 1/2"					SEE NOTES
Concrete condition	GOOD	CRACK IN GROUT	CRACK IN GROUT	GOOD					
Edge distance	4 7/16"	4 1/2"	6 1/2"	4 1/4"					
	6 1/2"	6 1/2"	4 1/2"	6 1/2"					
Anchor spacing	2'-8"	2'-8"	2'-8"	2'-8"					
Anchor angularity	0°	0°	0°	0°					
Thread engagement	OK	OK	OK	OK					

Comments: CANNOT MEAUSRE GROUT THICKNESS. PER DWG 12-3241 GROUT THICKNESS IS 1 1/2" BOLT GRIP & PROTRUDING LENGTH WERE OBTAINED BY ADDING 1 1/2" TO THE DIMENSI[ONS] MEASURED FROM TOP OF GROUT. * INACCESSIBLE / OVERSIZE HOLES @ A & D. @ A & D HOLE EXTENDS 3/32" & 3/16" PAST THE ℄ WASHER RESPECTIVELY.

Verified by: [signature] Qual./Cert. Inspector Date: 8-16-93

Reviewed by: T. Omanson Construction ARE Date: 8-27-93

INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
AUG 27 1993
CLERK T. Omanson

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A   REPORT DATE: 6/17/93   REQUEST NO. N/A

IDENTIFICATION

Unit Two
Component 2-QT-115-CD
Item Anchors
Material C/S
Other Sgug

TECHNIQUE

Test Unit/ S/N KB USK-7S CQC-405
Freq./Diameter 5 mhz / .250
Reference Standard QC .30
Couplant/Batch No. Ultragel II #9088

TEST DATA/REMARKS

Anchors A,B,C,D
A Back Reflection indicating anchor Bolt Length was not obtained During This Exam. This would Be Indicative of a J-Bolt Type anchor.

PERFORMED BY: [signature]   LEVEL: II   DATE: 6-17-93
REVIEWED BY: Stephen R. Vargo   LEVEL: II   DATE: 6/17/93

FORM NO. 12 SHP 5050 NDE.008-1

SAFE SHUTDOWN EQUIPMENT LIST (SSELWP)

FUNCTION: CCW

Equipment Class: 21 Train: 2

Equipment ID: 1-HE-15E Drawing Number: 1-5135A 1-5113

System: CCW

Equip Description: EAST CCW HEAT EXCHANGER

Building: AUXILIARY Room: 609 HALLWAY Elevation: 609

Normal state: Desired state: Power Required: N Sort: W,_ Notes:

Supporting System Drawing Number:

Required Interconnections and Supporting Components:

fety Related Status: NUCLEAR SR Min/Opt: MIN

ADDITIONAL INFORMATION

Alias Number: Power Train: NA

Component Served: EAST CCW HEAT EXCHANGER

Manufacturer: HLW INDUSTRIES Model:

Panel:

Elem Drawing: N/A Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Only: N

Component Type: HE
ISO Drawings:

Detailed Location:

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 6
ID : 1-HE-15E (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EAST CCW HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : MLW INDUSTRIES (HORIZONTAL)		

BASIS : External analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: Gary Thomas, Tom Huang, and Kailash Mahajan on 11/2/93.

Component Cooling Water Heat Exchanger on two reinforced saddles. Anchorage is two 7/8" diameter J bolts. There are 4 1" wedge expansion anchors in one pedestal in the horizontal direction.

C.G. of exchanger from the top of the saddle pedestal about 3'.

Pedestal concrete in good condition, but can see the grout to concrete interface.
Hand calculation was performed for the heat exchanger and the results show that the anchor bolts are adequate and the saddles are safe.

Evaluated by: Date:

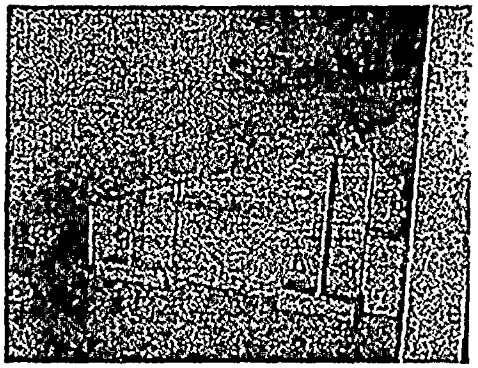
9/18/95

10-19-95

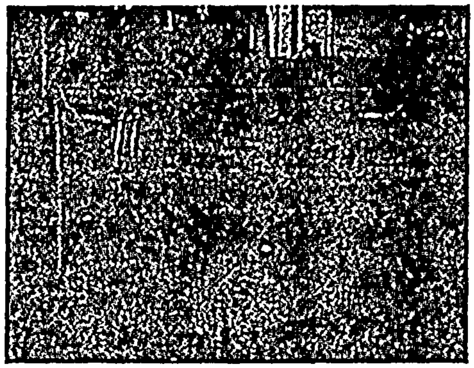
Attachment: Pictures
Attachment: ANCHORAGE ANALYSIS FOR THE TANK

DC COOK Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 6
ID : 1-HE-15E (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : EAST CCW HEAT EXCHANGER		
Building : AUXILIARY	Floor El. : 609.00	Room, Row/Col : HALLWAY,
Manufacturer, Model, Etc. : MLW INDUSTRIES (HORIZONTAL)		

PICTURES



ONE SADDLE WITH 4 HORIZONTAL BOLTS



OTHER SADDLE SUPPORT

Stevenson and Associates
A Structural-Mechanical Consulting Engineering Firm

CLIENT ______ JOB No. ______ SHEET 1 OF 2

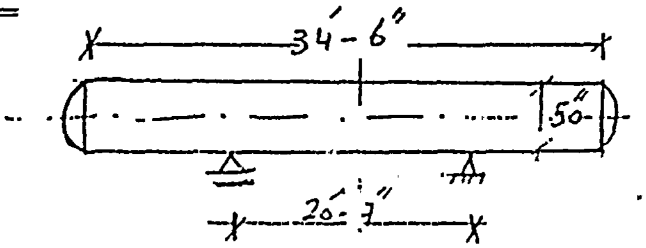
SUBJECT ______

REVISIONS: S. Mahmoud

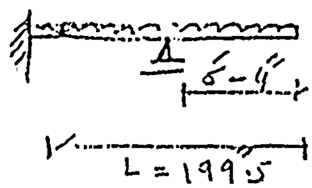
(1-HE-15E)

• Horizontal Heat Exchanger:

$\frac{L}{D} = \frac{414''}{50} = 8.3$



It can be considered as a beam on two supports



Total weight (W) = 47,000 lbs

from "formulas for natural frequency and mode shape, Blevins" Fig. 8-5(d) page (138) we find:

$\lambda_1 = 3.8$

$\therefore f_i = \frac{\lambda_i^2}{2\pi L^2}\left(\frac{EI}{m}\right)^{1/2}$

$f_1 = \frac{(3.8)^2}{2\pi(199.5)^2}\left(\frac{30\times10^6 \times 49,037}{0.30}\right)^{1/2}$

$\boxed{f_1 = 125\ HZ}$

$I = \frac{\pi}{8}D^3 t = \frac{\pi}{8}(50)^3 \times 1$

$I = 49,037\ in^4$

$m = \frac{M}{L} = \frac{47,000}{414 \times 386.4}$

$m = 0.3\ \frac{lb\cdot sec^2}{in/in}$

So, The tank is Rigid.

* from the floor Response spectra for Auxiliary Building at elevation (633) we find $S_a = 0.22g$.

FOR MEDIAN-CENTERED ⇒ $S_a' = 1.25 S_a = 1.25(.22g) = .275g$

Stevenson and Associates

A Structural-Mechanical Consulting Engineering Firm

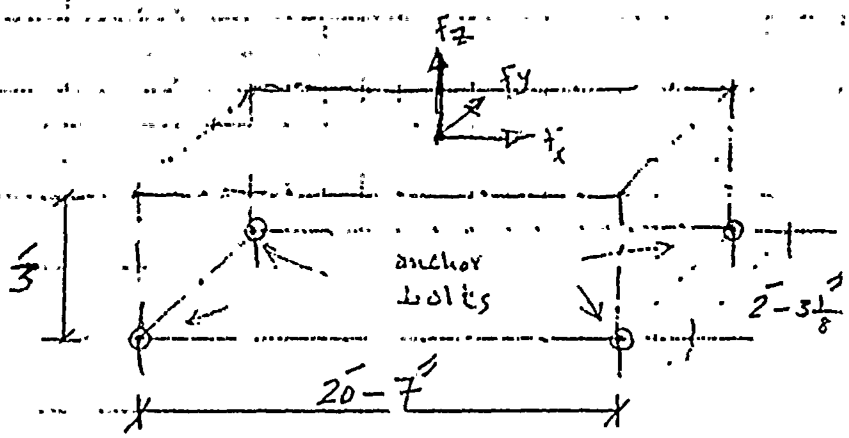
CLIENT [illegible] JOB No. [illegible] SHEET 9 OF 4

SUBJECT D. [illegible]

(1-HE-15E)

REVISIONS: B. Mahmoud

* check The safety of the anchor bolt:



Total weight = 47,000 lb

Total Mass $= \dfrac{47{,}000}{386.4} = 122$ lb/in/sec²

• Normal force/Anchor (f_N)

$$f_N = \left[\left(\frac{M \times a \times 3'}{20.58 \,(2)_{\text{Bolts}}}\right)^2 + \left(\frac{M \times S_a \times 3'}{2.26\,(2)_{\text{Bolts}}}\right)^2 + \left(\frac{2\, S_a \cdot M}{3\,(4 \text{ bolts})}\right)^2\right]^{1/2} - \underbrace{\frac{47{,}000}{4}}_{\text{Dead wt}}$$

$$= \left[\left(\frac{.275(47{,}000) \times 3}{20.58\,(2)}\right)^2 + \left(\frac{.275 \times (47{,}000) \times 3}{2.26\,(2)}\right)^2 + \left(\frac{2\,(.275)\,47{,}000}{3\,(4)}\right)^2\right]^{1/2}$$

$$\underbrace{-11{,}700}_{\text{Dead wt}} = 8895 - 11{,}700 \quad \therefore \; 0$$ TENSION IN BOLT

Shear force/Anchor (f_V)

$$f_S = \left(\frac{122 \times 0.275 \times 386.4}{4}\right)\sqrt{2} = 4583 \text{ lb}$$

Stevenson and Associates

A Structural Mechanical Consulting Engineering Firm

CLIENT ____ JOB No. ____ SHEET 3 OF 4

SUBJECT ____

(1-HE-15E)

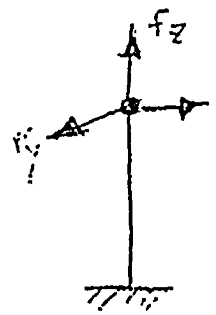
REVISIONS

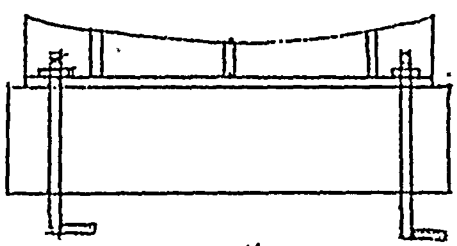
Allowable load for 7/8" anchor bolts is:

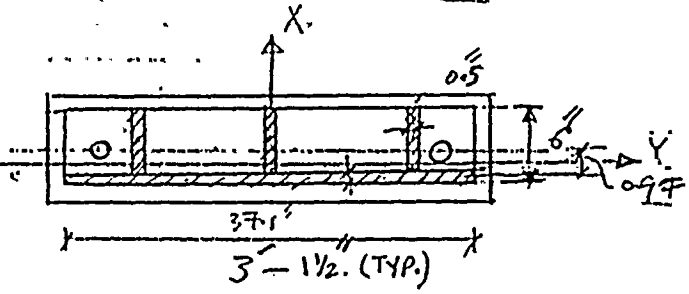
Shear : 10,220 Lbs

$$F.S \text{ (in shear)} = \frac{10{,}220}{4583} = 2.23$$

* check the saddle stress:







$$\bar{Y} = \frac{3 \times 6 \times 0.5 \times 3}{0.50 \times 37.5 + 9} = 0.97 \qquad A = \boxed{28} \text{ in}^2$$

$$I_Y \simeq 3 \times \frac{0.5 \times 6^3}{3} = 108 \text{ in}^4$$

$$I_X = \frac{0.5 \times 37.5^3}{12} + 2 \times 3 (15)^2 = 2{,}197$$

$S_a' = 0.275g$

$W/\text{saddle} = \frac{47{,}000}{2} = 23{,}500 \text{ lbs}$

$N = \left(0.275\left(\frac{2}{3}\right)+1\right) 23{,}500 = 27{,}808 \text{ lbs}$

$M_x = 0.275 \times 23{,}500 \cdot (36'') = 232.65 \text{ kip.in}$

$M_y = M_x$

$$f_N = \frac{N}{A} + \frac{M_y}{I_y}x + \frac{M_x}{I_x}y$$

$$= \frac{27.808}{28} + \sqrt{\left(\frac{232.65(3)}{108}\right)^2 + \left(\frac{232.65(17.5)}{2197}\right)^2}$$ SRSS

$$= 0.99 + \sqrt{(6.46)^2 + (1.85)^2}$$

$f_N = 7.72^k < .9(36) \text{ ksi} \rightarrow \text{o.k}$

$F.S. = \frac{32.4}{7.72} = 4.2$

$f_v = \frac{Q_x(\sqrt{2})}{A} = \left(\frac{0.275 \times 23{,}500}{28}\right)\sqrt{2} = 0.326 \text{ ksi}$

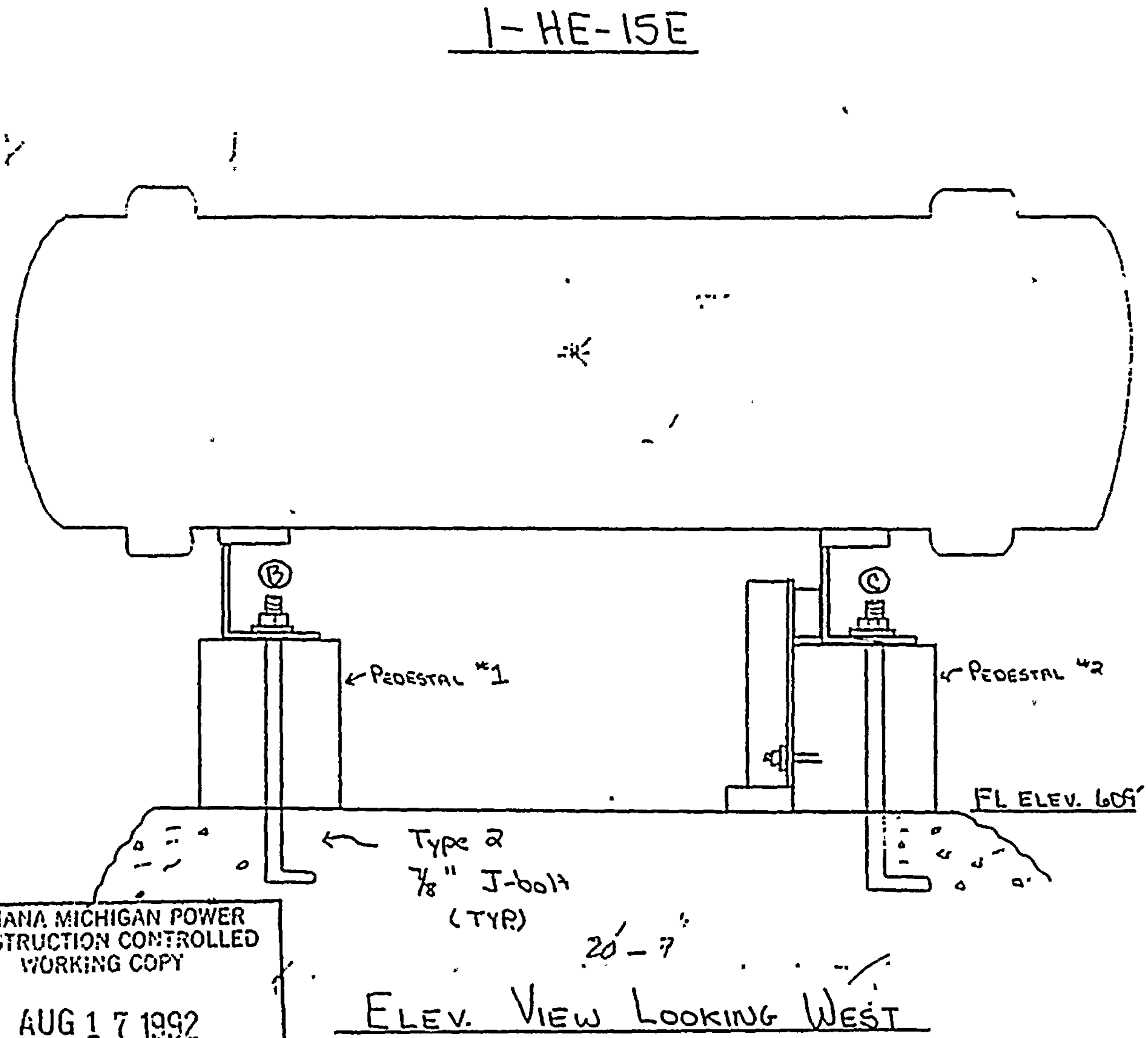
very safe.

ANCHOR INSPECTION DATA SHEET

1	Aux.	609 Hallway
Unit #	Bldg.	Location

12-3281 / 21	1-HE-15E
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
AUG 17 1992
CLERK D Wisniewski

Drawn by:	James Wisniewski	Date:	10-7-91
Verified by:	Tom Rich Qual./Cert. Inspector	Date:	2-21-92
Reviewed by:	James Wisniewski Construction Anchor Review Engineer	Date:	5/27/92

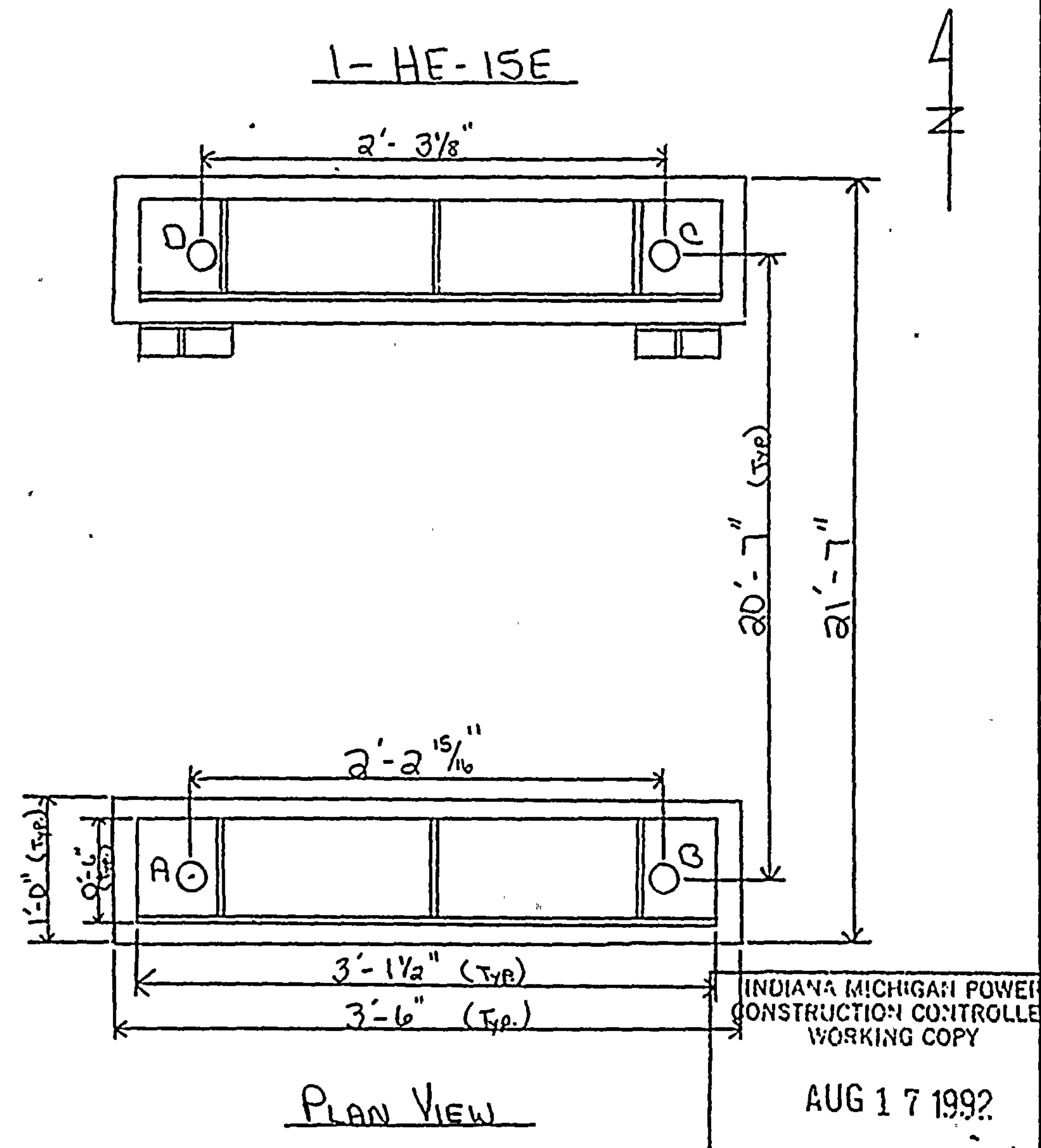
ANCHOR INSPECTION DATA SHEET

1	Aux.	609 Hallway
Unit #	Bldg.	Location

12-3281 / 21 — Installation dwg. / Rev.

1-HE-15E — Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
AUG 17 1992
CLERK D/ Wisniewski

Drawn by: James Wisniewski Date: 10-7-91

Verified by: [signature] Date: 2-21-92
Qual./Cert. Inspector

Reviewed by: James Wisniewski Date: 5/27/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	Aux.	609 Hallway
Unit #	Bldg.	Location

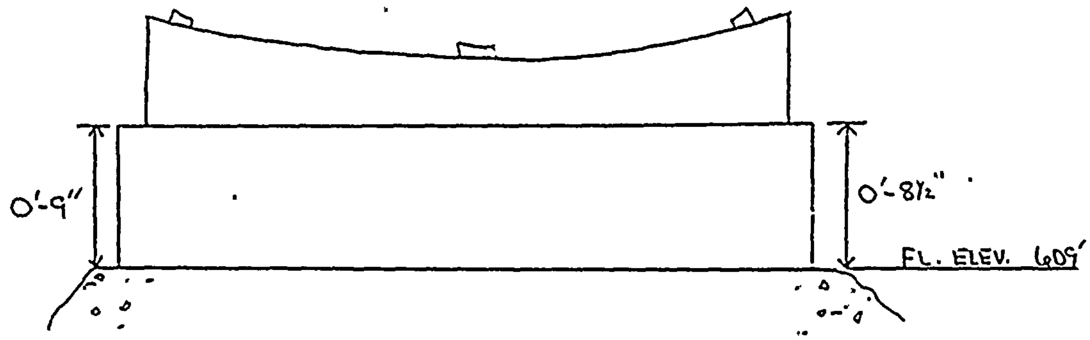
12-3281 / 21 — Installation dwg. / Rev.

1-HE-15E — Equipment No.

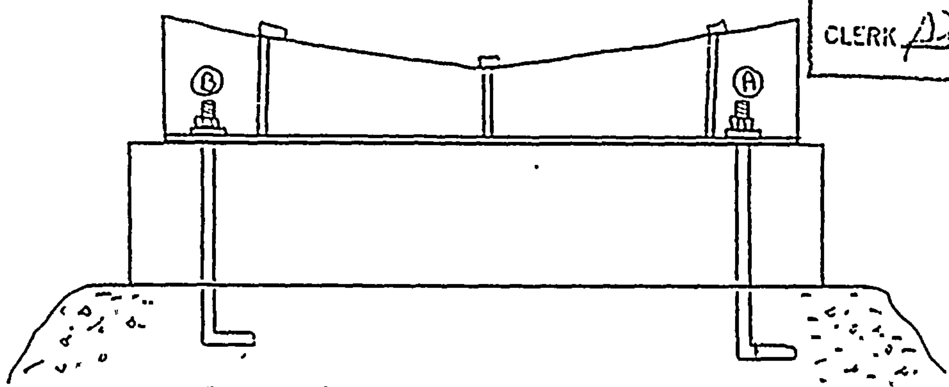
Anchorage Arrangement Sketch

1-HE-15E

PEDESTAL #1



ELEV. VIEW LOOKING NORTH



ELEV. VIEW LOOKING SOUTH

INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
AUG 1 7 1992
CLERK D.Y. Wisniewski

Drawn by: James Wisniewski Date: 10-7-91

Verified by: Jon Kirk Date: 2-21-92
Qual./Cert. Inspector

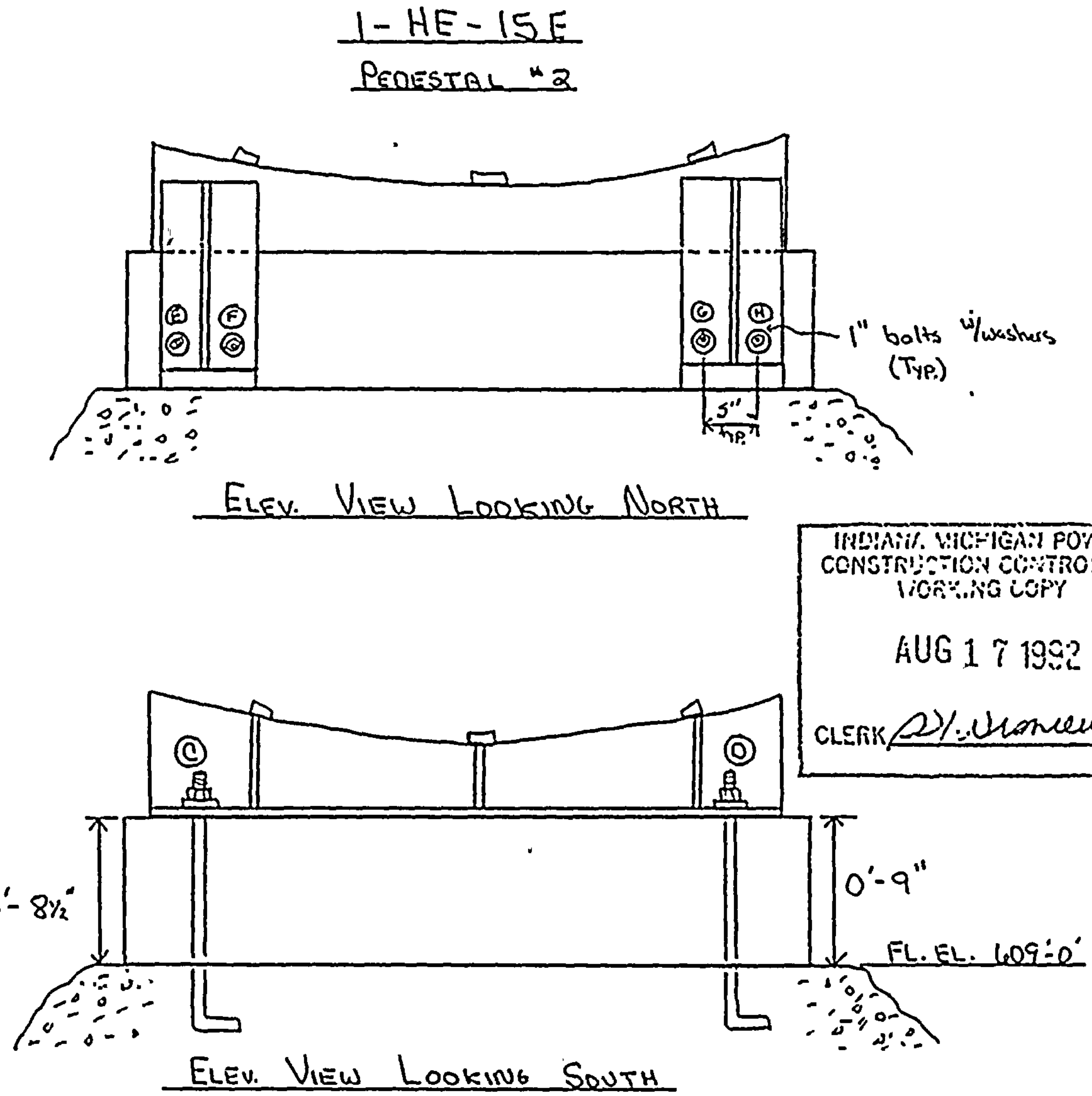
Reviewed by: James Wisniewski Date: 5/27/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

1	Aux.	609 Hallway
Unit #	Bldg.	Location

12-3281	21	1-HE-15E
Installation dwg.	Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
AUG 17 1992
CLERK

Drawn by: [signature] Date: 10-7-91

Verified by: [signature] Date: 8-21-92
Qual./Cert. Inspector

Reviewed by: [signature] Date: 5/27/92
Construction Anchor Review Engineer

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-HE-15E Dwg No.: 12-3281-21
Anchor type: Type 2 J-bolt Dia: 7/8" Dwg No.: 12-3285-23
Tightness established by: ☒ "Snug Fit" ☐ Torque
Torque Wrench No.: N/A Cal. Due Date: N/A
Tightness verified? ☒ Yes ☐ No James Wisniewski Construction ARE Date: 5/27/92
Equipment base flexible? ☐ Yes ☒ No James Wisniewski Construction ARE Date: 5/27/92

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	0"	0"	0"	0"					
Anchor length	2'-6 3/4"	2'-6 3/4"	2'-6 3/4"	2'-6 3/4"					
Protruding length	11 1/8"	10 1/2"	10 3/4"	11 1/8"					
Embedment	1'-7 7/8"	1'-8 1/4"	1'-8"	1'-7 5/8"					
Bolt grip	9 3/4"	9"	9 3/8"	9 11/16"					
Concrete condition	Ok	ok	Ok	ok					
Edge distance	N/A	N/A	N/A	N/A					
Anchor spacing	2'-2 15/16"	2'-2 15/16"	2'-3 1/8"	2'-3 1/8"					
Anchor angularity	0°	0°	0°	0°					
Thread engagement	ok	ok	ok	ok					

Comments: ANCHOR LENGTHS TAKEN FROM DRAWING 12-3281-21 and 12-30738-2. ANCHORS A, B, C & D DO NOT MEET THE REQUIREMENTS FOR EMBEDMENT AND BOLT GRIP. THIS PACKAGE REQUIRES THE EVALUATION OF THE AEPSC ARE. JW 5/12/92.
DISCREPENCIES MENTIONED ABOVE DO NOT DICTATE ANY OPERABLE CONCERN. T. Ommelaoow 8-8-92.

Verified by: [signature] Qual./Cert. Inspector Date: 5-27-92

Reviewed by: James Wisniewski Construction ARE Date: 5/27/92

INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
AUG 17 1992
CLERK [signature]

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-HE-15E   Dwg No.: 12-3281-21

Anchor type: WEDGE ANCHOR   Dia: 1"   Dwg No.: 12-3285-23

Tightness established by: ☒ "Snug Fit" ☐ Torque

Torque Wrench No.: N/A   Cal. Due Date: N/A

Tightness verified? ☒ Yes ☐ No James Wisniewski Construction ARE Date: 5/27/92

Equipment base flexible? ☐ Yes ☒ No James Wisniewski Construction ARE Date: 5/27/92

PHYSICAL CHARACTERISTICS

Bolt ID	E	F	G	H					Comments
Gaps	0"	0"	0"	0"					
Anchor length	8 3/8"	8 3/8"	8 3/8"	8 3/8"					
Protruding length	2 11/16"	2 1/4"	2 1/4"	2 1/4"					
Embedment	5 11/16"	6 1/8"	6 1/8"	6 1/8"					
Bolt grip	7/8"	1"	7/8"	1"					
Concrete condition	ok	ok	ok	ok					
Edge distance	4"	4 1/2"	4 1/2	4 1/2"					
	6 1/2"	11 1/2"	11 1/2	6 1/2"					
Anchor spacing	5"	5"	5"	5"					
Anchor angularity	0°	0°	0°	0°					
Thread engagement	ok	ok	ok	ok					

Comments: ANCHORS E, F, G & H do not meet the requirements for Edge distance and anchor spacing. This package requires the Review of the AEPSC ARE. JAW 5/12/92
BY ENG. REVIEW THE DISCREPENCIES MENTIONED ABOVE DO NOT DICTATE ANY OPERABILITY CONCERN. T. [illegible] 8-6-92

Verified by: [signature]   Date: 6-8-92
Qual./Cert. Inspector

Reviewed by: James Wisniewski   Date: 6-8-92
Construction ARE

INDIANA MICHIGAN POWER
CONSTRUCTION CONTROLLED
WORKING COPY
AUG 17 1992
CLERK D Wisniewski

Equipment No.: 1-HE-15E

Tightness established by "Snug Fit"

Tightness verified by: [signature] Date: 5-22-92

Qual./Cert. Inspector

Comments: ______

Q & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

12 SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: A-22358 REPORT DATE: 2/17/92 REQUEST NO. N/A

IDENTIFICATION

Unit ONE
Component 1-HE-15E
Item 1"ϕ WEDGE ANCHORS
Material C.S.
Other S.Q.U.G. PROGRAM

TECHNIQUE

Test Unit/ S/N MAGNAFLUX FX-5 / CQC-13
Freq./Diameter 5MHZ / .250
Reference Standard QC-30
Couplant/Batch No. ULTRAGEL II #9088

TEST DATA/REMARKS

ANCHOR	LENGTH
"E" →	8.4"
"F" →	8.4"
"G" →	8.4"
"H" →	8.4"

PERFORMED BY: Stephen R. Vargo LEVEL: II DATE: 2/17/92
REVIEWED BY: [signature] LEVEL: II DATE: 2/18/92

Equip ID: 1-QT-107-CD . Train: 2 Equip Class:21

Drawing No.: 1-5151C

Function: EMERG DIESEL

System: DIESEL FUEL OIL

Equip Desc: CD EMERG DIESEL FUEL OIL DAY TANK

Building: AUXILIARY Room: CD EMERG DIESEL GENERATOR ROOM

Elev: 587 Sort: S,_ Notes:

Normal State: Desired State: Power Req'd: N

Support System Drawing:

Req'd Support Comp:

Safety Related Status: NUCLEAR SR Min/Opt: MIN

Alias No: Power Train: NA

Comp Served: CD FUEL OIL DAY TANK

MFR:

Model: 36" D x 108" L, 465 GAL.

[illegible]el:

Elem. Drawing: N/A

Wiring Drawing: N/A

Power Source: N/A

Walkdown: F Relay Eval : N

Comp Type: TANK (CAPACITY - 2 HRS FULL LOAD
OPERATION)

Iso Drawing:

Location: IN THE NW REGION OF THE ROOM, 10 FEET NW OF THE GEN END
OF DGCD INSIDE THE FUEL OIL DAY TANK ENCLOSURE, AT THE
599 EL.

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 1 of 6
ID : 1-QT-107-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERG DIESEL FUEL OIL DAY TANK		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EDG RM,
Manufacturer, Model, Etc. : 36 D x 108 L, 465 GAL.		

BASIS : Horizontal TANK analysis

1. The buckling capacity of the shell of a large, flat-bottom, vertical tank is equal to or greater than the demand.	N/A
2. The capacity of the anchor bolts and their embedments is equal to or greater than the demand.	Yes
3. The capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand.	Yes
4. Attached piping has adequate flexibility to accommodate the motion of a large, flat-bottom, vertical tank.	Yes
5. A ring-type foundation is not used to support a large, flat-bottom, vertical tank.	N/A

IS EQUIPMENT SEISMICALLY ADEQUATE? Yes

COMMENTS

SRT: George G. Thomas (S&A) and Tom Huang (AEP) -- 10/7/93.

REF: 1. Anchor Inspection Data Sheets: Anchorage Arrangement Sketches and Physical Characteristics Data Sheet, Certified 4/5/93.
2. Worthington Dwg # 700006BU
3. Worthington Co. Fuel Oil Day Tank Calculation, 8/17/74.

Anchorage: 1-QT-107-CD is a horizontal tank which sits on 2 saddles. Each saddle has 2, 1/4" thick plates, forming a "U", with no gussets. There are 2 - 5/8" anchors per saddle.

Cracks in the leveling grout on the concrete pad were identified. The SRT judged this acceptable since the structural concrete pads are intact.

Horizontal Tank Analysis:
Saddle Weak Axis Moment of Inertia = 2I + 2(ad^2) = 2((30"x0.25in^3)/12) + 2(15in^2 x (4^2)in^2") = 480in^4.

Results of Horizontal Tank Analysis show tank anchorage is adequate (conservatively using expansion bolts for the 5/8" diameter Nelson Stud anchors), and Ref. 3 calculation contains saddle stresses check.

Interactions: Block wall has been confirmed by AESPC to have been evaluated in the IE 80-11 program.

Evaluated by: George G. Thomas — Date: 11/20/95

T Chen Huang — 11-28-95

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 2 of 6
ID : 1-QT-107-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERG DIESEL FUEL OIL DAY TANK		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EDG RM,
Manufacturer, Model, Etc. : 36 D x 108 L, 465 GAL.		

Attachment: TANK Analysis Results

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)	GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 3 of 6

ID : 1-QT-107-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERG DIESEL FUEL OIL DAY TANK		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EDG RM,
Manufacturer, Model, Etc. : 36 D x 108 L, 465 GAL.		

TANK Analysis Results

Step 1 -- Input Data

a) Assumptions

1. Tank is cylindrical, horizontally oriented and supported on saddles.	Yes
2. Tank and saddles are made of carbon steel.	Yes
3. Saddles are uniformly spaced.	Yes
4. Saddles overhang is less than spacing / 2.	Yes
5. Base plates have slotted anchor bolt holes for thermal growth except for the base plate under the fixed saddle.	Yes
6. Imposed nozzle loads are not significant.	Yes
7. The tank foundation is adequate.	Yes
8. Anchor bolts are cast in place or expansion type.	Yes

b) Materials

Weight of Tank + Fluid	4.5 kips
Weight Density of Tank + Fluid	70.7 lbs/ft^3
Saddle Elastic Modulus	29000.0 ksi
Saddle Shear Modulus	1150.0 ksi
Base Plate Yield Strength	36.0 ksi
Anchor Type	5/8 in Expansion Bolts

c) Dimensions

Tank Diameter, D	3.03 ft
Tank Length, L	9.0 ft
Tank Thickness, t	0.19 in
Height of Tank + Fluid C.G., Hcg	1.71 ft
Number of Saddles	2
Saddle Spacing, S	6.0 ft
Saddle Height, h	2.38 in
Saddle Shear cross-sectional area	15.0 in^2
Saddle Weak Axis Moment of Interia	480.0 in^4
Number of Bolt Locations / Saddle	2
Number of Bolts / Bolting Location	1
Extreme Bolt Spacing, D'	2.17 ft
Anchor Bolt Eccentricity, e	6.0 in
Weld Thickness	0.19 in
Base Plate Thickness	0.19 in

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 4 of 6
ID : 1-QT-107-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERG DIESEL FUEL OIL DAY TANK		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EDG RM,
Manufacturer, Model, Etc. : 36 D x 108 L, 465 GAL.		

d) Anchor Bolts

Type = Expansion Anchor	Diameter = 5/8 in
Manufacturer = Phillips Stud (S)	Product Name =

	Pullout	Shear
Nominal Capacity	3.17 kips	3.79 kips

Concrete Compression Strength, fc' = 3500.0 psi

Reduction Parameters

Label	Check	Condition	Capacity Reduction Factor	
			Pullout	Shear
1. Type of Anchorage	Yes		1.0	1.0
2. Installation Adequacy	Yes	Installation is adequate	1.0	1.0
3. Embedment Length	Yes	Embedment Length = 2.38 in	1.0	1.0
4. Gap at Threaded Anchors	Yes	Gap size = 0.0 in	1.0	1.0
5. Spacing between Anchorages	Yes		1.0	1.0
6. Edge Distance	Yes	Edge Distance = 6.25 in	1.0	1.0
7. Concrete Strength and Condition	Yes		0.88	1.0
8. Concrete Crack Location and Size	Yes	Crack Size = 0.0 in	1.0	1.0
9. Essential Relays in Cabinets	Yes	Essential relays are not present	1.0	1.0
10. Base Stiffness and Prying Action	Yes		1.0	1.0
11. Equipment Base Strength and Structural Load Path	Yes	Base strength and load path are O.K.	1.0	1.0
12. Embedment Steel and Pads	Yes	Installation is O.K.	1.0	1.0

Does the tank satisfy all the assumptions and is within the applicable range of parameters? Yes

Step 2 -- The allowable bolt loads

Allowable Tension Load, Pu'	2.774 kips
Allowable Shear Load, Vu'	3.79 kips

Step 3 -- Determine base plate bending strength reduction factor

RB	0.1562

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)			GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 5 of 6
ID : 1-QT-107-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers		
Description : CD EMERG DIESEL FUEL OIL DAY TANK			
Building : AUXILIARY	Floor El. : 587.00		Room, Row/Col : CD EDG RM,
Manufacturer, Model, Etc. : 36 D x 108 L, 465 GAL.			

Step 4 -- Determine base plate weld strength reduction factor

RW	17.7858

Step 5 -- Determine the anchorage tension and shear allowable loads

Allowable Anchorage Tension Load, Pu	0.433 kips
Allowable Anchorage Shear Load, Vu	3.79 kips

Step 6 -- Calculate the ratios and values

alpha (Pu/Vu)	0.11
Wb	1.13 kips/bolt
Vu / Wb	3.37
Hcg / D'	0.788
Hcg / S	0.285
F1	2.236
F2	1.804

Step 7 -- Determine the acceleration capacity of the tank anchorage

lambda_1	1.507 G
lambda_u	0.715 G
Anchor Acceleration capacity, lambda	0.715 G

Step 8 -- Determine the maximum saddle spacing for transverse and vertical rigid frequency response

Maximum Saddle Spacing, Sc	13.42 ft

Step 9 -- Compute the resonant frequency of the tank in the longitudinal direction

Saddle Stiffness, Ks	7230.98 kips/in
Resonant Frequency of Tank in Longitudinal Direction	125.34 Hz

DC Cook Unit 1 SCREENING EVALUATION WORK SHEET (SEWS)		GIP Rev 2, Corrected, 2/14/92 Status: Yes Sheet 6 of 6
ID : 1-QT-107-CD (Rev. 0)	Class : 21 - Tanks and Heat Exchangers	
Description : CD EMERG DIESEL FUEL OIL DAY TANK		
Building : AUXILIARY	Floor El. : 587.00	Room, Row/Col : CD EDG RM,
Manufacturer, Model, Etc. : 36 D x 108 L, 465 GAL.		

Step 10 -- Determine the seismic demand acceleration

ZPA	0.25 G

Tank is rigid in all three directions.
Tank anchorage is adequate because anchorage acceleration capacity is greater than ZPA

Step 11 -- Check the saddle stresses

The program does not check the saddle stresses
Check the saddle stresses by an independent calculation

<u>Summary</u>

<u>IS EQUIPMENT SEISMICALLY ADEQUATE?</u>

The tank anchorage is adequate.

Cook Nuclear Plant
SQUG Pre-Walkdown Anchor Inspection Summary Sheet

Component No. 1-QT-107-CD Class 21

SQUG Discrepancy

Any particular area the Seismic Review Team should pay extra attention to?
Yes ___ No ✓ (If yes, check items that apply.)

	Remarks
Anchor Type	
Anchor Diameter	
Anchor Spacing	
Anchor Number	
Anchor Embedment	
Anchor Edge Distance	
Anchor Gap	
Anchor Thread Engagement	
Anchor Grip	
Anchor Angularity	
Concrete Crack	

Others (describe briefly)

Design Basis Discrepancy

If there is concern for Design Basis Discrepancy, circle the applicable item and explain.

1. Hardware Maintenance Type Discrepancy
2. Drawing Update Type Discrepancy
3. Significant Operability/Design Basis Discrepancy
4. Others

Condition:

NONE

Actions Taken:

NONE

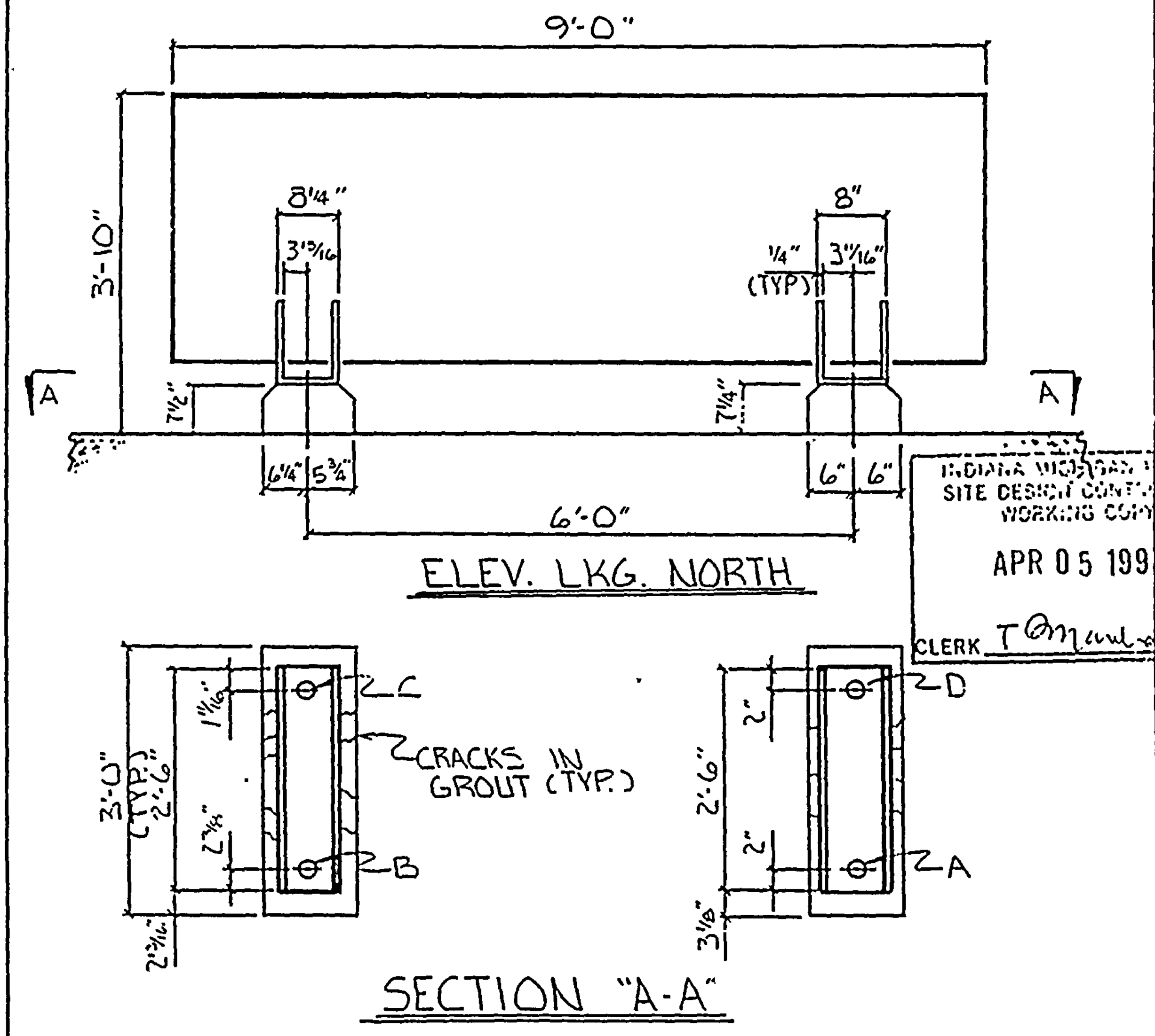
Prepared By T. Omanlaran Date 4-12-93

ANCHOR INSPECTION DATA SHEET

ONE	AUX 599'-0"	ON THE NORTH SIDE OF "CD" DG ROOM UP INSIDE THE FUEL OIL DAY TANK ENCLOSURE
Unit #	Bldg.	Location

12-3890	1-QT-107-CD
Installation dwg. / Rev.	Equipment No.

Anchorage Arrangement Sketch



INDIANA MICHIGAN POWER
SITE DESIGN CONTROLLED
WORKING COPY
APR 05 1993
CLERK T Omaulany

Drawn by:	J. ROSE	Date:	1-27-93
Verified by:	CW Graham Qual./Cert. Inspector	Date:	4-2-93
Reviewed by:	T Omaulany Construction Anchor Review Engineer	Date:	4-5-93

ANCHOR INSPECTION DATA SHEET

Equipment No.: 1-QT-107-CD   Dwg No.: 12-3890

Anchor type: NELSON STUD TYPE   Dia: 5/8"φ   Dwg No.:

Tightness established by: ☐ "Snug Fit" ☐ Torque

Torque Wrench No.: NA   Cal. Due Date:

Tightness verified? ☐ Yes ☒ No   NA   Date:
Construction ARE

Equipment base flexible? ☐ Yes ☒ No   T. Omanhony   Date: 3-12-93
Construction ARE

PHYSICAL CHARACTERISTICS

Bolt ID	A	B	C	D					Comments
Gaps	0	0	0	0					
Anchor length	11 3/4"	11 3/4"	11 3/4"	11 3/4"					
Protruding length	2 1/2"	3 1/4"	3 9/16"	2 3/4"					
Embedment	9 1/4"	8 1/2"	8 3/16"	9"					
Bolt grip	1 1/2"	1 13/16"	1 11/16" ⊙	1 3/4" ⊙					
Concrete condition	☒	☒	☒	☒					
Edge distance	N/A	N/A	N/A	N/A					
Anchor spacing	2'-1 3/4"	2'-2"	2'-2"	2'-1 3/4"					
Anchor angularity	0°	0°	0°	0°					
Thread engagement	OK	OK	OK	OK					

INDIANA MICHIGAN POWER ... CONTROL ... WORKING COPY APR 05 1993 CLERK T. Omanhony

Comments: ⊙ THIS END OF THE MOUNTING PLATE IS EMB. IN THE SLAB GROUT.
☒ CANNOT VERIFY CONCRETE CONDITION BECAUSE OF GROUT. GROUT IS CRACKED.

CRACKS IN THE GROUT ONLY, STRUCTURAL CONCRETE PADS ARE OK

Verified by: [signature]   Date: 4-2-93
Qual./Cert. Inspector

Reviewed by: T. Omanhony   Date: 4-5-93
Construction ARE

rcf 10/7/93
DDS 10/7/93

S & A DEPARTMENT
CONTROLLED DOCUMENT
COPY NO. 3-1

SHP 5050 NDE.008
ATTACHMENT NO. 1

ULTRASONIC TEST REPORT

JOB ORDER NO.: N/A REPORT DATE: 1/29/93 REQUEST NO. N/A

IDENTIFICATION

Unit ONE
Component 1-QT-107-CD
Item ANCHORS
Material C.S.
Other SQUG PROGRAM

TECHNIQUE

Test Unit/ S/N KB USK 7 / CQC-405
Freq./Diameter 5MHZ / .250
Reference Standard QC-30
Couplant/Batch No. ULTRAGEL II 9088

TEST DATA/REMARKS

ANCHOR	LENGTH
A	11.75"
B	11.75"
C	11.75"
D	11.75"

PERFORMED BY: Stephen R. Vayo LEVEL: II DATE: 1/29/93
REVIEWED BY: [illegible signature] LEVEL: II DATE: 2/1/93

FORM NO. 12 SHP 5050 NDE.008-1

Page 1 of 1
Revision 0

ATTACHMENT 6 TO AEP:NRC:1040E

SAMPLE LARS CALCULATIONS
001, 005, 010, 011, 022, 023, 027 AND 030
RAI ITEM 8

This attachment contains the following:

1. A 16 page document containing the procedures, input data, and references used in the Limited Analytical Reviews.
2. The requested Limited Analytical Reviews: LAR #s 001,005,010,011,022,023,027 and 030.
3. The calculation used to resolve the outlier generated by LAR 022.
4. The procedure used to address the outlier generated by LAR 005.

PROCEDURES, INPUT DATA, AND REFERENCES USED IN THE LIMITED ANALYSIS REVIEWS

3. LIMITED ANALYTICAL REVIEWS

3.1 Problem Statement

This Limited Analytical Review (LAR), performed within the scope of Unresolved Safety Issue (USI) A46, evaluates the structural integrity of cable tray and conduit supports which have been chosen as representative, worst case examples of the major different types of raceway support configurations within D.C.Cook Nuclear Power Plants 1 and 2. Twenty nine sample supports have been chosen from the plant raceway support systems for evaluation.

3.2 Summary of Results

Interaction Values

The critical interaction value and related comments for each of the raceway support evaluations in this LAR are summarized in Table 3.1 below. Refer to the Attachments to this section for details of each of the evaluations.

Table 3.1 Critical Interaction Values

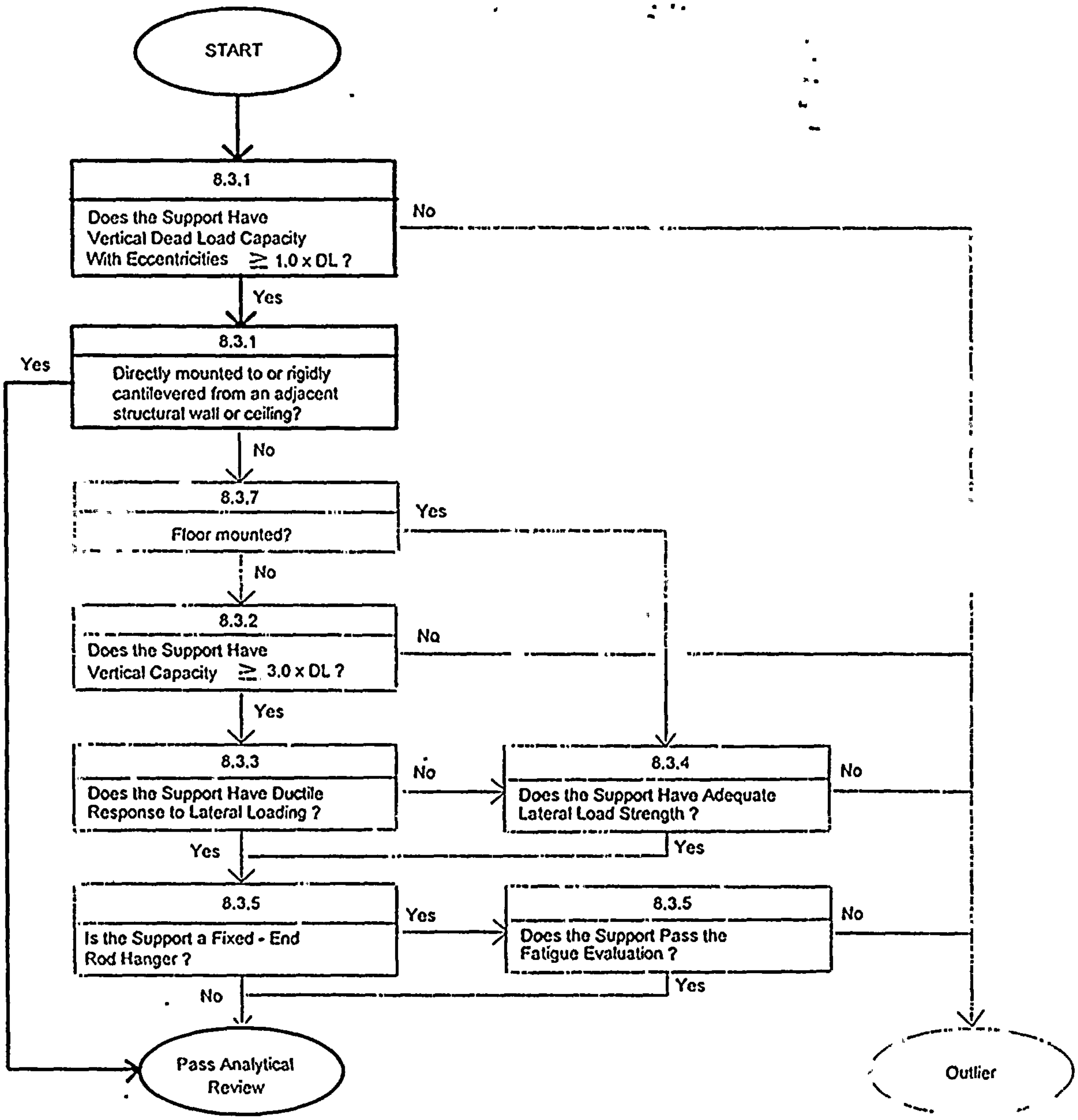
	Interaction Value					
LAR No.	Members/Connections		Anchorage		Maximum	
001	0.18	DL	0.68	3DL	0.68	3DL
002	***					
003	0.50	DL	0.48	DL	0.50	DL
004	0.29	DL	(LOW)	DL	0.29	DL
005	0.74	DL	5.6	3DL	5.6	3DL
006	0.50	DL	0.76	3DL	0.76	3DL
007	0.81	DL	0.56	3DL	0.81	DL
008	0.94	DL	0.33	DL	0.94	DL
009	0.85	LL	0.39	LL	0.85	LL
010	1.05	DL	0.43	DL	1.05	DL
011	0.28	LL	1.02	LL	1.02	LL
012	0.15	DL	0.45	DL	0.45	DL
013	0.72	DL	0.58	LL	0.72	DL
014	0.38	DL	0.93	3DL	0.93	3DL
015	0.84	DL	0.32	LL	0.84	DL
016	0.79	LL	0.40	LL	0.79	LL
017	0.70	DL	0.31	3DL	0.70	DL
018	0.72	DL	1.04	3DL	1.04	3DL
019	0.33	DL	0.27	DL	0.33	DL
020	0.18	DL	0.67	DL	0.67	DL
021	low	DL	0.22	DL	0.22	DL
022	1.7	DL	---	---	1.7	DL
023	0.77	DL	0.90	DL	0.90	DL
024	0.25	DL	0.10	DL	0.25	DL
025	0.55	LL	0.23	LL	0.55	LL
026	***					
027	0.75	DL	0.96	3DL	0.96	3DL
028	0.14	DL	low	---	0.14	DL
029	***					
030	low	DL	low	DL	low	DL
031	0.12	DL	0.20	DL	0.19	DL
032	0.68	DL	0.24	DL	0.68	DL

DL Dead Load
3DL 3x Dead Load (Vertical Load Check)
LL Lateral Load Check
RF Rod Fatigue Check
Outlier
*** Not used.

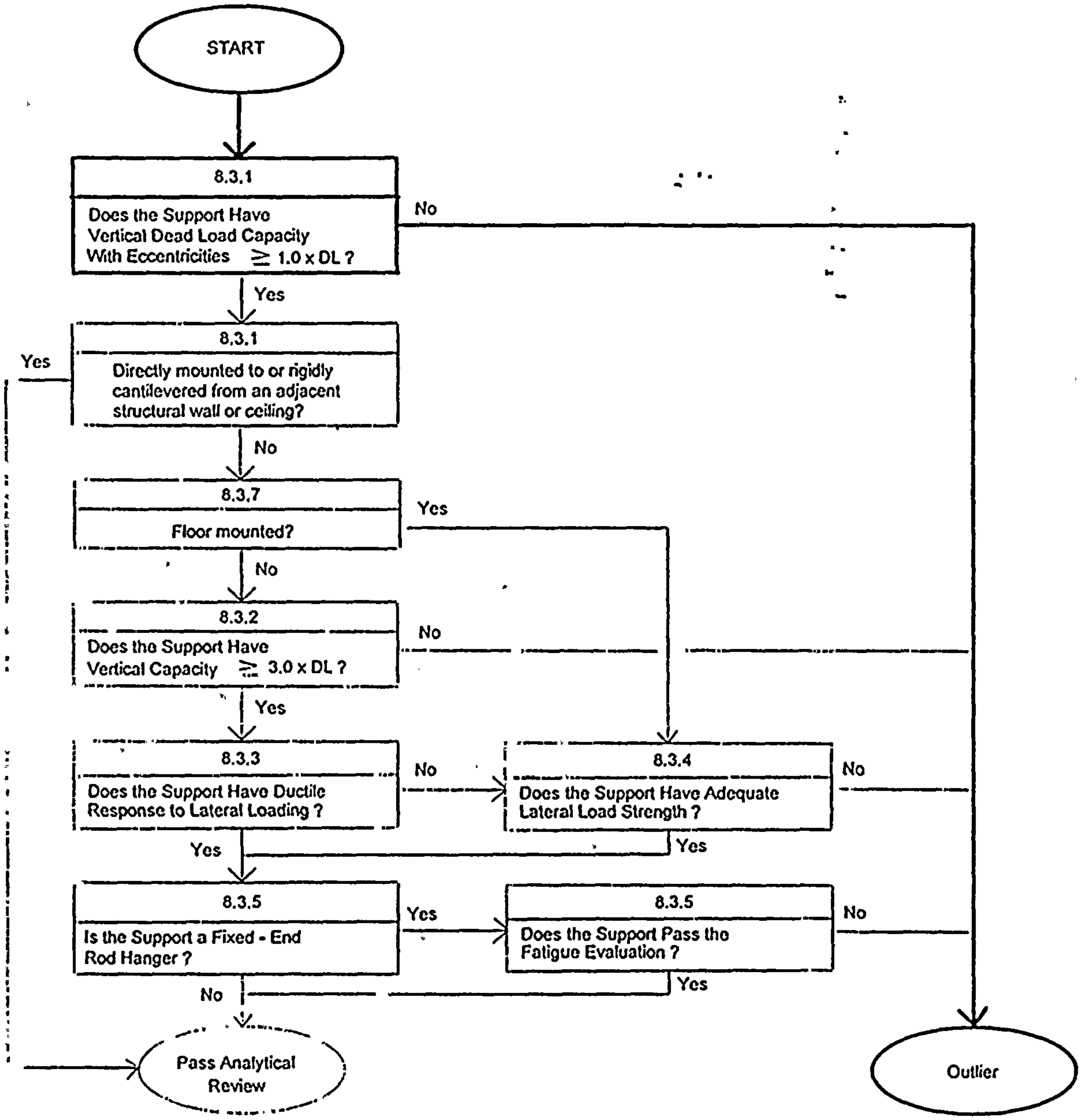
Logic Diagrams for Cable Tray and Conduit Support Evaluations

Logic diagrams indicating the evaluation path taken to demonstrate the acceptance of each of the raceway supports are shown below. Note that the particular evaluation path taken for the support in question is defined in heavy outline.

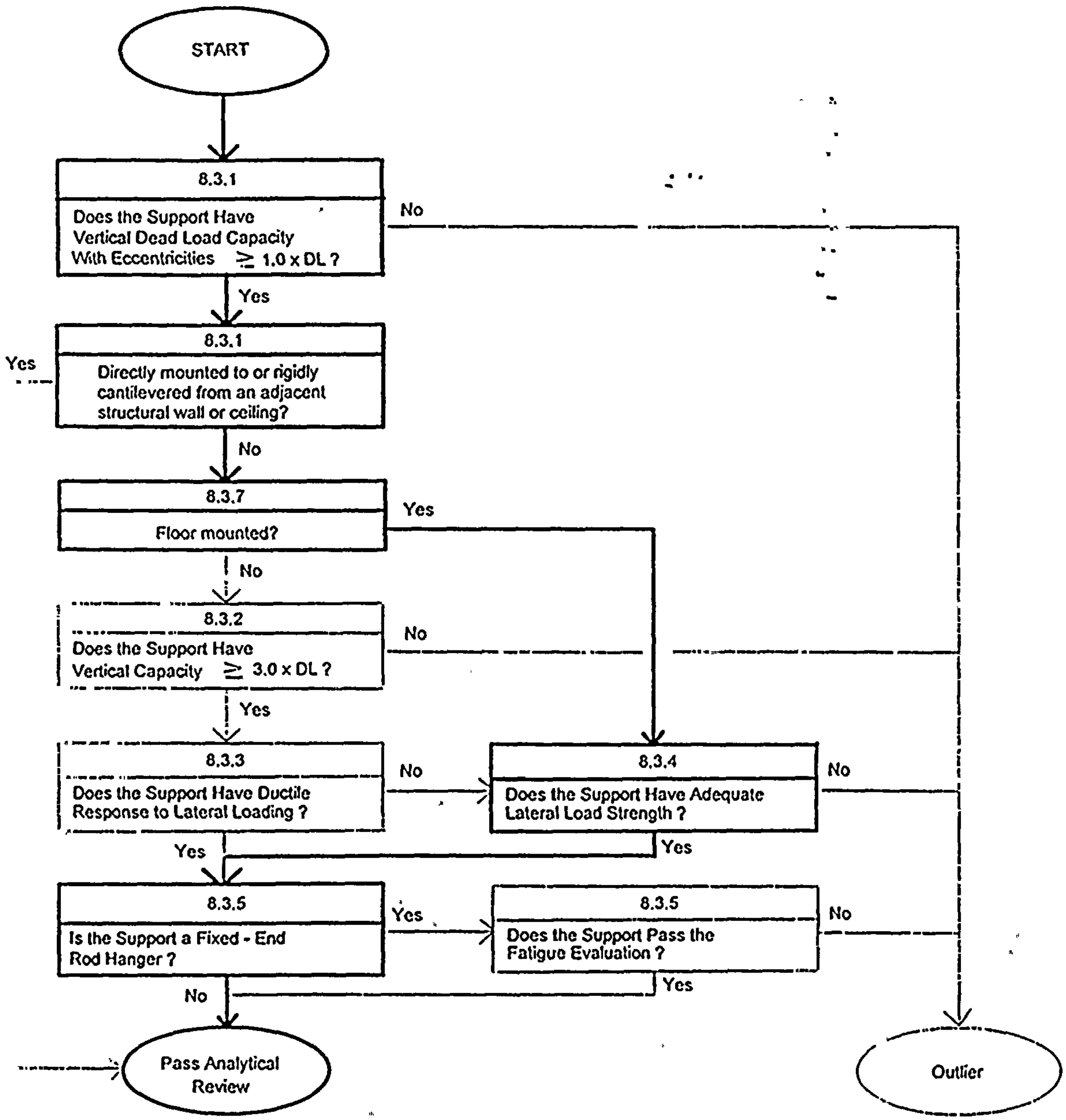
LAR Nos. 003, 004, 008, 010, 012, 019, 020, 021, 023, 024, 030, 031, 032



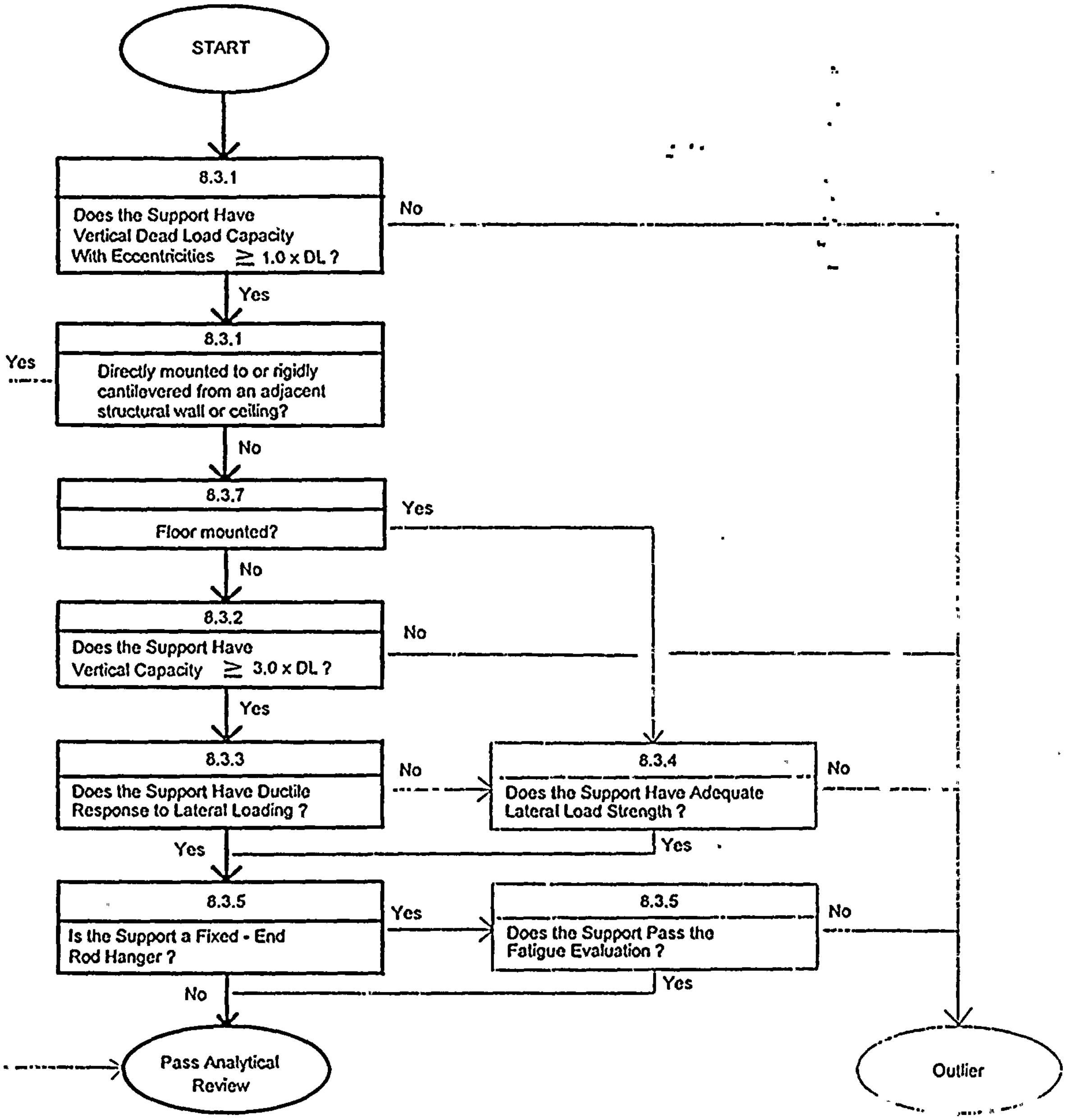
(Rigid Mount)



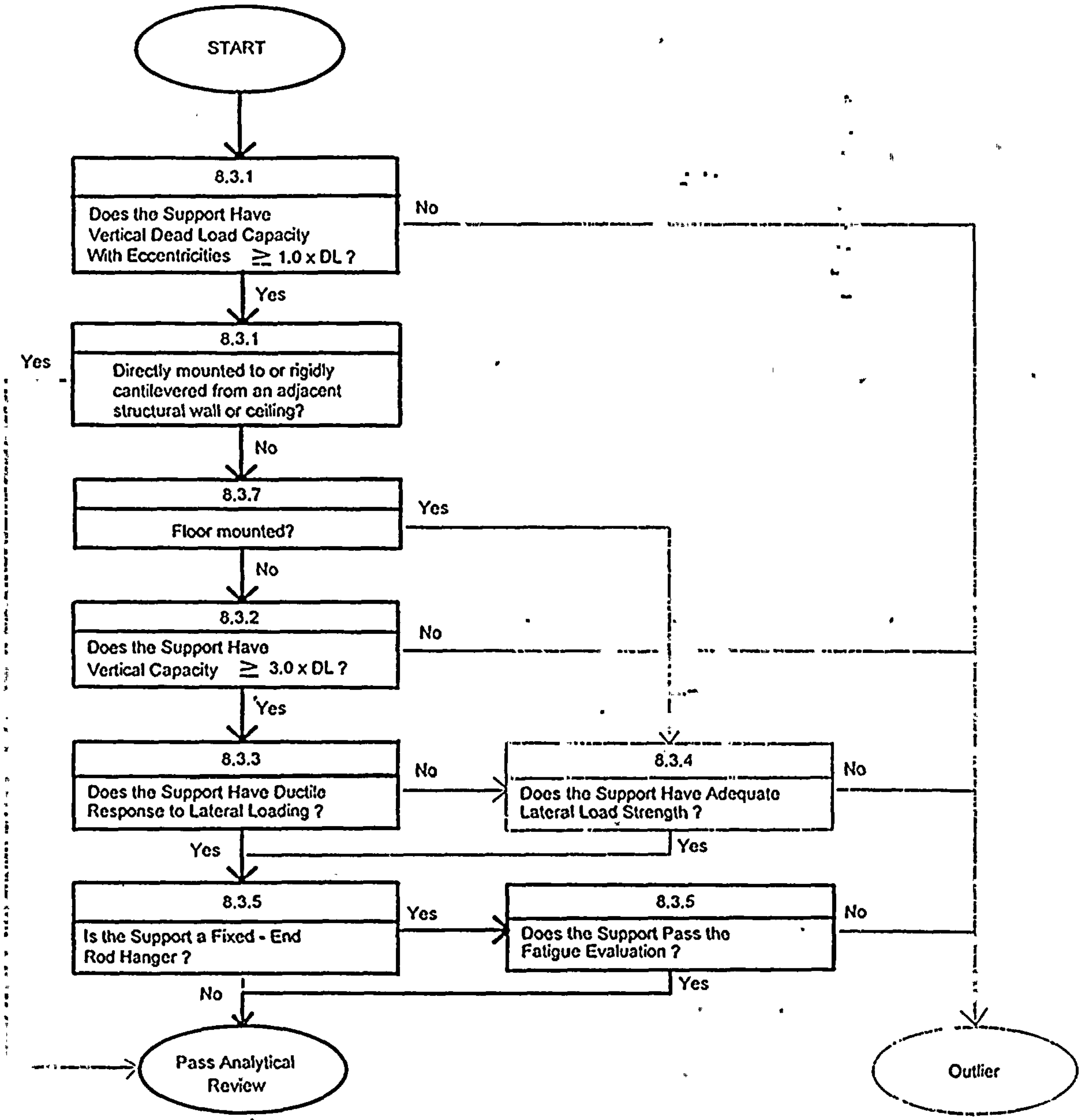
(Any support failing DL)



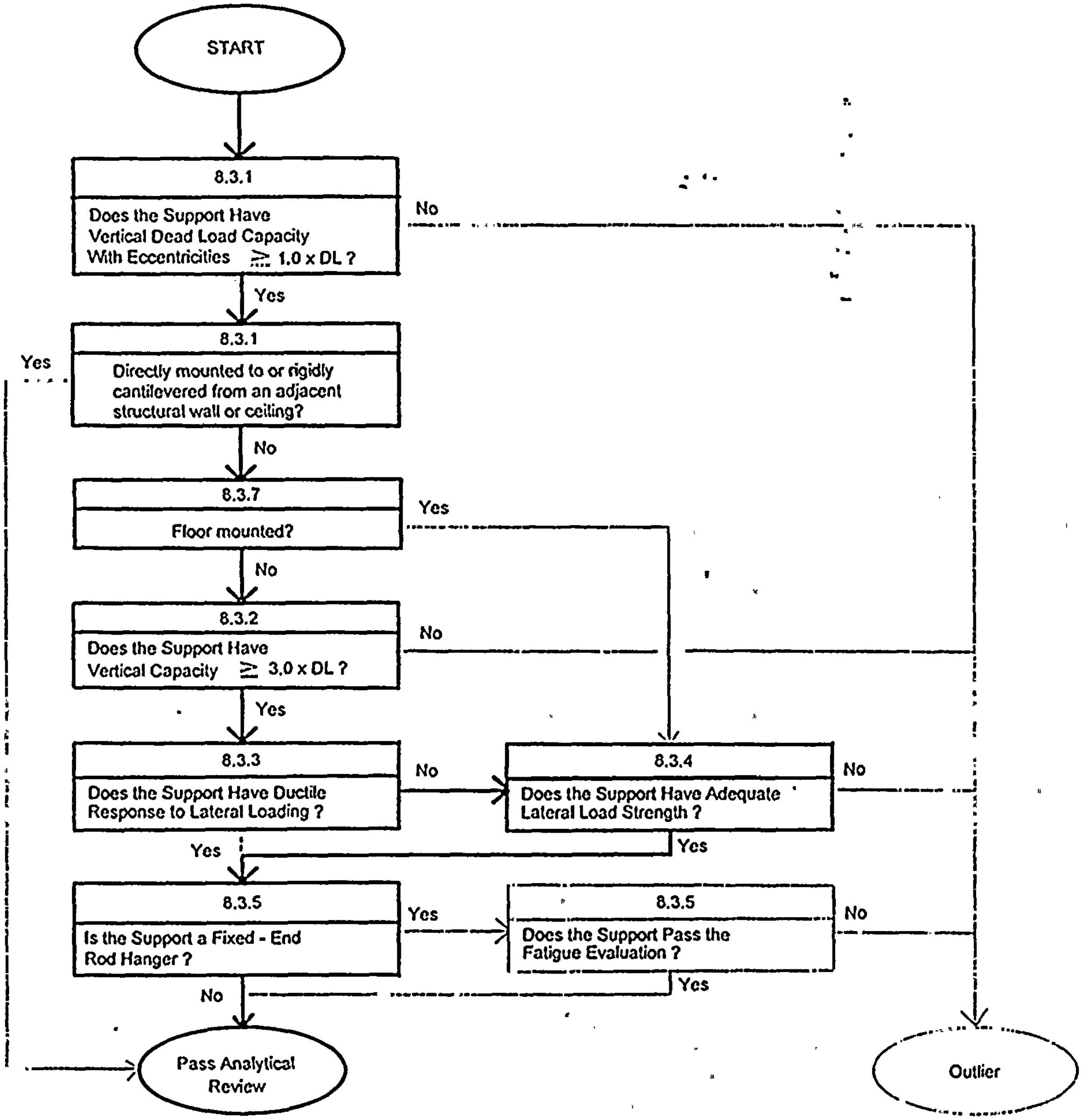
(Floor Mounted Support)



(Trapeze Frames)



(Rod Hanger Trapezes)



(Floor to Ceiling Supports)

3.3 Method of Solution

Hand calculations are performed employing the methodology outlined in Section 8 of Reference 3.6.4, "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment." Support structures are broken down, where applicable, into subsections which lend themselves to common, closed form solutions for structures subjected to static loading.

3.4 Allowables and Assumptions

The following is a compilation of allowable stress and load criteria used throughout the raceway support evaluations.

Structural Steel: All structural steel support members are assumed to be ASTM A36 with a minimum yield strength of 36 ksi. AISC Specification allowables for Allowable Stress Design (Ref. 3.6.1) are used for the dead load analysis. For other analyses, the allowable stress is increased to 0.9 Fy = 32.4 ksi.

Weld Filler Metal: All welds are assumed to be E60xx. The allowable weld shear stress, based on Table J2.5 of Ref. 3.6.1, is 0.3 x 60 = 18 ksi for dead load analysis. For all other analyses, 1.7 x 0.3 x 60 = 30.6 ksi is used.

Unistrut Channels and Accessories: Dimensions, properties, and allowables used to analyze various Unistrut support system components are based on the Manufacturer's Catalog Data provided in Refs. 3.6.2 and 3.6.3. These values are used for the dead load analysis and all other analyses. Values for Unistrut components commonly used at D.C.Cook are summarized below:

Unistrut bending moment: Ref. 3.6.3, p.23

P1000: 5080 in-lb (allowable bending stress of 25 ksi)

Channel nuts/bolts: Ref. 3.6.3, p.69

5/8" : pullout in P1000 or P3000	:	2500 lb
5/8" : slip in P1000 or P3000	:	1500 lb
1/2" : pullout in P1000 or P3000	:	2000 lb
1/2" : slip in P1000 or P3000	:	1500 lb
3/8" : pullout in P1000 or P3000	:	1000 lb
3/8" : slip in P1000 or P3000	:	800 lb

Bolts are assumed tightened to manufacturer's recommended values.

Embedded Unistrut Channels: D.C. Cook embedded channels are Unistrut P1000 (or equivalent) galvanized, 12 ga. channels with a material yield strength = 33 ksi, modified by the addition of 3/8" ϕ x 4"L Nelson Studs at 12" o.c. Results of tests of modified channels (Ref 3.6.20) indicate a minimum pullout capacity of 6400 lb/ft. The mode of failure was ripping of strut material around the stud; stud remaining in concrete. Using the AISC Allowable Stress Design allowable shear stress of 0.4 x Fy = 13.2 ksi on a 45° cone shaped slip surface results in an allowable pullout of 13.2 ksi x π x (D + t) x t = 13.2 x 3.14 x (0.375 + 0.105) x 0.105" = 2090 lb, therefore use the standard catalog value of 2000 lb, but not more than the allowable value for pullout of Unistrut channel nuts/bolts as listed above. For all other load cases, use an allowable stress of 1.7 x 0.4 x Fy resulting in an allowable pullout of 3550 lb, but not more than the catalog allowable value for the pullout of Unistrut channel nuts/bolts as listed above.

To summarize:

Pullout of embedded strut:	2000 lb	5/8" channel nut/bolt
(dead load analysis)	2000 lb	1/2" channel nut/bolt
	1000 lb	3/8" channel nut/bolt
Pullout of embedded strut:	2500 lb	5/8" channel nut/bolt
(all other analyses)	2000 lb	1/2" channel nut/bolt
	1000 lb	3/8" channel nut/bolt

Concentrated loads may not be spaced closer than 12" apart unless the sum total of concentrated loads on any 12" of Unistrut length does not exceed the single load allowable.

Conduit Weights: The following estimated weights per foot for rigid steel conduit, as provided by Reference 3.6.14, will be used unless noted otherwise within the individual LAR's.

1/2"	1.1 lb/ft
3/4"	1.3 lb/ft
1"	2.0 lb/ft
1-1/2"	3.5 lb/ft
2"	4.9 lb/ft
3"	11.1 lb/ft
4"	16.6 lb/ft

Cable Tray Weights: The weight per foot used in these LARs for the standard D.C.Cook cable tray (12" wide by 6" high) is 25 pounds per linear foot, unless noted otherwise within the individual LAR's.

Concrete Anchor Bolts: Concrete anchor bolt allowables used in all analyses are based on Tables C.2-1 and C.2-2 of the GIP, Ref. 3.6.4. The anchor bolt type must be known to use the maximum values.

If anchor bolts are identified as "non-shell" type anchors on the PASS, then, per Ref. 3.6.12, the anchors are either 5/8" Hilti "Kwik-Bolts" or 5/8" Phillips wedge-type anchors. All other anchors must be identified on the PASS or they will be considered "unknown." Unknown anchors require a reduction factor of 0.6 on the allowable loads provided in Ref. 3.6.4, Tables C.2-1 and C.2-2.

All concrete anchors, known or unknown, shell or non-shell type, which are not loaded in tension by dead weight, require an additional reduction factor of 0.75 for the "Reduced Inspection Alternative", and, because one third of the anchor bolts (there must be a minimum of six) must be assumed to be "not available", another reduction factor of 0.67 must be taken.

The design concrete strength at D. C. Cook is 3500 psi. This requires a reduction factor of 0.875 to be applied to the pullout capacity of all anchors. No reduction is required for the shear capacity.

If a tightness check has been performed, it will be so stated on the PASS and the "Reduced Inspection Alternative" reduction factors may be waived.

Concrete Anchor Bolts (cont'd)

To summarize:

"Known" concrete anchors such as 5/8" Hilti "Kwik-Bolts", 5/8" Phillips Wedge-type, or 5/8" Phillips Red Head "self drills":

Pall = 3.17 kips x 0.875 x 0.75 x 0.67= 1.39 kips Vall = 3.79 kips x 0.75 x 0.67= 1.90 kips	(not in tension by deadweight)
Pall = 3.17 kips x 0.875 = 2.77 kips Vall = 3.79 kips	(in tension by deadweight)

All other 5/8" concrete anchors:

Pall = 3.17 kips x 0.875 x 0.6 x 0.75 x 0.67 = 0.83 kips Vall = 3.79 kips x 0.6 x 0.75 x 0.67= 1.14 kips	(not in tension by deadweight)
Pall = 3.17 kips x 0.875 x 0.6 = 1.66 kips Vall = 3.79 kips x 0.6 = 2.28 kips	(in tension by deadweight)

All 3/4" concrete anchors:

Pall = 4.69 x 0.875 x 0.6 x 0.75 x 0.67 = 1.23 kips Vall = 5.48 x 0.6 x 0.75 x 0.67 = 1.65 kips	(not in tension by deadweight)
Pall = 4.69 x 0.875 x 0.6 = 2.46 kips Vall = 5.48 x 0.6 = 3.29 kips	(in tension by deadweight)

All 1/2" concrete anchors:

Pall = 2.29 x 0.875 x 0.6 x 0.75 x 0.67 = 0.60 kips Vall = 2.38 x 0.6 x 0.75 x 0.67 = 0.72 kips	(not in tension by deadweight)
Pall = 2.29 x 0.875 x 0.6 = 1.20 kips Vall = 2.38 x 0.6 = 1.43 kips	(in tension by deadweight)

All 3/8" concrete anchors:

Pall = 1.46 x 0.875 x 0.6 x 0.75 x 0.67 = 0.39 kips Vall = 1.42 x 0.6 x 0.75 x 0.67 = 0.43 kips	(not in tension by deadweight)
Pall = 1.46 x 0.875 x 0.6 = 0.77 kips Vall = 1.42 x 0.6 = 0.85 kips	(in tension by deadweight)

Shear-tension interaction limitations per the GIP, Ref. 3.6.4, Section C.2.11 will be used to evaluate the effect of combined anchor bolt loading.

3.5 Input Data

Plant Area Summary Sheets

The hangers evaluated in this calculation were selected by the Seismic Review Team (SRT) that performed the raceway walkdown. The selections are documented in the Plant Area Summary Sheets (PASS), which are part of the project documentation.

Plant Seismic Response Spectra

Horizontal seismic accelerations are required for the Lateral Load Evaluation and the Rod Hanger Fatigue Evaluations as defined in the GIP, Ref. 3.6.4.

Lateral Load Evaluations:

Three options are presented in the GIP, Ref. 3.6.4, Section 8.3.4 for determining the horizontal seismic acceleration to be used in lateral load evaluations. Acceleration values for D.C.Cook corresponding to each of the options are summarized below.

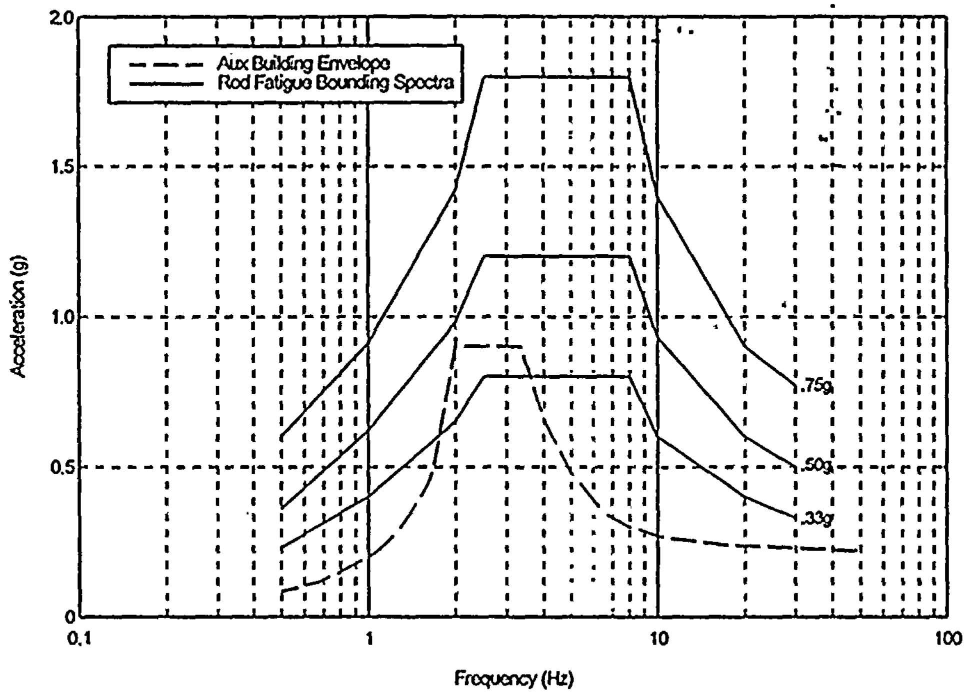
Elevation	ZPA	Building	Option 1	Option 2	Option 3
587	0.20	Aux	1.21	0.63	0.94
633	0.22	Aux	1.21	0.69	0.94
650	0.22	Aux	1.21	0.69	0.94
609	0.22	DGB	1.21	0.69	0.94
598	0.32	Cont	1.21	1.00	0.94
612	0.37	Cont	1.21	1.16	0.94
625	0.42	Cont	1.21	1.31	0.94
651	0.52	Cont	1.21	1.63	0.94
699	0.80	Cont	1.21	2.50	2.50

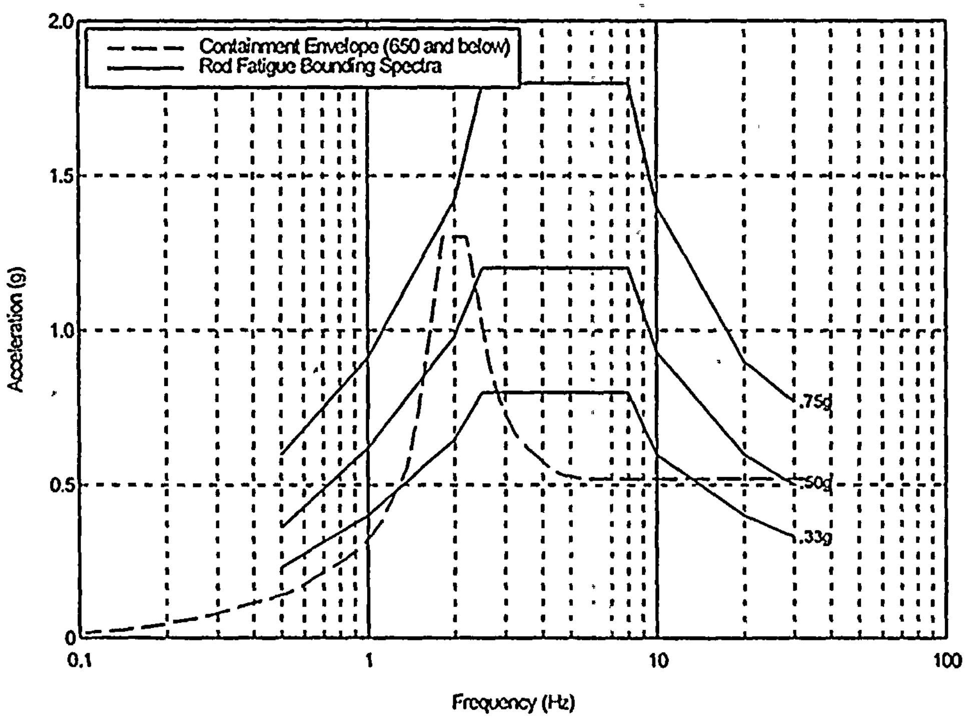
Option 1: 2g scaled by the maximum of SSE/Bounding Spectrum (ZPA value controls)
Option 2: 2.5*1.25*Floor ZPA (1.25 is for 'realistic' floor spectra)
Option 3: 2.5*1.25*1.5*SSE ZPA (within 40' of grade)

Conclusion: Option 2 for Aux and DGB, Option 3 for Containment

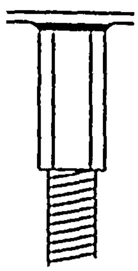
Rod Hanger Fatigue Evaluations:

The rod fatigue bounding spectra provided in the GIP, Ref. 3.6.4, Figure 8-9, are plotted below vs. the envelope of the D.C.Cook 5% damping spectra for the Auxiliary Building and the envelope for Containment at El. 650' and below. These curves are used to determine the applicable bounding curve in the Fatigue Evaluation Screening Charts, Figure 8-10 to 8-14 of the GIP.





Fatigue Evaluation Screening Charts and Procedures

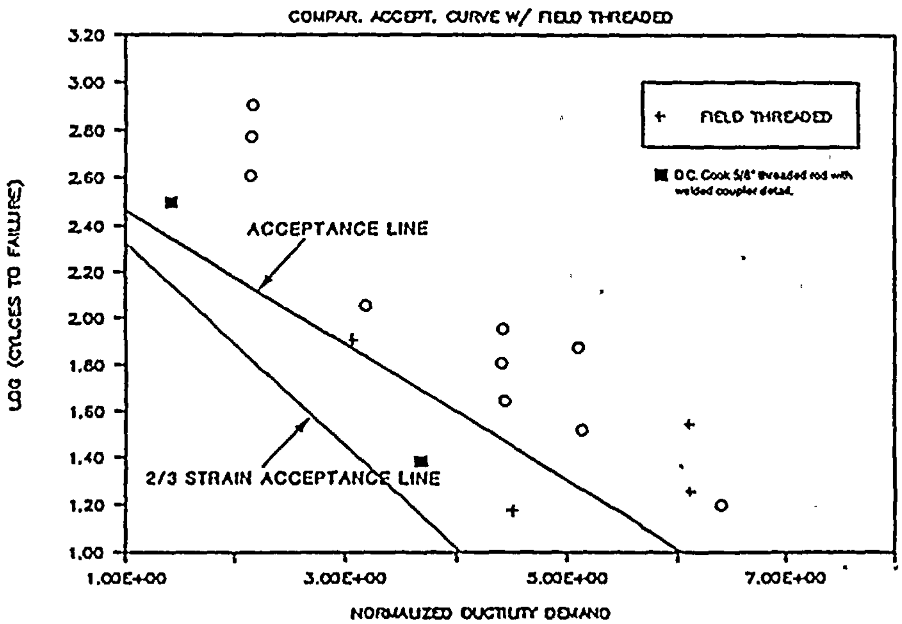


All threaded rods used in raceway supports at D.C.Cook are manufactured all-thread rods. Some rods, however, are anchored using the welded rod coupler detail shown to the right. The SRT was concerned that the coupler material is not as ductile as the rod material, particularly after being welded.

Fatigue tests were performed on D.C.Cook threaded rods with the welded rod coupler detail (Ref.3.6.23). These tests show that for the same ductility demand, the number of cycles to failure using the welded coupler detail is approximately half the number of cycles to failure using typical "nutted" rod connection details at D.C. Cook (Ref. 3.6.6, Table 8-2).

The test data points for the welded coupler detail are plotted below on Figure 8-5 from Reference 3.6.6 (this figure was used to develop the fatigue evaluation screening charts in the GIP). Each test data point represents 3 tests (6 tests total) on 5/8" rods with an applied axial tensile preload (σ_T) of 2.2 ksi (500 lb.) The test data points lie above the "2/3 Strain Acceptance Line", which represents the ductility demand vs. cycles to failure acceptance criteria for field-threaded rods. Therefore, in these LAR's, in order to cover rod-hung raceway supports that have not been selected as LAR candidates because of lower weight or longer length, but which may have welded coupler anchorage details, Rod Hanger Fatigue Evaluations will conservatively include the procedures specified in the GIP for field-threaded rods.

FATIGUE DATA FOR THREADED RODS



3.6 References

3.6.1 "Manual of Steel Construction, Allowable Stress Design", 9th Edition, American Institute of Steel Construction, Inc. Chicago, IL, 1989.

3.6.2 "General Engineering Catalog", No. 10, Unistrut Building Systems, GTE Products Corporation, Wayne, MI, 1983.

3.6.3 "General Engineering Catalog", No. 12, North American Edition, Unistrut Corporation, Wayne, MI, 1992.

3.6.4 "Generic Implementation Procedure (GIP), for Seismic Verification of Nuclear Plant Equipment", Revision 2A, March, 1993, Seismic Qualification Utility Group.

3.6.5 "Design of Welded Structures", Omer W. Blodgett, James F. Lincoln Arc Welding Foundation, July 1976.

3.6.6 "Seismic Evaluation of Rod Hanger Supports for Electrical Raceway Systems", EPRI NP-7152-D, March, 1991.

3.6.7 "Cable Tray and Conduit System Seismic Evaluation Guidelines", EPRI NP-7151-D, March, 1991.

3.6.8 "The Performance of Raceway Systems in Strong-Motion Earthquakes", EPRI NP-7150-D, March, 1991.

3.6.9 "Seismic Verification of Nuclear Plant Equipment Anchorage" EPRI NP 5228-SL, Revision 1,Volume 1, June, 1991.

3.6.10 AEP Guideline No. 18.3, Rev. 4, 4/9/86: "Guide for Cable Tray Loading"

3.6.11 Test Report 91C1681-02, Testing of D.C.Cook typical Unistrut attachment brackets for rod hung cable trays.

3.6.12 AEP Drawing No. 1-2-EDS-633-14, Sheet 1 of 2, 5/31/91.

3.6.13 "Longitudinal Load Resistance in Seismic Experience Database Raceway Systems", EPRI NP-7153-D, March 1991.

3.6.14 AEP Document No. 02-0120-1097, Revision 0, Page 3 (Rigid Conduit Weights)

3.6.15 Letter from I.C.Huang of AEP Service Corporation to Steve Anagnostis of Stevenson and Associates, 1/10/94, re: as-installed conduit weights for raceway supports LAR011 and LAR017.

3.6.16 "Rigid Frame Formulas", A. Kleinlogel, Frederick Ungar Publishing Co., New York, 1952.

3.6.17 Donald C. Cook Nuclear Plant Drawings:

1-1594-4
1-1460-75
1-1528-51
1-1525-57
1-1464-83

3.6.18 AEP Guideline No. 18.2A, Rev. 0, 6/27/86: "Guide for Cable Tray System Design".

3.6.19 Telecopy dated 4/29/94 from I. Huang of AEP to Steve Anagnostis of Stevenson and Associates regarding as-installed cable tray and conduit weights for LAR's 1,3,5,9,10,16,18, and 22.

3.6.20 Letter from I.C.Huang/AEP to Steve Anagnostis/Stevenson and Associates, April 7, 1994--results of testing of D C Cook modified embedded Unistrut.

3.6.21 Stevenson & Associates Design Report, AEP Raceways 82C200-02, Cable Tray Testing--Analysis and Report, 9/30/83.

3.6.22 Telecopy from I.C.Huang/AEP to Steve Anagnostis/Stevenson and Associates, May 6, 1994--Field information concerning LAR011 (bolt spacing and conduit spans).

3.6.23 "Low Cycle Fatigue Tests on 5/8 inch Threaded Road" by Dario A. Gasparini, P.E./Ph.D., Dept. of Civil Engineering, Case Western Reserve University for Stevenson & Associates, March 25, 1992.

REQUESTED SAMPLE LAR CALCULATIONS
001,005,010,011,022,023,027,030

Stevenson and Associates
A Structural-Mechanical Consulting Engineering Firm

CLIENT AEP JOB No. 89C1570 SHEET 1 OF 6
SUBJECT A46 LAR'S
DC COOK, LAR-001
(PASS ID # RACE-125, LAR #1)
AUX BLDG. EL 609'-0"

REVISIONS
0 CCE 4/26/94
AF 5/25/94

REF LOAD CALCULATIONS

P.A.S.S. TRIBUTARY LENGTH = (5'-9 3/4" + 5'-9 3/4")/2 = 5.8'

6.14 CONDUIT WEIGHTS: USE DC COOK GENERIC CONDUIT WEIGHTS PER REFERENCE 6.14:

4" = 16.6 #/FT × 5.8' = 96 #

2" = 4.9 #/FT × 5.8' = 28 #

3/4" = 1.3 #/FT × 5.8' = 8 #

6.19 CABLE TRAY WEIGHTS: USE SPECIFIC CABLE TRAY WEIGHTS AS PROVIDED BY REF 6.19, SEE FINAL PAGE OF THIS LAR

6.4 SECT. 8.3.1 DEAD LOAD CHECK

CHECK BENDING IN CROSS-MEMBERS:

CENTER P1000:

8# 28# 32# 84#

F_2 13" 2 1/4" 5 1/2" 11 3/8" 6 3/8" F_3

INDICATES ROD NO. FROM LEFT (1@3/4") (1@2) (4@3/4") (3@2")

38.5"

(152 # TOTAL)

F_2 = 84(6 3/8) + 32(17 3/4) + 28(23 1/4) + 8(25.5)/38.5

F_2 = 51 # F_3 = 101 #

MMAX = 842 IN-LB < 5080 IN-LB ∴ OK (INT = 0.17)

CENTER ∠ 2×2×1/4:

28.5" 10"

F_2 96 # F_3

F_2 = 25 #. F_3 = 71 # MMAX = 710 IN-LB

M/S = 710/0.247 = 2.9 KSI < 21.6 ∴ OK (INT = 0.13)

CLIENT AEP JOB No. 89C1570 SHEET 2 OF 6

SUBJECT A46 LAR'S
DC COOK, LAR-001
(PASS ID # RACE 125, LAR #1)
AUX BLDG EL. 609'-0"

REVISIONS
0 CCF 4/26/94
A.K. 5/25/94

REF. DEAD LOAD CHECK (CONT'D)

RIGHT ∠ 2x2x1/4 WITH 2 TRAYS, BOTTOM TIER:

154# 62#

7 1/2" 12" 7 1/2"

F_3 F_4

LEFT TRAY = 26.6 #/FT × 5.8' = 154#

RIGHT TRAY = 10.7 #/FT × 5.8' = 62#

$F_3 = 128^{\#}$, $F_4 = 88^{\#}$

$M_{MAX} = 128(7.5) = 960$ IN-LB

$M/S = 960/0.247 = 3.9$ KSI < 21.6 ∴ OK

(INT = 0.18)

CHECK ANCHORAGE

TOTAL F_1 (ROD 1, LEFT-MOST ROD)

$F_1 = \frac{1}{2}(8.9 + 30.8 + 12.6 + 9.2 + 9.1 + 11.5)(5.8')$

$F_1 = 238^{\#}$

TOTAL F_2 (ROD 2)

$F_2 = 238^{\#} + 51^{\#} + 25^{\#} = 314^{\#}$

TOTAL F_3 (ROD 3)

$F_3 = 101^{\#} + 71^{\#} + 128^{\#}$

$+ 5.8'\left(\frac{19.5''}{27''}\right)(18.2 + 12.6 + 22.8) \Big\}(=225^{\#})$

$+ 5.8'\left(\frac{7.5''}{27''}\right)(10.5 + 12.6) \Big\}(=37^{\#})$

$F_3 = 562^{\#}$

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CLIENT AEP JOB No. 89C1570 SHEET 3 OF 6

SUBJECT A46 LAR'S
DC COOK, LAR-001
(PASS ID # RACE 125, LAR#1)
AUX BLDG EL. 609'-0"

REVISIONS
0 CCF 4/26/94
A.K. 5/25/94

REF. DEAD LOAD CHECK (CONT'D):

TOTAL F_4 (ROD 4, RIGHT-MOST ROD)

$$F_4 = 5.8'\left(\frac{19.5''}{27''}\right)(10.7+10.5+12.6)\ \{(=142\#)$$

$$+5.8'\left(\frac{7.5''}{27'}\right)(26.6+18.2+12.6+22.8)\ \{(=129\#)$$

$F_4 = 271\#$

FOR 5/8" Φ ROD:
ALLOWABLE PULLOUT LOAD ON EMBEDDED UNISTRUT FOR DEAD LOAD CASE = 2000#

WORST-CASE REACTION = 562# < 2000# ∴ OK

(INT = 0.28)

6.4 SECT. 8.3.2 VERTICAL CAPACITY CHECK (3×DL)

CHECK ANCHORAGE FOR 3×DL:

ALLOW. PULLOUT ON EMBEDDED STRUT FOR 3×DL CASE = 2500# FOR 5/8" Φ ROD:
3×562# = 1690# < 2500# ∴ OK
(INT = 0.68)

6.4 SECT. 8.3.3 DUCTILITY CHECK

FIXED-END ROD HANGER SUPPORT SYSTEMS ARE INHERENTLY DUCTILE. PROCEED TO ROD HANGER FATIGUE EVALUATION.

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CLIENT AEP JOB No. 89C 1570 SHEET 4 OF 6

SUBJECT A46 LAR'S
DC COOK, LAR-001
(PASS ID # RACE 125, LAR #1)
AUX BLDG. EL. 609'-0"

REVISIONS
0 CCF 4/26/94
AK. 5/25/94

REF — ROD HANGER FATIGUE EVALUATION

6.4 SECT. 8.3.5 — RIGHT-MOST RODS (3 + 4) ARE WORST-CASE.

TOTAL WEIGHT: $F_3 + F_4 = 562 + 271 = 833^{\#}$

ROD LENGTH: 4'-0 3/4"

APPLICABLE ROD FATIGUE BOUNDING SPECTRUM = 0.50g (SEE SECTION 5.2 TO THIS CALC.)

THE ABOVE WEIGHT/ROD LENGTH COMBINATION FALLS WITHIN THE ACCEPTABLE REGION OF THE FATIGUE EVALUATION SCREENING CHART FOR 5/8" DIAMETER MANUFACTURED ALL-THREAD RODS (FIG. 8-13 OF REF 6.4)

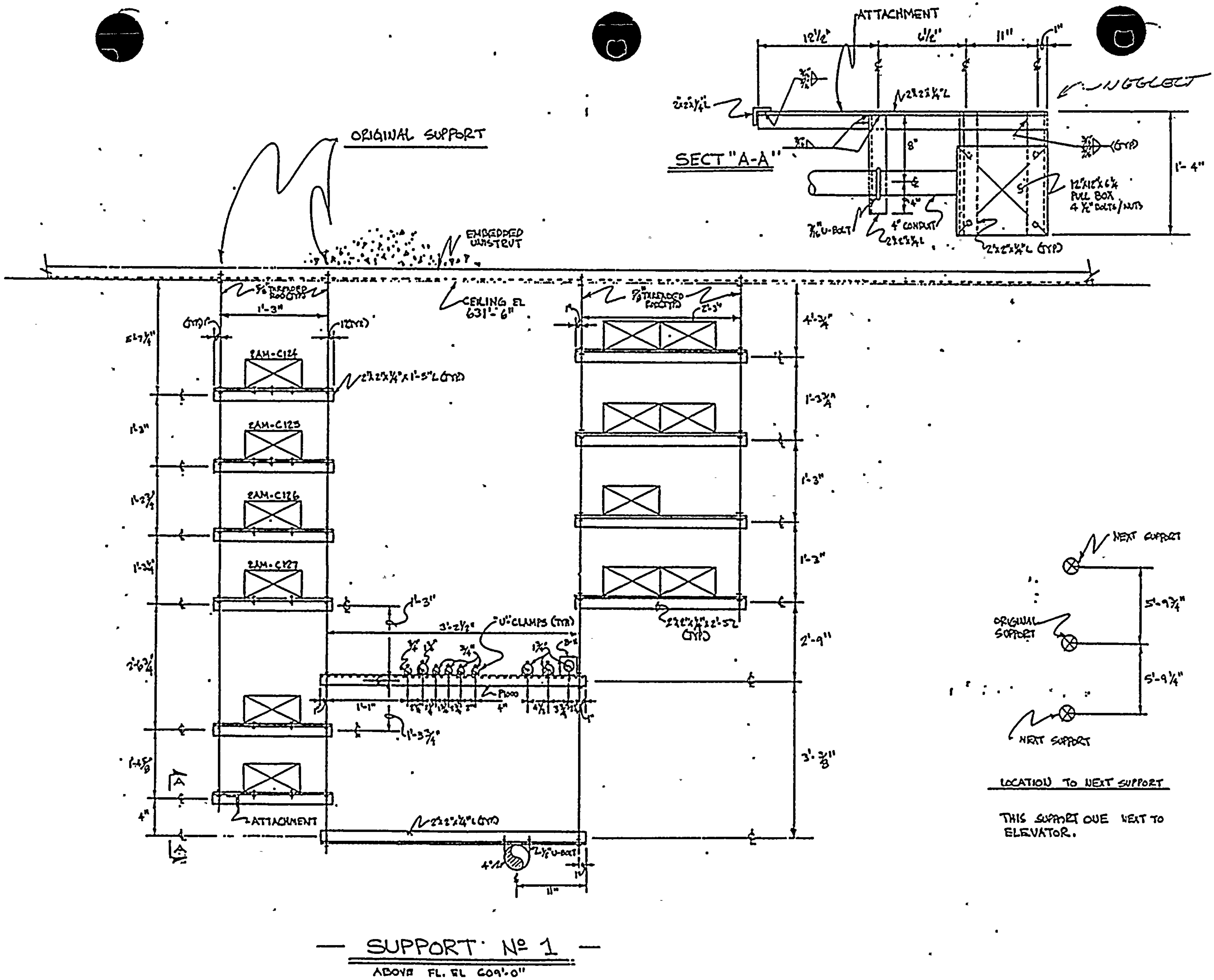
∴ OK

PERFORM FATIGUE EVALUATION ASSUMING WELDED ROD COUPLER ANCHORAGE DETAIL (FOLLOW PROCEDURE FOR FIELD-THREADED RODS - SEE SECTION 5.3 TO THIS CALC.):

$$\left.\begin{array}{l} W = 2 \times 833 = 1670^{\#} \\ L = 2/3 \times 48 = 32'' \end{array}\right\} \Rightarrow \text{COMBINATION OK}$$

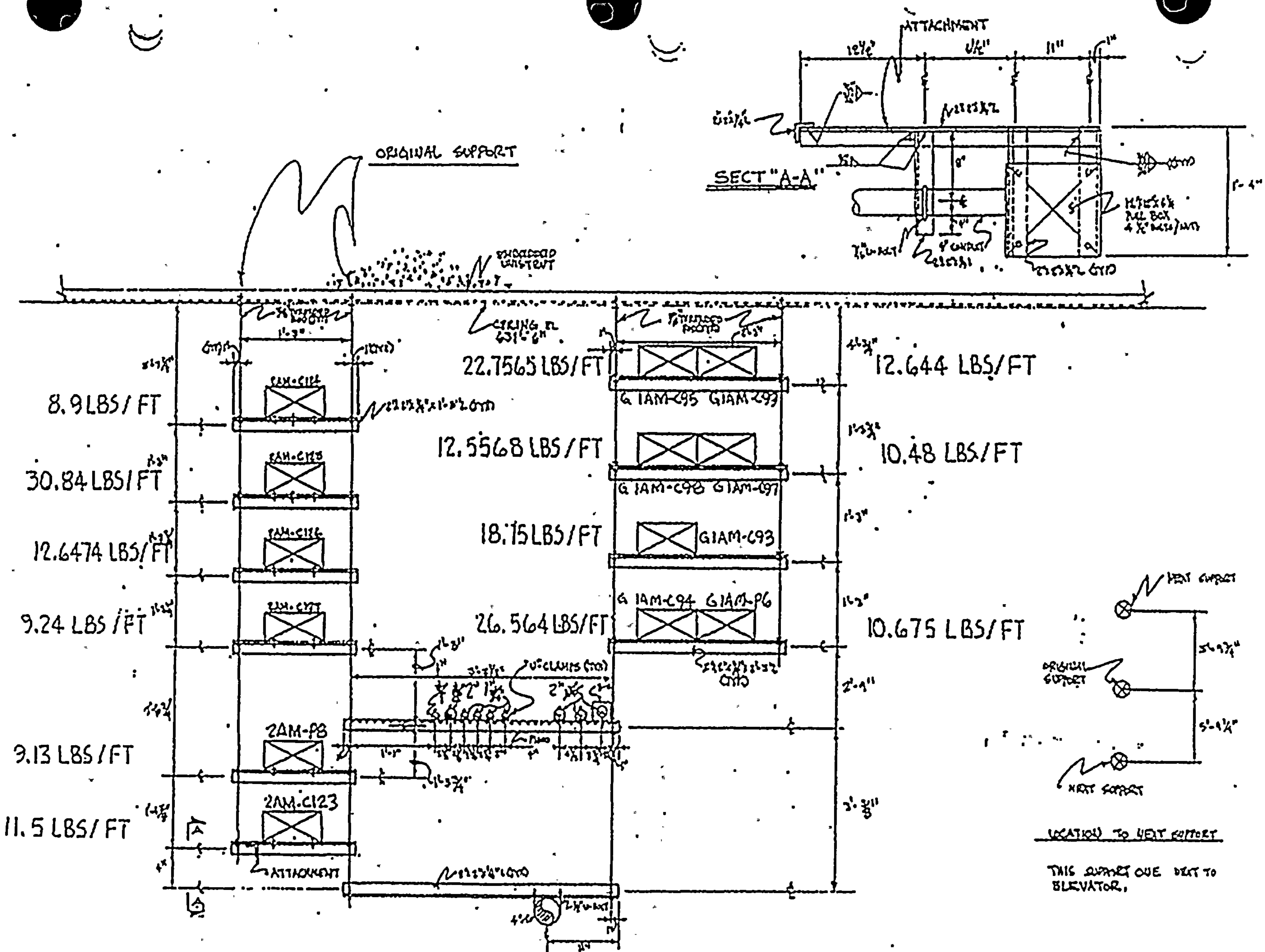
CONCLUSION

THIS SUPPORT SATISFIES THE LIMITED ANALYTICAL REVIEW REQUIREMENTS SET FORTH IN REF 6.4 AND IS THEREFORE CONSIDERED TO BE SEISMICALLY ADEQUATE


ORIGINAL SUPPORT
EMBEDDED UNISTRUT
CEILING EL 631'-6"
SECT "A-A"
ATTACHMENT
12 1/2"
6 1/2"
11"
1"
2"x2"x1/4"L
1'-4"
12"x12"x6 1/4" PULL BOX 4 1/2" BOLTS/NUTS
4" CONDUIT
2"x2"x1/4"L (TYP)
2AM-C124
2AM-C125
2AM-C126
2AM-C127
2"x2"x1/4"x1'-5"L (TYP)
"U" CLAMPS (TYP)
2"x2"x1/4"x2'-5"L (TYP)
2"x2"x1/4"L (TYP)
2 1/2" U-BOLT
1'-3"
1'-3 3/4"
2'-9"
3'-2 1/2"
NEXT SUPPORT
ORIGINAL SUPPORT
5'-9 3/4"
5'-9 1/4"
LOCATION TO NEXT SUPPORT
THIS SUPPORT DUE NEXT TO ELEVATOR.
SUPPORT Nº 1
ABOVE FL. EL 609'-0"

LAKOO1

9/6



ACTUAL WEIGHTS FOR LAR# 1

CONDUIT IDENTIFICATION UNKNOWN

SUPPORT № 1

ABOVE FL. EL 609'-0"

L/R001 6/6

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CLIENT: AEP JOB No. 89C1570 SHEET 1 OF 6

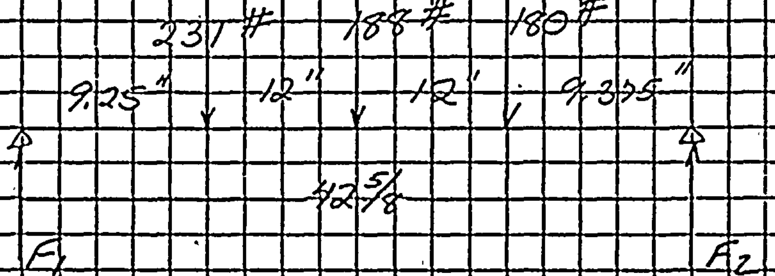
SUBJECT: A46 LAR'S
DC COOK UNIT 1
LAR-005
(PASS ID# RACE103, LAR #1)
AUX. BLDG. EL. 625'

REVISIONS: 0 — CCE 5/5/94, A.K. 5/25/94

REF	
	LOAD CALCULATIONS
PASS	TRIBUTARY LENGTH = [(3'-5" + 6'-2")/2 + (3'-5½" + 4'-8")/2]/2 = 5.5'
6.19	CONDUIT AND CABLE TRAY WEIGHTS: USE ACTUAL CONDUIT AND CABLE TRAY WEIGHTS AS PROVIDED BY REF 6.19, SEE FINAL PAGE OF THIS LAR.
6.4 SECT. 9.3.1	**DEAD LOAD CHECK**

CHECK MEMBER BENDING STRESS:

BOTTOM TIER GOVERNS:



(TOTAL LOAD THIS TIER = 599 #)

$F_2 = [231(9.25) + 188(21.25) + 180(33.25)]/42.625$

$F_2 = 284$ #

$F_1 = 315$ #

$M_{MAX} = 315(21.25) - 231(12) = 3922$ IN-LB

$M_{MAX}/S_{2\times2\times1/4} = 3922/0.247 = 15.9$ KSI $<$ 21.6 KSI

∴ OK (UNIT = 0.74)

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CLIENT AEP JOB No. 89C1570 SHEET 2 OF 6

SUBJECT A46 LAR'S
DC COOK UNIT 1
LAR-005
(PASS ID # RACE 103, LAR # 1)
AUX BLDG EL. 625'

REVISIONS
0 CCF 5/5/94
A.K 5/25/94

REF. DEAD LOAD CHECK (CONT'D)

CHECK ANCHORAGE DETAIL @ EMBEDDED STRUT

REACTIONS @ TOP TIER:

16# 18# 18# 10# 10# 161# 60#

3¾, 2¼, 2¼, 2¼, 2¼, 8⅛, 12

42 5/8

F_1 F_2

(TOTAL LOAD THIS TIER = 293#)

$F_2 = [16(3\frac{3}{4}) + 18(6+8.5) + 10(10\frac{3}{4}+13) + 161(21.1) + 60(33.1)] / 42\frac{5}{8}$

$F_2 = 139$ LB

$F_1 = 154$ LB

REACTIONS @ MIDDLE TIER:

59# 59# 79# 143#

4½", 6", 10⅝", 12", 9½"

(TOTAL LOAD THIS TIER = 340#)

F_1 F_2

$F_2 = [59(4.5+10.5) + 79(21.1) + 143(33.1)] / 42\frac{5}{8}$

$F_2 = 171$ #

$F_1 = 169$ #

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CLIENT: AEP JOB No. 89C1570 SHEET 3 OF 6

SUBJECT: A46 LAR'S
DC COOK UNIT 1
LAR-005
(PASS ID# RACE 103, LAR #1)
AUX BLDG EL. 625'

REVISIONS: 0 CCF 5/5/94 A.K 5/25/94

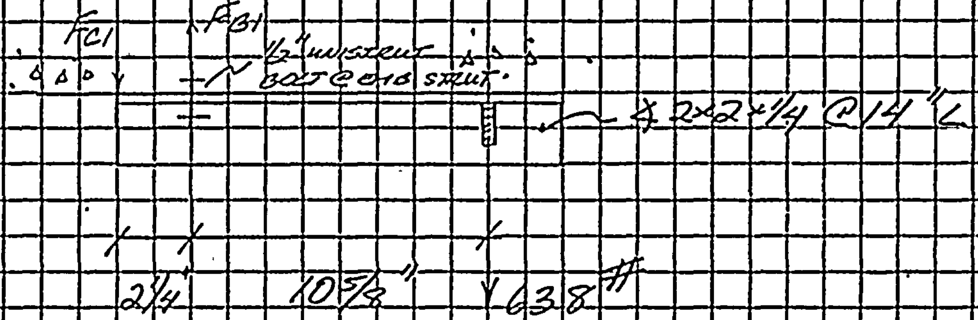
Ref. DEAD LOAD CHECK (CONT'D)

LOADS @ ANCHORAGES:

$F_{1\,TOTAL} = 315 + 154 + 169 = 638\#$

$F_{2\,TOTAL} = 284 + 139 + 171 = 594\#$

LOOK @ ANCHORAGE @ F_1 – WORST LOAD AND LARGEST ECCENTRICITY:



$F_{B1} = 638(12\,7/8)/2\,1/4 = 3650\#$

ALLOWABLE PULLOUT LOAD ON THE ON THE EMBEDDED = ALLOWABLE PULLOUT LOAD ON 1/2" UNISTRUT BOLT = 2000#

$3650 > 2000\#$ ∴ FAILS
(INT = 1.8)

SUPPORT IS AN OUTLIER

CLIENT AEP JOB No. 89C1570 SHEET 4 OF 6

SUBJECT A46 LAR'S
DC COOK UNIT 1
LAR-005
(PASS ID # RAUS 103, LAR # 1)
AUX BLDG EL 625'

REVISIONS: 0 CCF 5/5/94, A.K. 5/25/94

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REF. DEAD LOAD CHECK (CONT'D)

CHECK ∠ 2×2×1/4 IN BENDING:

M = 638# (10.625") = 6780 IN-LB

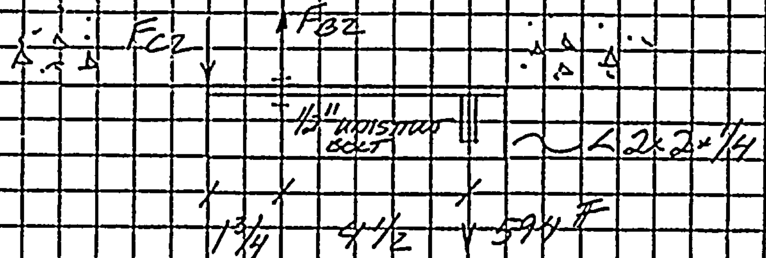
M/S = 6780/0.297 = f_b = 22.8 KSI

6.1 p. 5-311 1.25 f_b < F_b = 0.66 Fy = 23.8 KSI

1.25 (22.8) = 34.8 > 23.8 ∴ FAILS

(INT = 1.5)

CHECK OTHER ANCHORAGE @ F_Z:



F_{BZ} = 594 (6.25)/1.75 = 2120 #

ALLOWABLE PULLOUT ON STRUT = ALLOWABLE PULLOUT ON 1/2" UNISTRUT BOLT = 2000 #

2120 > 2000 ∴ FAILS (INT = 1.06) → SAY OK

CHECK BENDING IN ∠ 2×2×1/4:

M = 594 (4.5) = 2670 IN-LB

6.1 p. 5-311 f_b = 1.25 (2670)/0.247 ≤ 0.66 Fy

13.5 KSI < 23.8 ∴ OK

(INT = 0.57)

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CLIENT AEP JOB No. 89C1570 SHEET 5 OF 6

SUBJECT A46 LAR'S
DC COOK UNIT 1
LAR-005
(PASS ID # RACE 103, LAR #1)
AUX. BLDG. EL. 625'

REVISIONS
0 CCF 5/5/94
A.K. 5/25/94

REF.	VERTICAL CAPACITY CHECK (3×DL)
6.4 Sect. 8.3.2	AT ANCHORAGE #1:
	COMPARE 3× PULLOUT LOAD ON 1/2" UNISTRUT BOLT TO 2000 LB ALLOWABLE:
	$3F_{B1} = 3(3650) = 10,950$ LB
	$10,950 > 2000$ ∴ FAILS (UNT. = 5.6)
	COMPARE 3× BENDING STRESS IN ∠ 2×2×1/4 TO 0.9 Fy:
	$3(1.25 f_{B1}) = 3(34.8) = 104$ KSI
	104 KSI $> 0.9(36) = 32.4$ KSI ∴ FAILS (UNT = 3.2)
	AT ANCHORAGE #2:
	COMPARE 3× PULLOUT LOAD ON 1/2" UNISTRUT BOLT TO 2000 LB ALLOWABLE:
	$3F_{B2} = 3(2120) = 6360$ LB
	$6360 > 2000$ ∴ FAILS (UNT = 3.2)
	COMPARE 3× BENDING STRESS IN ∠ 2×2×1/4 TO 0.9 Fy:
	$3(1.25 f_{B2}) = 3(13.5) = 40.5$ KSI
	40.5 KSI > 32.4 KSI ∴ FAILS (UNT = 1.3)

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CLIENT AEP JOB No. 89C1570 SHEET 6 OF 6

SUBJECT A46 LAR'S

DC COOK UNIT 1

LAR-005

(PASS ID # RACE 103, LAR # 1)

AUX. BLDG. EL. 625'

REVISIONS 0 CCF 5/5/94 A.K. 5/25/94

REF.	DUCTILITY CHECK
6.4 SECT 8.3.3	WITH ADEQUATE ANCHORAGE, THIS ROD HANGER TRAPEZE SUPPORT WOULD BEHAVE IN A DUCTILE MANNER UNDER HORIZONTAL MOTION. A ROD HANGER FATIGUE EVALUATION WILL BE PERFORMED.

	ROD HANGER FATIGUE EVALUATION
6.4 SECT. 8.3.5 FIG. 8-9 E 8-13	$L = 2'-10''$ $W = 599 + 293 + 340 = 1232^{\#}$

USE 0.5g ROD FATIGUE BOUNDING SPECTRUM (ENVELOPES AUX BLDG ENVELOPE SPECTRUM: SEE SECTION 5.2 TO THIS CALCULATION)

THIS ROD HANGER SUPPORT HAS THE WELDED ROD COUPLER ANCHORAGE DETAIL. THEREFORE FOLLOW PROCEDURE FOR FIELD-THREADED RODS (SEE SECTION 5.3 TO THIS CALCULATION):

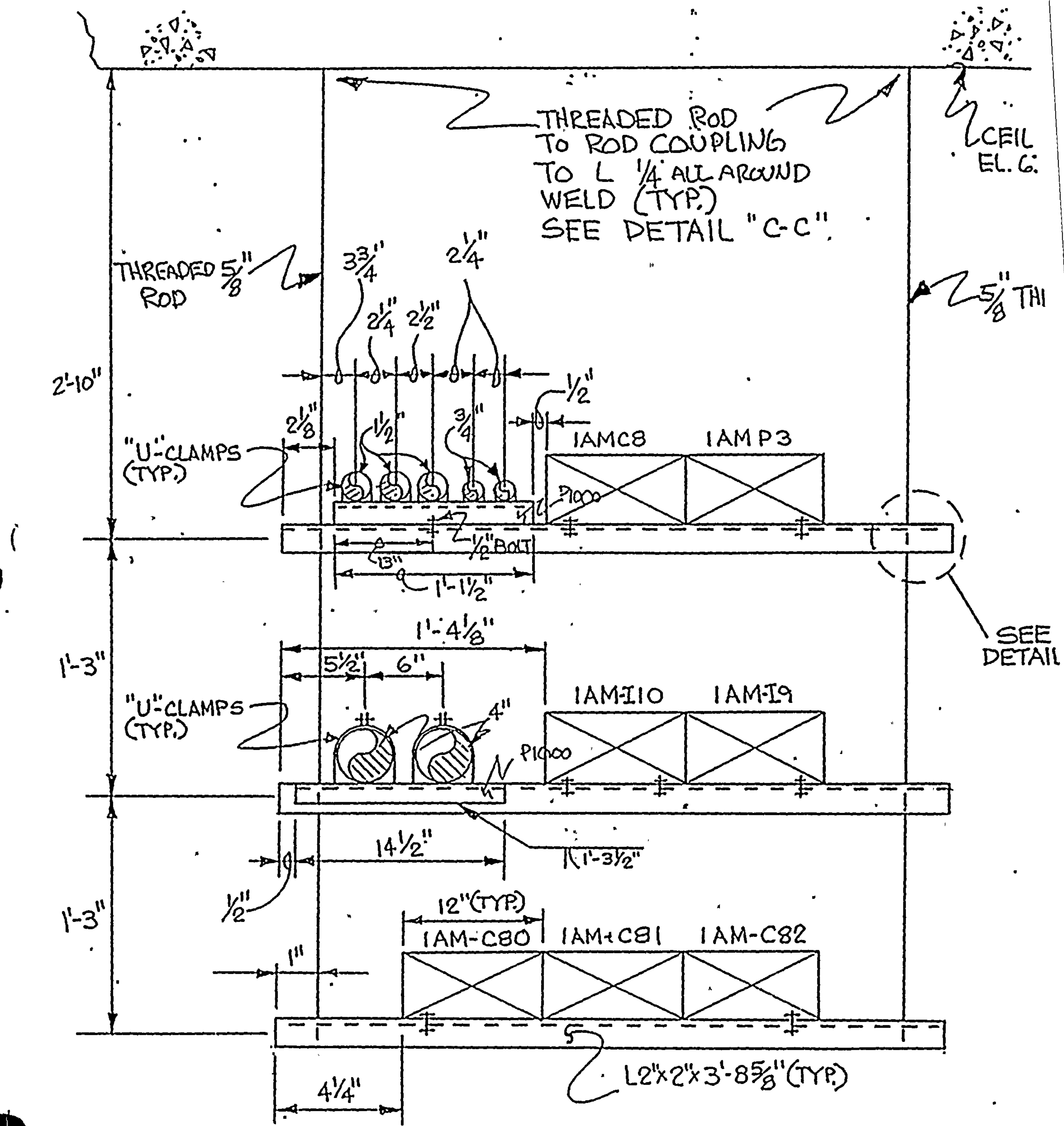
$2 \times W = 1232 \times 2 = 2460^{\#}$

$2/3\ L = 2/3\ (34'') = 23''$

THE MODIFIED WEIGHT AND ROD LENGTH COMBINATION ABOVE FALLS WITHIN THE ACCEPTABLE REGION OF THE FATIGUE EVALUATION SCREENING CHART FOR 5/8" DIAMETER MANUFACTURED ALL-THREAD ROD, ∴ OK

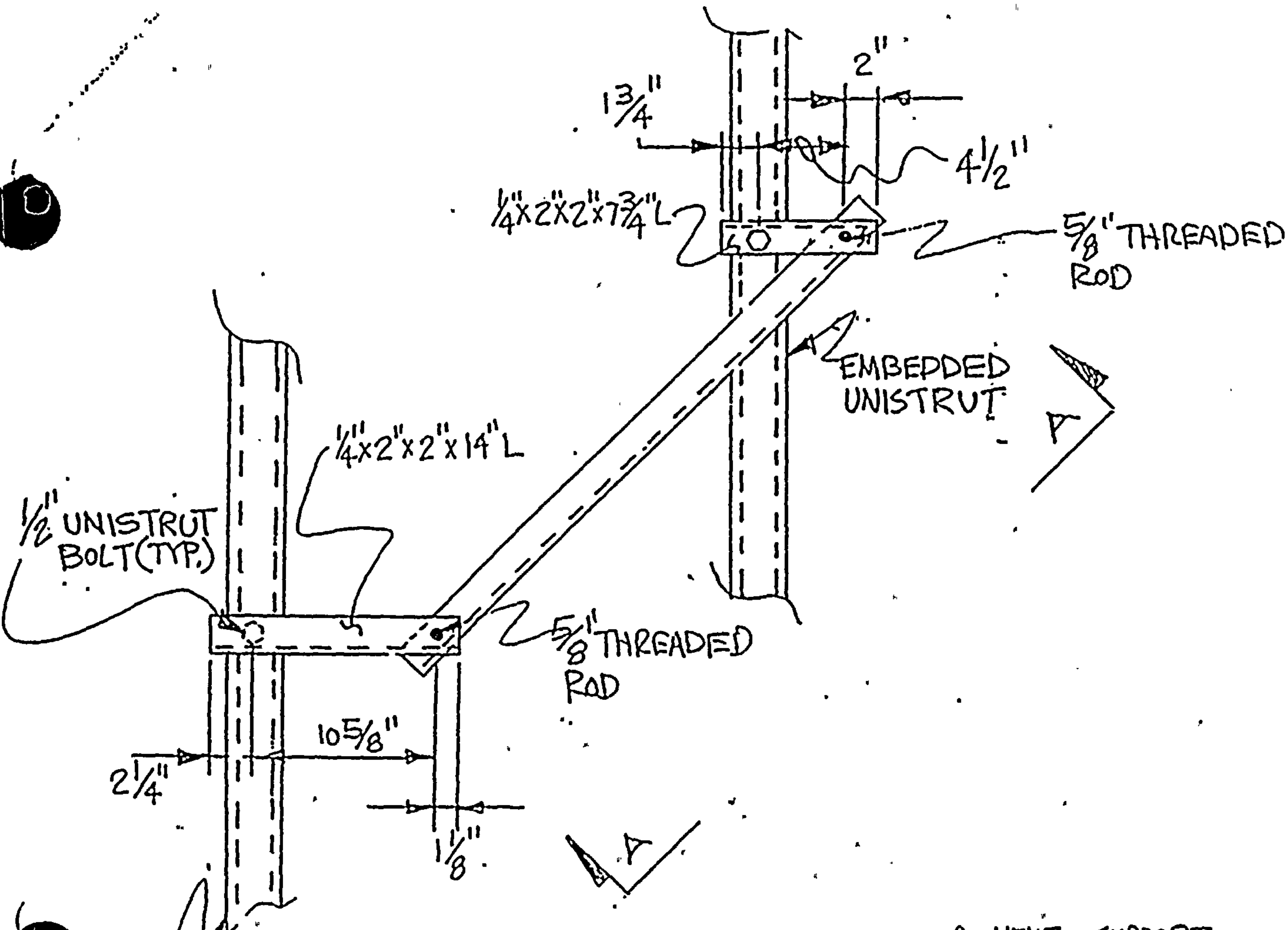
CONCLUSION

THIS SUPPORT FAILS TO SATISFY THE ACCEPTANCE CRITERIA OF REF 6.4 FOR DEAD LOAD (ONE OF 2 ANCHORAGE LOCATIONS FAILS) AND VERTICAL CAPACITY (BOTH ANCHORAGE LOCATIONS FAIL) AND IS THEREFORE AN OUTLIER.

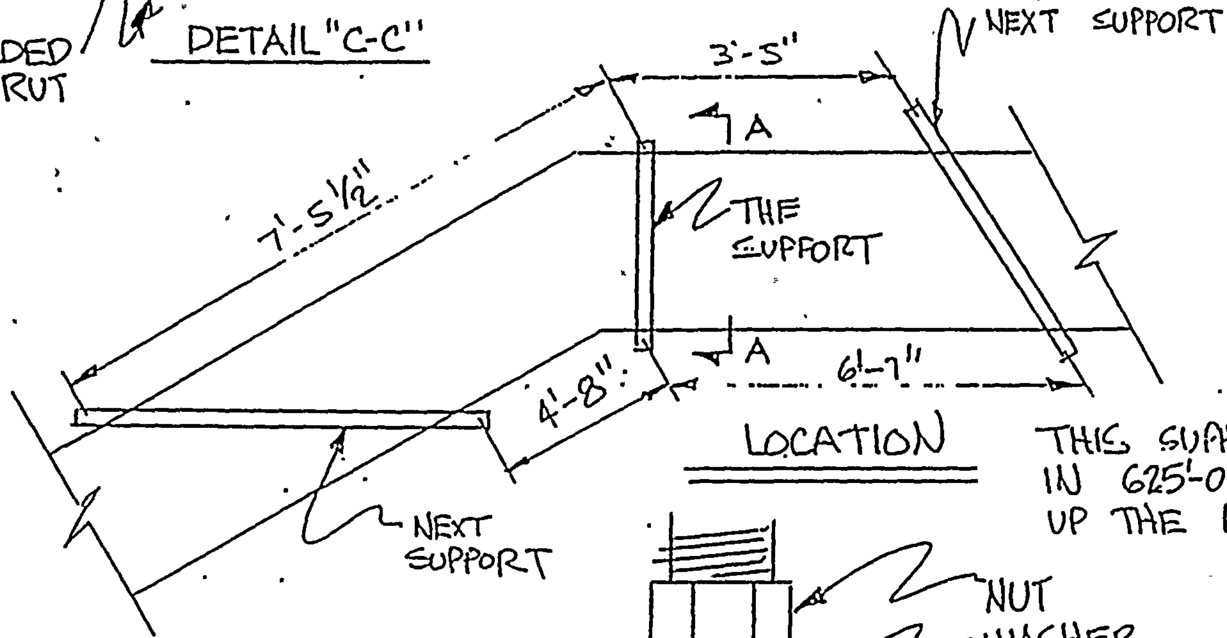


THREADED ROD
TO ROD COUPLING
TO L 1/4 ALL AROUND
WELD (TYP.)
SEE DETAIL "C-C".
CEIL
EL. 6.
THREADED 5/8" ROD
3 3/4"
2 1/4"
2 1/4"
2 1/2"
5/8" THI
2'-10"
1/2"
2 1/8"
1/2"
3/4"
"U"-CLAMPS (TYP.)
1AMC8
1AMP3
P1000
1/2" BOLT
13"
1'-1 1/2"
SEE DETAIL
1'-4 1/8"
5 1/2"
6"
1'-3"
"U"-CLAMPS (TYP.)
4"
1AM-I10
1AM-I9
P1000
14 1/2"
L 1'-3 1/2"
1/2"
1'-3"
12" (TYP.)
1AM-C80
1AM-C81
1AM-C82
1"
L2"x2"x3'-8 5/8" (TYP.)
4 1/4"

SECT "A-A"

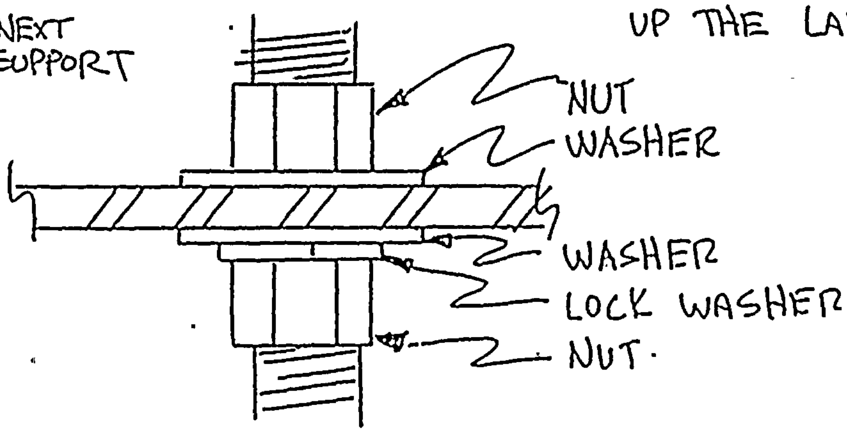


DETAIL "C-C"



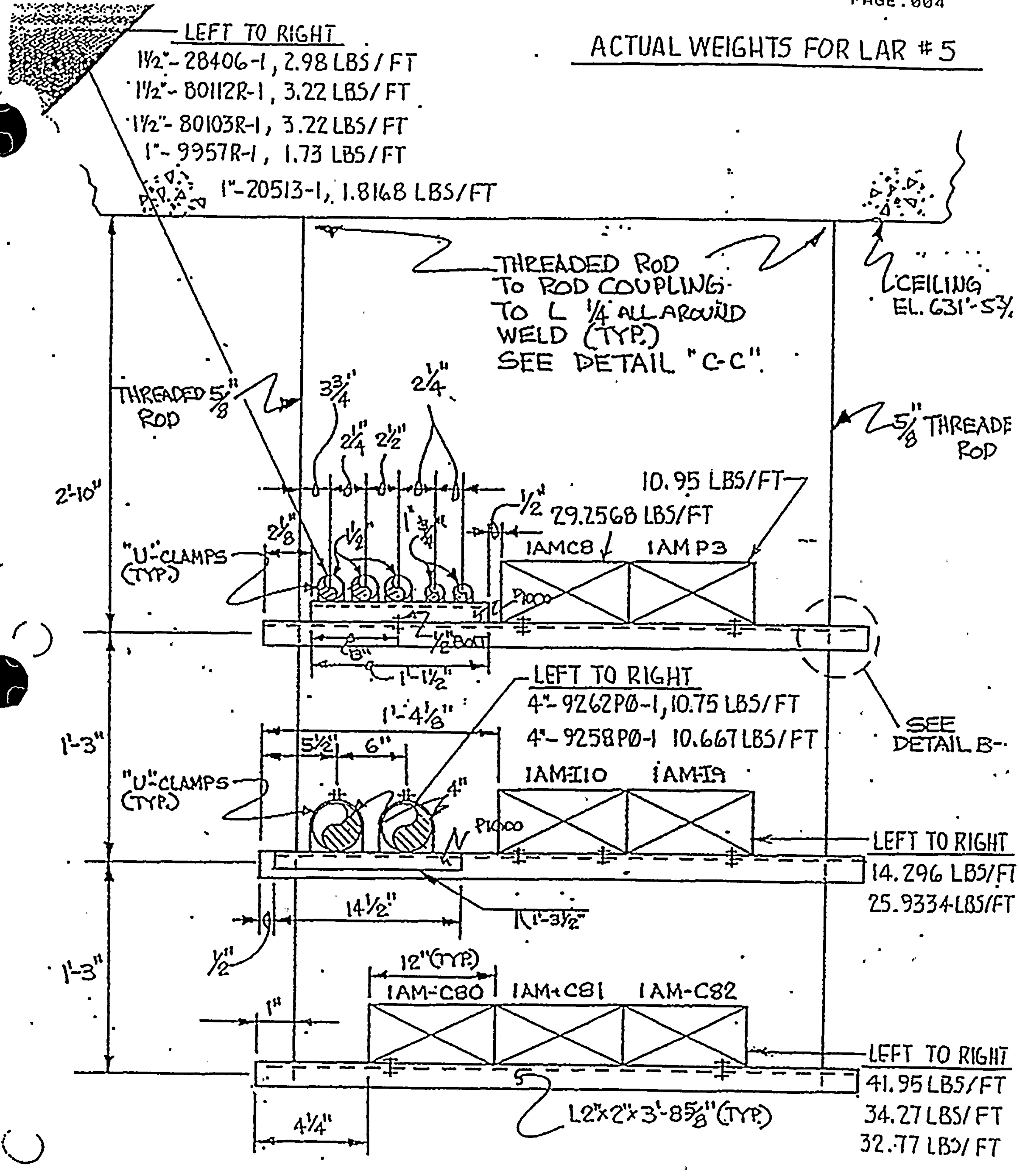
LOCATION

THIS SUPPORT ONE IN 625'-0 VESTIBULE UP THE LADDER



"B-B"

ACTUAL WEIGHTS FOR LAR # 5



SECT "A-A"

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CLIENT AEP JOB No. 89C1570 SHEET 1 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID# RACE109, LAR #2)
AUX. BLDG. EL. 596'

REVISIONS
0 CCF 5/18/94
A.K. 5/26/94

REF. THIS LAR EVALUATES A SYSTEM OF CABLE TRAY AND CONDUIT SUPPORTS IN THE UNIT 1 AUX BLDG WHICH SUPPORT APPROXIMATELY 36 FEET OF CABLE TRAY AND CONDUIT RUN. THE SUPPORT SYSTEM INCLUDES ONE CONDUIT TRAPEZE, ONE CABLE TRAY TRAPEZE, 3 WALL BRACKETS AND ONE COMBINATION WALL/FLOOR BRACKET.

THE CABLE TRAY AND CONDUIT SPANS TO EACH SUPPORT ARE AS FOLLOWS:

PASS	1/2 × 7'-0"	= 3'-6"	FROM PREVIOUS CONDUIT AND CABLE TRAY TRAPEZE SUPPORTS
		+ ~2'-0"	TO DIRECTIONAL CHANGE FROM HORIZONTAL TO VERTICAL RUN
		+ ~3'-0"	TO FIRST CONDUIT TIE (TIES ARE NOT ATTACHED TO BUILDING)
		+ 5'-4 3/4"	TO SECOND CONDUIT TIE
		+ 5'-1 5/8"	TO FIRST WALL BRACKET
		+ 5'-11 1/4"	TO SECOND WALL BRACKET
		+ 5'-11 1/4"	TO THIRD WALL BRACKET
		+ 3'-6"	TO COMBINATION WALL/FLOOR BRACKET
	+ 1/2 × 4'-0"	= 2'-0"	TO NEXT FLOOR SUPPORT

THE TOTAL LENGTH OF RUN = 36.4'

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CLIENT AEP JOB No. 89C1570 SHEET 2 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID# PAGE 109, LAR #2)
AUX. BLDG. EL. 596'

REVISIONS
0 CGG 5/18/94
A.K. 5/26/94

REF. 6.19 THE CABLE TRAY AND CONDUIT WEIGHTS USED IN THE EVALUATION ARE ACTUAL WEIGHTS AS PROVIDED BY REF. 6.19, SEE FINAL PAGE OF THIS LAR.

"OUTBOARD" CABLE TRAYS:

(1) @ 27.07 #/FT
(1) @ 19.35 ⟹ 71 #/FT
(1) @ 24.06

"INBOARD" CABLE TRAYS + TWO 4" CONDUITS:

(1) @ 12.91
(1) @ 11.80 ⟹ 46 #/FT
(1) @ 10.67
(1) @ 10.5

CONDUIT:

(4) @ 1" = 1.69
1.69
1.73 ⟹ 17 #/FT
1.77
(1) @ 1½" = 1.95
(1) @ 3" = 7.70

TOTAL WGT/FT = 134 #/FT

(4900)

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CLIENT AEP JOB No. 89C1570 SHEET 3 OF 17

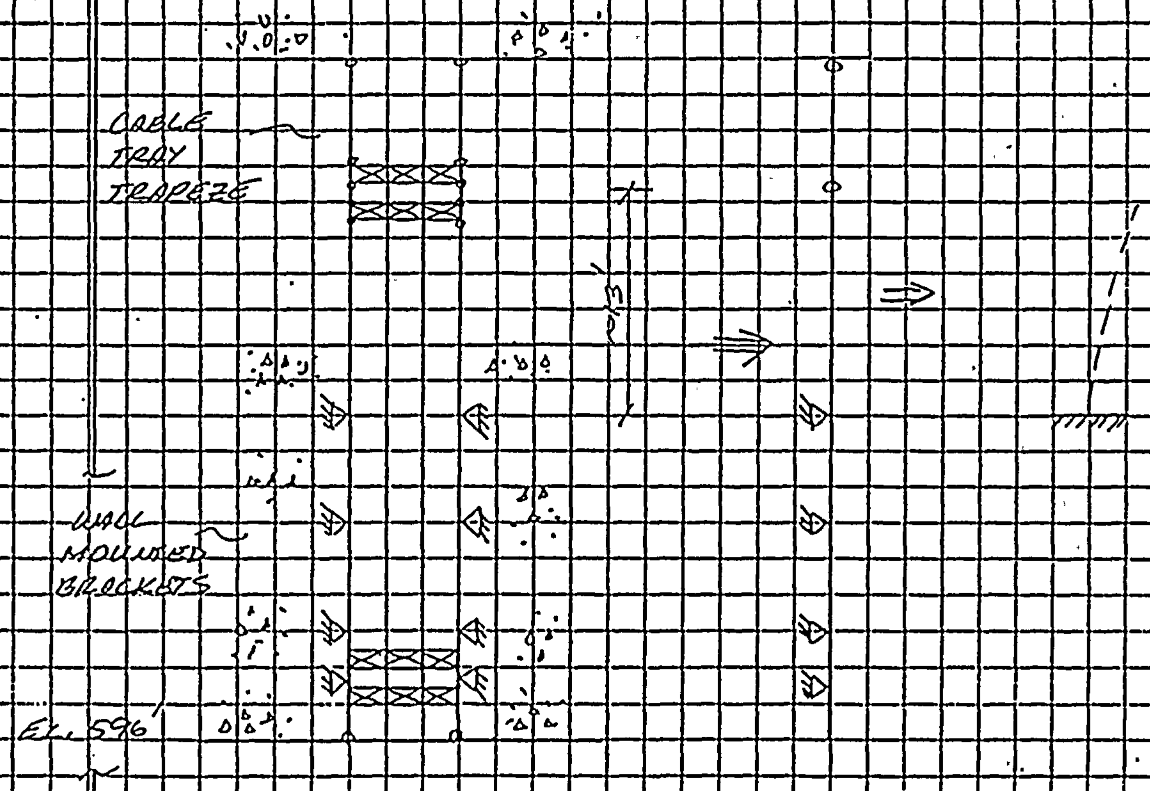
SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID # RACE 109, LAR #2
AUX BLDG EL. 596'

REVISIONS
0 CGC 5/18/94
A.K. 5/26/94

REF

EXCEPT FOR THE CONDUIT TRAPEZE, THIS SYSTEM IS TOO CONSTRAINED TO ALLOW SIGNIFICANT MOTION DURING AN EARTHQUAKE. THE FIVE CABLE TRAYS AND TWO 4"Ø CONDUITS IN COMBINATION WITH THE FOUR BRACKETS PRODUCE A SYSTEM THAT IS TOO STIFF TO ALLOW THE CABLE TRAY TRAPEZE TO SWING FREELY. STATIC LOAD TESTS PERFORMED ON DC COOK SOLID BOTTOM CABLE TRAYS (SEE REF. 6.21) ESTABLISHED A TRANSVERSE CROSS-SECTIONAL RIGIDITY, EI, OF 2.7E8 $LB\text{-}IN^2$ AND AN ALLOWABLE TRANSVERSE MOMENT OF 50,000 IN-LB. THE TWO 4"Ø RIGID STEEL CONDUITS HAVE AN EI OF $2 \times 29E6\ PSI \times 7.23\ IN^4$ $= 4.2E8\ LB\text{-}IN^2$. THE AGGREGATE EI IS THEREFORE $5 \times 2.7E8 + 4.2E8 = 1.8E9\ LB\text{-}IN^2$

LOOKING AT THE SYSTEM:



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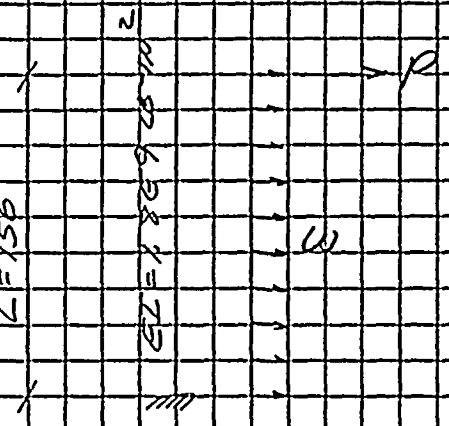
CLIENT AEP JOB No. 89C1570 SHEET 4 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID# RACB 109, LAR #2)
AUX. BLDG. EL. 596'

REVISIONS: 0 CCF 5/18/94; A.K. 5/26/94

REF — LOOK AT THE STATIC DISPLACEMENT AT THE CANTILEVER TIP DUE TO 0.69g:



WGT/FT OF OUTBOARD 3 TRAYS PLUS INBOARD 2 TRAYS AND (2) 4"Φ CONDUITS = 71 + 46 = 117 PLF

$P = (3'\text{-}6" + 2'\text{-}0") \times 117\,\#/FT \times 0.69g = 444\,\#$

$W = 117\,\#/FT / 12 \times 0.69g = 6.7\,\#/IN$

6.1 p.2-302

$\Delta = \frac{PL^3}{3EI} + \frac{WL^4}{8EI} = \frac{444(156)^3}{3(1.869)} + \frac{6.7(156)^4}{8(1.869)}$

$\Delta = 0.31 + 0.27 = 0.58"$

CHECK THAT THE TRAYS CAN CARRY THE MOMENT:

$M = 444\,\# \times 156" + 6.7(156)^2/2 = 151$ IN-KIPS

MALLOW FOR 5 TRAYS (NEGLECT 4" CONDUITS) = 5 × 50,000 = 250 IN-KIPS → O.K.

THE ABOVE CALCULATIONS SHOW THAT THE CANTILEVERED PORTION OF THE TRAYS IS CAPABLE OF SUPPORTING ITSELF WHILE IMPOSING SMALL DISPLACEMENT AT THE CABLE TRAY TRAPEZE SUPPORT. NOTE THAT THE ABOVE CALCULATIONS TREAT

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CLIENT AEP JOB No. 89C1570 SHEET 5 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID# RACE 109, LAR#2)
AUX. BLDG. EL. 596'

REVISIONS
0 CCF 5/18/94
A.K. 5/26/94

REF

THE TRAYS AS INDEPENDENT OF EACH OTHER. ACTUALLY, PER THE PASS, THESE TRAYS ARE BOLTED TOGETHER INTERNALLY. THE RESULTING COMPOSITE ACTION, WHICH HAS BEEN NEGLECTED, WOULD SUBSTANTIALLY REDUCE BOTH THE DISPLACEMENT AT THE TRAPEZE AND THE BENDING STRESSES.

BASED ON THE PRECEEDING ANALYSIS, THE SUPPORT SYSTEM WILL BE EVALUATED AS FOLLOWS:

- THE CONDUIT TRAPEZE, WHICH CAN SWING FREELY, WILL BE EVALUATED FOR DL, VERTICAL CAPACITY, AND ROD HANGER FATIGUE.
- THE CABLE TRAY TRAPEZE, WHICH IS CONSTRAINED BY THE TRAYS AND WALL MOUNTED BRACKETS, WILL BE CHECKED FOR DEAD LOAD ONLY.
- THE SUPPORT BRACKETS WILL BE CHECKED FOR DEAD LOAD AND LATERAL LOAD.

CLIENT AEP	JOB No. 89C1570 SHEET 6 OF 17
SUBJECT DC COOK LAR'S DC COOK UNIT 1 LAR-010 (PASS ID# RACE 109, LAR #2) AUX. BLDG. EL. 596'	REVISIONS 0 CGE 5/18/94 A.K. 5/26/94

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REF — CONDUIT TRAPEZE: DEAD LOAD CHECK

6.4 SECT. 8.3.1 — THE CONDUIT TRAPEZE SUPPORTS FOUR 1"Ø CONDUITS AND ONE 3"Ø CONDUIT AS FOLLOWS:

1" @ 1.69 #/FT
1" @ 1.69
1" @ 1.73
1" @ 1.77
3" @ 7.70
14.6 #/FT

TRIBUTARY LENGTH = 3'-6" + 2' + 3' + 5'-4¾" + ½(5'-1⅝") = 16.5'

TOTAL LOAD ON CONDUIT TRAPEZE:

14.6 #/FT × 16.5' = 241#

MAX MOMENT IN CROSS-MEMBER - ASSUME POINT LOAD @ MID-SPAN:

$M_{MAX} = PL/4 = 241(13.25")/4 = 800$ IN-LB

USING P1000 PROPERTIES ONLY:

$M_{ALLOW} = 5080$ IN-LB > 800 IN-LB
∴ OK (INT = 0.16)

FOR ANCHORAGE CHECK = USE 2/3 - 1/3 DISTRIBUTION:

$F_{MAX} = 2/3(241) = 161$# ON EMBEDDED STRUT

F_{MAX} = 161# MUST BE COMBINED WITH THE REACTION FROM THE CABLE TRAY TRAPEZE, WHICH IS 3¾" AWAY, BEFORE COMPARISON TO THE ALLOWABLE LOAD OF 2000#. THIS WILL BE DONE WITH THE CABLE TRAY TRAPEZE EVALUATION.

REF.	CONDUIT TRAPEZE: VERTICAL CAPACITY CHECK (3x DL)
6.4 Sect. 8.3.2	3x MAX ANCHORAGE REACTION:
	= 3 x 161# = 483#
	THE 483# ANCHORAGE LOAD MUST FIRST BE COMBINED WITH THE REACTION FROM THE CABLE TRAY TRAPEZE, WHICH IS 3 3/4" AWAY, BEFORE COMPARISON TO THE 2500# ALLOWABLE LOAD. THIS WILL BE DONE WITH THE CABLE TRAY TRAPEZE EVALUATION.
	CONDUIT TRAPEZE: DUCTILITY CHECK
6.4 Sect. 8.3.3	FIXED-END ROD HANGERS ARE INHERENTLY DUCTILE UNDER HORIZONTAL SEISMIC MOTION. PROCEED TO ROD HANGER FATIGUE EVALUATION.
	CONDUIT TRAPEZE: ROD HANGER FATIGUE EVALUATION
6.4 Sect. 8.3.5 Fig 8-9 Fig 8-13	USE 0.5g ROD FATIGUE BOUNDING SPECTRUM (ENVELOPES AUX. BLDG. ENVELOPE SPECTRUM, SEE SECTION 5.2 TO THIS CALCULATION)
	PER FIG. 8-13, SCREENING CHART FOR 5/8" RODS, L = 19", W = 241# IS AN ACCEPTABLE COMBINATION.

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CLIENT AEP JOB No. 89C1570 SHEET 8 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS 1DA RACE 109, LAR #2)
AUX. BLDG. EL. 596'

REVISIONS
0 CCF 5/18/94
A.K. 5/26/94

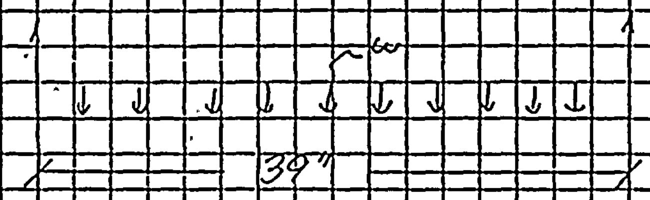
REF: CABLE TRAY TRAPEZE SUPPORT: DEAD LOAD CHECK

THE "INBOARD" RUN OF TWO CABLE TRAYS AND TWO 4" Ø CONDUITS IS ASSUMED TO BE SUPPORTED BY THE FOUR DIRECT-MOUNT P1000'S THAT COMPRISE THE INBOARD PORTION OF THE WALL BRACKETS.

THE "OUTBOARD" RUN OF THREE CABLE TRAYS IS SUPPORTED BY THE CABLE TRAY TRAPEZE AND THE FLOOR SUPPORT AT THE LOWEST WALL BRACKET. THE OUTBOARD PORTIONS OF THE OTHER THREE WALL BRACKETS ARE NOT CAPABLE OF CARRYING VERTICAL LOAD.

IT IS ASSUMED THAT THE TRAPEZE AND FLOOR SUPPORT SHARE THE LOAD FROM THE OUTBOARD TRAYS APPROXIMATELY EQUALLY.

CHECK TRAPEZE CROSS MEMBER:



TOTAL WEIGHT:

CABLE TRAYS: 71 #/FT × 1/2 (36.4') = 1300 #

CONDUIT: SAY 5' × 17 #/FT = 85 #

TOTAL = 1385 ⇒ w = 1385/39 = 35.5 #/IN

CLIENT AEP JOB No. 89C1570 SHEET 9 OF 17

SUBJECT DC Cook LAR's
DC Cook Unit 1
LAR-010
(PASS ID# RACE109, LAR #2)
Aux. Bldg. EL 596'

REVISIONS
0 CCE 5/18/94
AK 5/26/94

REF. CABLE TRAY TRAPEZE: DL CHECK (CONT'D)

$M_{MAX} = wL^2/8 = 35.5(39)^2/8 = 6750$ IN-LB

$M/S = 6750/0.247 = 27.3$ KSI
(2x2x1/4)

ALLOW. BENDING STRESS $= 0.66F_y = 23.8$ KSI

$27.3 > 23.8 \rightarrow$ INT. ≤ 1.15, SEE BELOW

ALTHOUGH THESE CALCULATIONS INDICATE A MINOR OVERSTRESS IN BENDING, THIS IS JUDGED TO BE OK BECAUSE THE STIFFENING EFFECT OF THE TRAYS IS NEGLECTED. ALSO, EXCESS LOAD WOULD BE SUPPORTED BY THE FLOOR FRAME - SEE "FLOOR SUPPORT: DL CHECK"

CHECK ANCHORAGE:

REACTION, EACH ROD $= 1/2(39)(35.5) = 692$#

PASS ALLOW. LOAD @ SHELL ANCHOR, 5/8" ϕ, PHILLIPS "RED HEAD" SELF DRILL CONCRETE ANCHOR, IN TENSION BY DEADWEIGHT: 3.17 KIPS

$692 < 2770$ ∴ OK (INT = 0.25)

AT EMBEDDED STRUT - ADD D.L. REACTION FROM CONDUIT TRAPEZE = 161#:

$692 + 161 = 853^{\#} < 2000^{\#}$ ∴ OK (INT = 0.43)

AS PREVIOUSLY DISCUSSED, A 3x DL CHECK IS NOT REQUIRED FOR THE CABLE TRAY TRAPEZE BECAUSE

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CLIENT AEP JOB No. 89C1570 SHEET 10 OF 17

SUBJECT DC COOK LAR'S

DC COOK UNIT 1

LAR-010

(PASS ID# RACE 109, LAR# 2)

AUX BLDG EL. 596'

REVISIONS: 0 CCE 5/18/94 A.K. 5/26/94

REF. CABLE TRAY TRAPEZE + DL CHECK (CONT'D)

THE TRAYS AND WALL BRACKETS CONSTRAIN LATERAL MOTION OF THE TRAPEZE SUPPORT. TO COMPLETE THE 3×DL EVALUATION FOR THE CONDUIT TRAPEZE, DEDUCT THE CABLE TRAY TRAPEZE DL REACTION FROM THE ALLOWABLE:

$$\underset{\text{ALLOWABLE PULLOUT}}{2500^{\#}} - 692^{\#} \Rightarrow \underline{\underline{1800^{\#}}}$$

1800# REPRESENTS THE REMAINING CAPACITY AT THE EMBEDDED STRUT WHICH IS AVAILABLE FOR THE CONDUIT TRAPEZE 3×DL CHECK:

$$3 \times 161^{\#} = 483^{\#} < 1800^{\#} \therefore OK$$

(INT = 0.27)

FLOOR SUPPORT: DL CHECK

THE FLOOR SUPPORT CARRIES THE REMAINING DL:

CABLE TRAYS: 71#/FT × 1/2 (36.4') = 1300#

CONDUIT: SAY 5' @ 17#/FT = 85#

TOTAL = 1385#

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CLIENT AEP JOB No. 89C1570 SHEET 11 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID# RACE 109, LAR #2)
AUX BLDG EL 596'

REVISIONS
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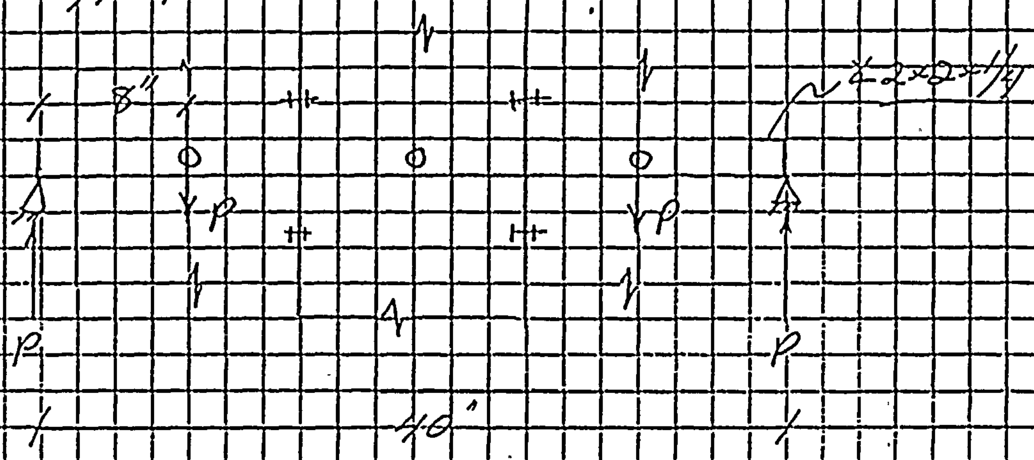
A.K. 5/26/94

REF. FLOOR SUPPORT: DL CHECK (CONT'D)

PER THE PASS, THE TRAYS ARE INTERNALLY BOLTED TOGETHER; THUS THE WEIGHT IS DISTRIBUTED TO THE OUTER TWO 3/4" Φ BOLTS:



CHECK BENDING IN L 2x2x1/4:

$P = 1385/2 = 693\#$

$M = 8P = 8(693) = 5540$ IN-LB

$M/S = 5540/0.247 = 22.4$ KSI

9th
p. 5-3N

$f_{b_{ALLOW}}$: 22.4 KSI < $0.66 F_y$ = 23.8 KSI

∴ OK, INT = 0.94

CHECK THAT EXCESS LOAD FROM THE CABLE TRAY TRAPEZE SUPPORT CROSS MEMBER CAN BE CARRIED BY THE FLOOR SUPPORT CROSS MEMBER. COMBINE INTERACTIONS:

$\frac{1}{2}(1.15 + 0.94) = 1.045$ ∴ OK

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	SUBJECT DC COOK LAR'S DC COOK UNIT 1 LAR-010 (RASS ID# RACE109, LAR#2) AUX BLDG EL 596'	REVISIONS	0 CCE 5/18/94 A.K. 5/26/94

REF. FLOOR SUPPORT: DL CHECK (CONT'D)

CHECK BEARING @ CABLE TRAY AND 3/4" Φ BOLT INTERFACE:

6.18 THE CABLE TRAYS ARE 16 ga GALVANIZED SHEET METAL: MATERIAL THICKNESS = 0.064" (1/16" THICK)

6.1 p.4-6 PER AISC TABLE I-E THE ALLOWABLE LOAD FOR A 3/4" FASTENER BEARING ON 1/8" THICK MATERIAL IS 6.5 KIPS FOR Fu = 58 KSI. USING 1/2 THE ALLOWABLE = 1/2 × 6.5 = 3.2 KIPS FOR 1/16" THICK MATERIAL:

$692^{\#} < 3200^{\#}$ ∴ OK

(UNT = 0.22)

WELD AT CROSS MEMBER TO VERTICAL ∠ 2×2×1/4'S OK BY INSPECTION.

CHECK VERTICAL ∠'S 2×2×1/4:

$L = 3'\text{-}8" = 44"$

$k = 1.0$ (TRAYS ARE LATERALLY RESTRAINED)

$r = 0.391$ IN

$kL/r = 113 \rightarrow F_a = 11.3$ KSI

$P/A = 693^{\#}/0.931\ IN^2 = 0.74\ KSI < 11.3\ KSI$ – LOW

CLIENT ABP JOB No. 89C1570 SHEET 13 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
PASS ID# RACK 109, LAR #2
AUX BLDG EL 596'

REVISIONS
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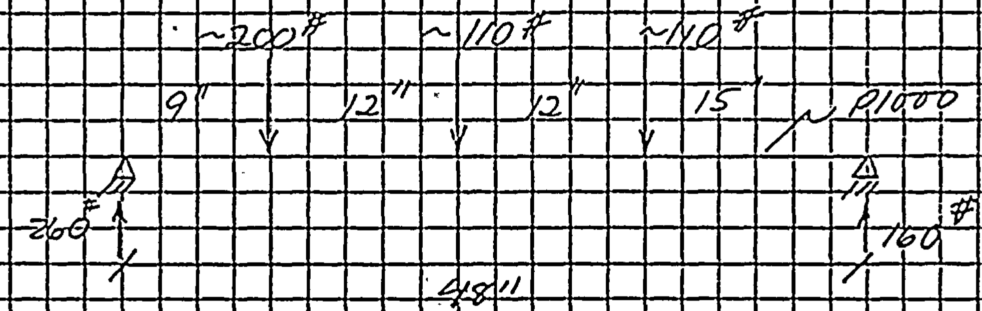
REF. WALL BRACKETS: DL CHECK

THE INBOARD PORTIONS OF THE WALL BRACKETS, THE P1000'S ATTACHED DIRECTLY TO THE CONCRETE WALL, SUPPORT THE INBOARD RUN OF TWO CABLE TRAYS AND TWO 4"Ø CONDUITS.

TOTAL WEIGHT = 36.4' × 46 #/FT = 1670 #

THERE ARE FOUR P1000'S – EACH WILL SUPPORT 1/4 OF THE TOTAL WEIGHT:



$M_{ALLOW} = S_{2-2} \times 25\,KSI = 0.29 \times 25 = 7250$ IN-LB

2 - - 2 $S_{22} = 0.29\,IN^3$

$M_{MAX} = 260(21) - 200(12) = 3060$ IN-LB

$3060 < 7250$ ∴ OK (INT = 0.42)

UNISTRUT BOLTS OK BY INSPECTION.

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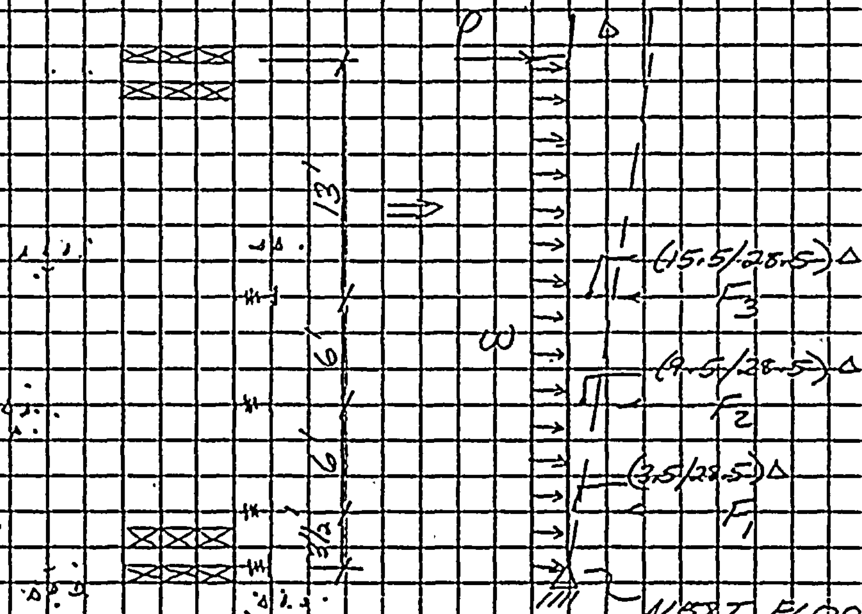
CLIENT AEP JOB No. 89C1570 SHEET 14 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID# RACE 109, LAR #2)
AUX. BLDG. EL. 596'

REVISIONS 0 CCF 5/18/94 A.K. 5/26/94

REF. WALL BRACKETS; LATERAL LOAD CHECK

CHECK THE OUTBOARD ANGLE FRAMES OF THE WALL BRACKETS FOR LATERAL LOAD:



NEXT FLOOR SUPPORT IS ~ 4' FROM THE LOWEST FLOOR BRACKET MAKING THIS END OF THE RUN VERY STIFF; ASSUME PINNED.

THE STIFFNESS OF THE UPPER 3 BRACKETS IS THE SAME. ASSUME THE SUPPORT REACTIONS F_1, F_2, & F_3 TO BE PROPORTIONAL TO THE DISTANCE FROM THE PINNED END:

THEN $F_2 = \frac{9.5}{3.5} F_1 = 2.7 F_1$

$F_3 = \frac{15.5}{3.5} F_1 = 4.4 F_1$

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CLIENT AEP JOB No. 89C1570 SHEET 15 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID# RACE109, LAR#2)
AUX. BLDG. EL. 596'

REVISIONS
0 CCF 5/18/94
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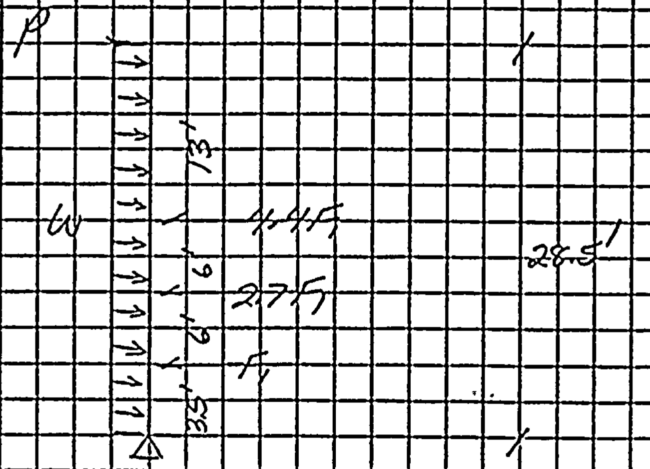
REF. WALL BRACKETS: LATERAL LOAD CHECK (CONT'D)



$P = 0.69g(71\ \#/FT) \times (3.5' + 2') = 269\#$

$W = 0.69g(71\ \#/FT) = 49.0\ \#/FT$

$\Sigma M_{PIN} = 0 = F_1(3.5) + 2.7F_1(9.5) + 4.4F_1(15.5)$
$- 269(28.5) - 49.0(28.5)(28.5/2)$

$97.4F_1 = 7670 + 19,900$

$97.4F_1 = 27,570$

$F_1 = 283\#$

@ UPPERMOST SUPPORT $F = 4.4F_1 = 1250\#$

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CLIENT ABP JOB No. 89C1570 SHEET 16 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASSID# RACE 109, LAR #2)
AUX. BLDG. EL. 596'

REVISIONS
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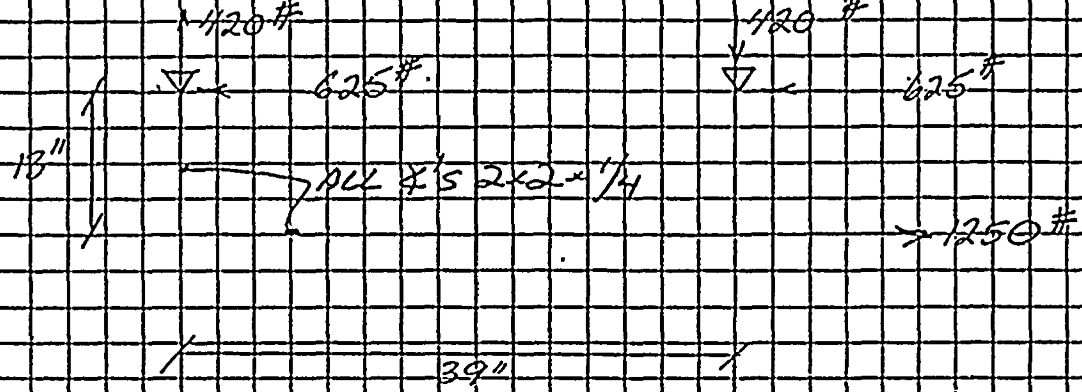
REF. WALL BRACKETS: LATERAL LOAD CHECK (CONT'D)

LOOK @ ∠ 2x2x1/4 FRAME



$M_{MAX} = 625^{\#} \times 13'' = 8125$ IN-LB

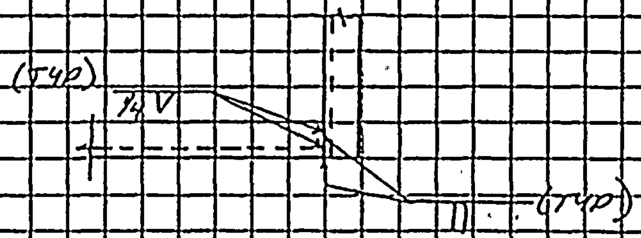
$M/S = 8125/(0.247) = 32.9$ KSI

32.9 KSI $\sim 0.9F_y = 32.4$

∴ OK

(INT = 1.02)

THE ANGLE TO ANGLE WELDS DEVELOP THE FULL SECTION OF THE ANGLES AND ARE OK BY INSPECTION.



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CLIENT AEP JOB No. 89C1570 SHEET 17 OF 17

SUBJECT DC COOK LAR'S
DC COOK UNIT 1
LAR-010
(PASS ID# RACE 109, LAR #2)
AUX. BLDG. EL. 596'

REVISIONS
0 CCF 5/18/94 A.K. 5/26/94

REF CONCLUSION

THIS SYSTEM OF CABLE TRAYS, CONDUITS AND SUPPORTS SATISFIES THE LIMITED ANALYTICAL REVIEW CRITERIA OF REF. 6.4 AND IS CONSIDERED TO BE SEISMICALLY ADEQUATE.

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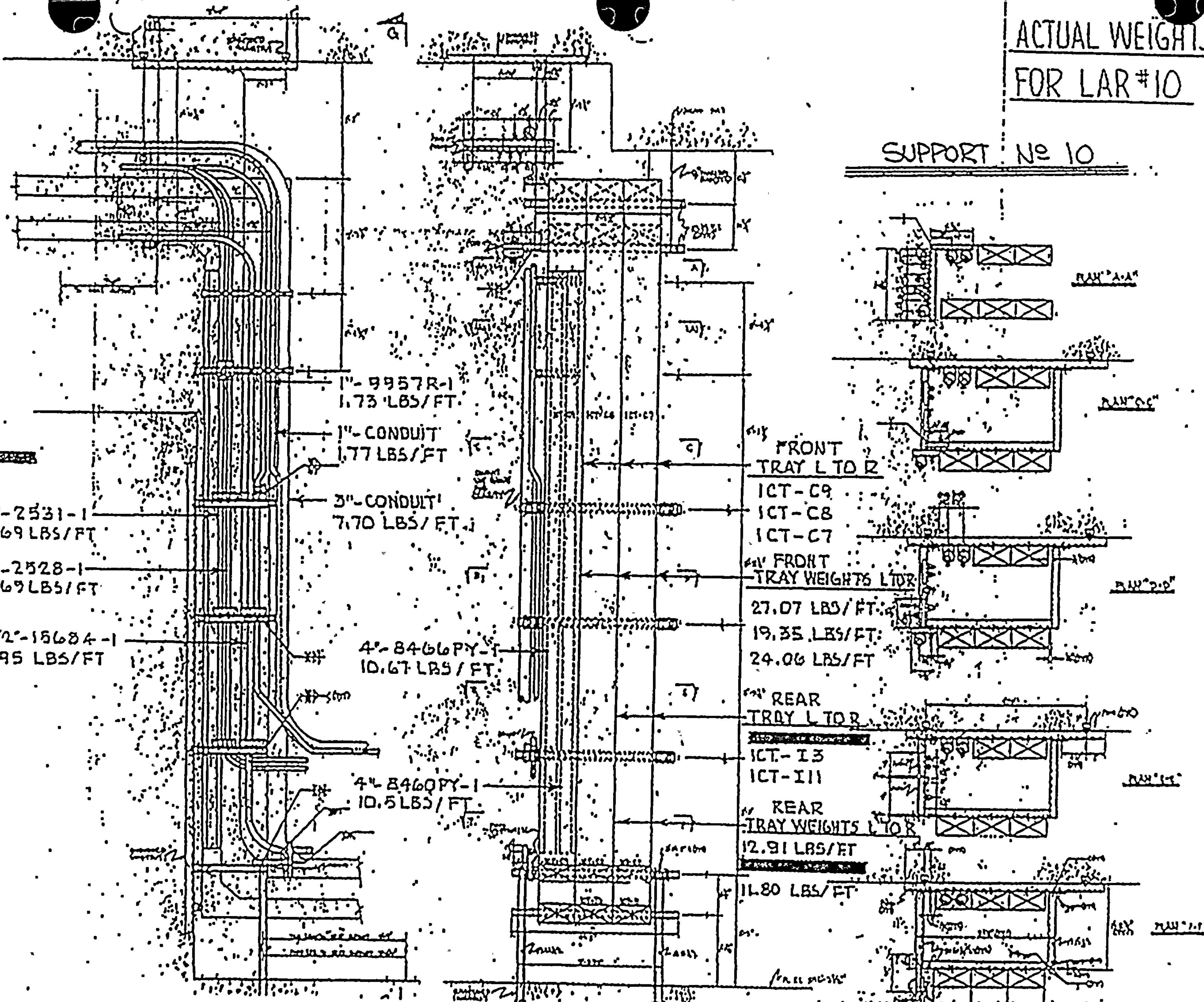
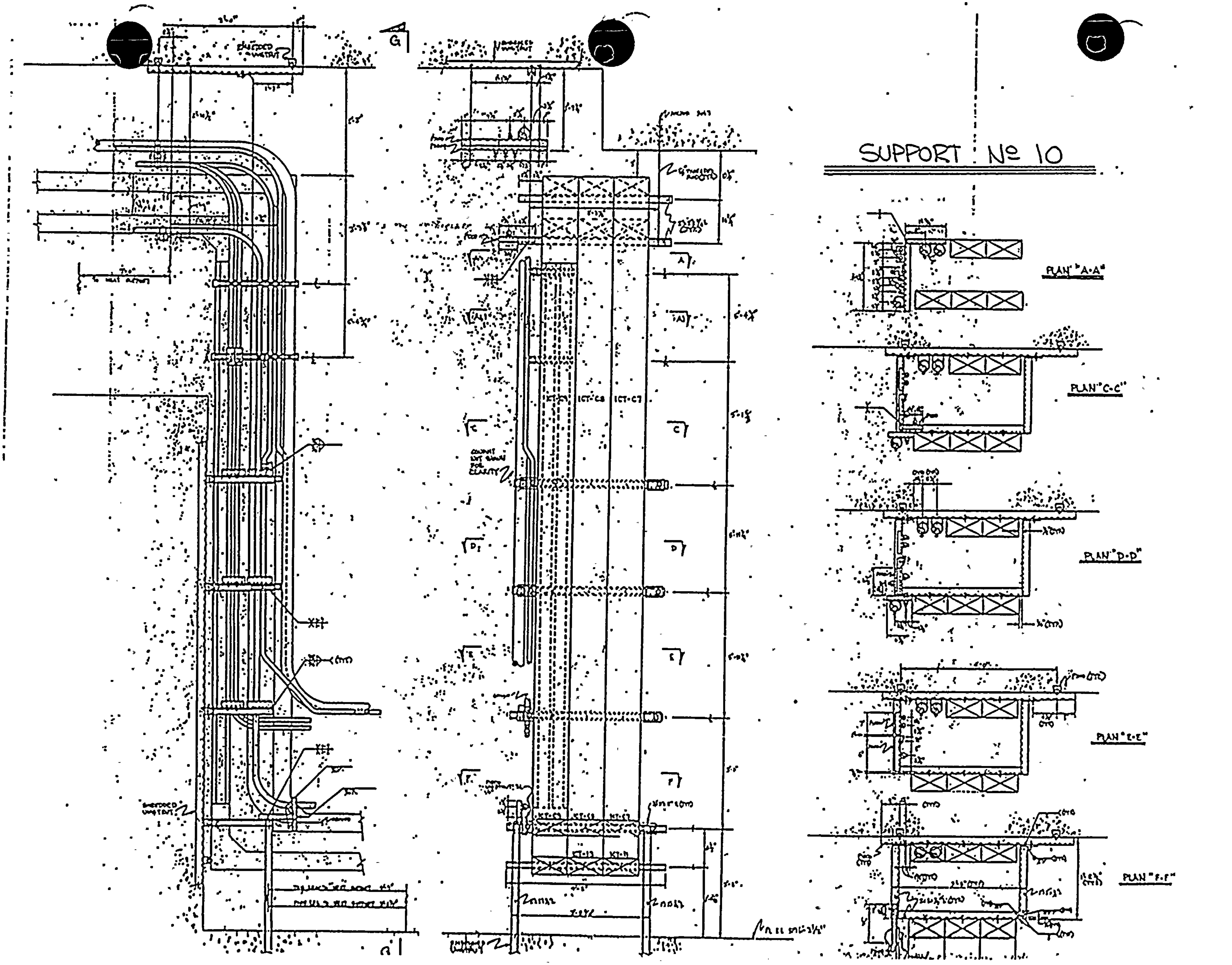
ACTUAL WEIGHT FOR LAR #10

SUPPORT № 10



SUPPORT Nº 10

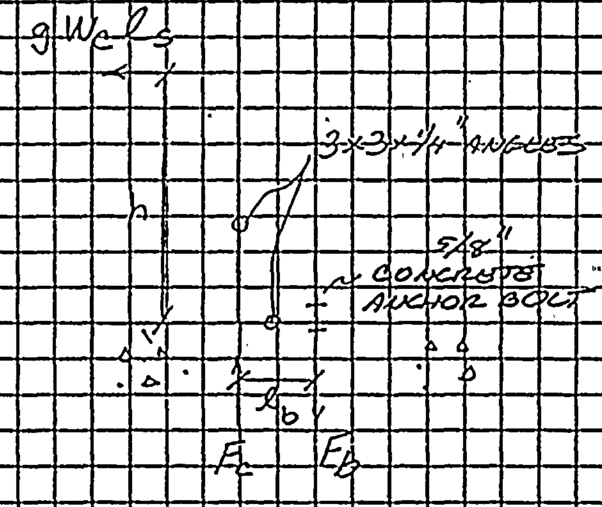


S&A Stevenson and Associates — A Structural-Mechanical Consulting Engineering Firm	CLIENT AEP JOB No. 89C1570 SHEET 1 OF 9
	SUBJECT A46 LAR'S
	DC COOK UNIT 1
	LAR-011
	(PASS ID# RACE-101, LAR #1)
	AUX. BLDG. EL. 586'
	REVISIONS 0 CCF 5/10/94 D.K. 5/26/94

REF. LOAD CALCULATIONS

6.22 AND PASS — THIS LAR EVALUATES A NUMBER OF FLOOR MOUNTED CANTILEVER SUPPORTS OF THE SAME BASIC GEOMETRY BUT WHICH HAVE VARYING CONDUIT SPANS AND ANCHOR BOLT POSITIONS - SEE pp 10 & 11 OF THIS LAR. THE REPRESENTATIVE CASE FOR ANALYSIS IS SELECTED BELOW.

THE BASIC GEOMETRY OF THESE SUPPORTS IS AS FOLLOWS:



W_c = CONDUIT WGT
l_s = SPAN BETWEEN SUPPORTS
F_c = BEARING FORCE ON CONCRETE FLOOR
F_b = TENSION IN CONC ANCHOR BOLT
l_b = DISTANCE FROM CONCRETE BEARING POINT TO ℄ CONCRETE ANCHOR
g = SEISMIC ACCELERATION FOR LATERAL LOAD CHECK

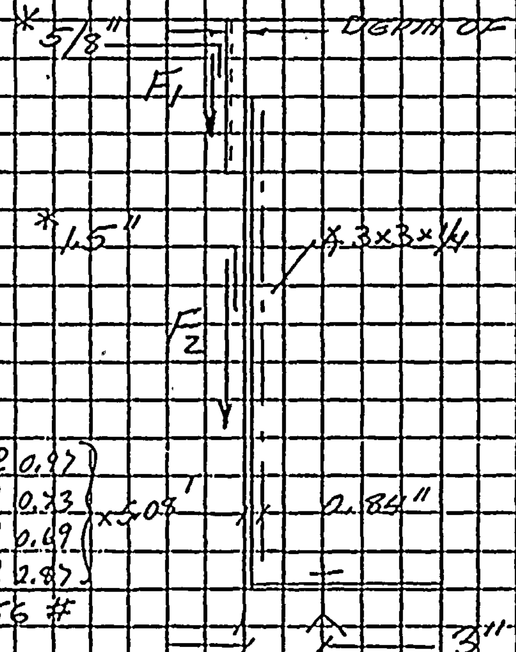
A LATERAL LOAD CHECK IS REQUIRED FOR FLOOR MOUNTED SUPPORTS. THE ANCHOR BOLT WILL BE THE CRITICAL SUPPORT ELEMENT.

$$F_b = \underbrace{g W_c h}_{\text{CONSTANT, ALL CASES}} \underbrace{\frac{l_s}{l_b}}_{\text{VARIES}} \Rightarrow F_b \propto \frac{l_s}{l_b}$$

E-W DIRECTION: USE $l_s = 5'-1''$ AND $l_b = 3''$ AS COMPOSITE VALUES

N-S DIRECTION: USE $l_s = 6'$ AND $l_b = 4\frac{1}{4}''$ AS COMPOSITE VALUES

REF.	LOAD CALCULATIONS
	E-W DIRECTION: $l_s / l_b = 5.08' / 3'' = 1.69$ '/''
	N-S DIRECTION: $l_s / l_b = 6' / 4.25'' = 1.41$ '/''
	THE CRITICAL COMBINATION OF CONDUIT SPAN AND DISTANCE FROM BOLT TO CONCRETE BEARING POINT OCCURS FOR THE E-W SUPPORTS. THEREFORE USE $l_s = 5.08'$ AND $l_b = 3''$ IN THE EVALUATIONS.
6.15	CONDUIT WEIGHTS: USE ACTUAL CONDUIT WEIGHTS AS PROVIDED IN REF. 6.15. SEE LAST TWO PAGES OF THIS LAR.
6.4 SECT. 8.3.1	DEAD LOAD CHECK



* ECCENTRICITIES OF F_1 & F_2 ARE CONSERVATIVELY TAKEN AS 1/2 THE NOMINAL OD OF THE LARGEST CONDUIT IN THE GROUP.

$F_1 = \left.\begin{array}{l} 1@0.97 \\ 1@0.73 \\ 1@0.69 \\ 3@2.87 \end{array}\right\} \times 5.08'$

$F_1 = 56$ #

$F_2 = \left.\begin{array}{l} 1@3.81 \\ 1@3.72 \\ 2@7.91 \\ 1@3.92 \\ 1@3.72 \\ 1@8.39 \end{array}\right\} \times 5.08'$

$F_2 = 220$ #

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SUBJECT AEP/ A46 LAR'S DC COOK UNIT 1 LAR-011 (PASS ID# RACE101, LAR#1) AUX. BLDG EL. 586' JOB No. 89C1570 SHEET 3 OF 9

REVISIONS: 0 CCF 5/10/94 A.K. 5/26/94

REF. DEAD LOAD CHECK (CONT'D)

REACTIONS:

$F_4(3.0) = F_1(1.5) + F_2(1.5)$

$F_4 = [56(1.5) + 200(1.5)]/3.0$

→ $F_4 = 128$ #

→ $F_3 = F_1 + F_2 + F_4 = 384$ #

MAX MOMENT IN ∠3×3×1/4:

$M_{MAX} = (56+200)(1.5+.84) = 599$ IN-LB

CHECK (2) 3/16" HEX BOLTS CONNECTING P3300 TO ∠3×3×1/4:

A_B (BASED ON NOMINAL DIAMETER) = 0.0276 IN^2

6.1 USING ALLOWABLE STRESS F_V = 10 KSI FOR A307 BOLTS: V_{ALL} = 276 #/BOLT

APPLIED D.L./BOLT = 56/2 = 28 # ∴ OK

BOLT BEARING STRESS ON P3300 AND ∠3×3×1/4 OK BY INSPECTION

CHECK COMPRESSIVE BEARING STRESS ON ∠3×3×1/4

FLANGE AREA @ F_3 = 3" × 1/4" = 0.75 IN^2

$P/A = 384/0.75 = 0.51$ KSI LOW

REF. DEAD LOAD CHECK (CONT'D)

CHECK MAX. BENDING STRESS IN ∠3x3x1/4:

6.1 M_{MAX}/S = 599 IN-LB / 0.577 = 1.0 KSI
LOW ∴ OK

CHECK ANCHOR BOLT:

6.4
APP. C
MAXIMUM ALLOWABLE TENSILE LOAD ON AN UNSPECIFIED 5/8"Ø CONCRETE ANCHOR BOLT, TIGHTNESS CHECK PERFORMED PER THE PASS, IS 1900#.

F_y = 128# < 1460# ∴ OK

DUE TO THE LIGHT LOADING CONDITION AS EVIDENCED BY THE PRECEDING CALCULATIONS, THE WELDS AT THE BASE OF THE ∠3x3x1/4 ARE ADEQUATE BY INSPECTION.

THIS SUPPORT CONFIGURATION SATISFIES THE DEAD LOAD CHECK WITH SIGNIFICANT MARGIN.

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SUBJECT AEP/ A46 LAR'S DC COOK UNIT 1 LAR-011 (PASS ID# RACG101, LAR#1) AUX BLDG EL 586' JOB No. 89C1570 SHEET 5 OF 9

REVISIONS: 0 CCF 5/10/94; A.K. 5/26/94

REF.	VERTICAL CAPACITY CHECK
6.4 SQT. 8.3.2	THIS CHECK IS N/A FOR FLOOR MOUNTED SUPPORTS.
6.4 SQT 8.3.3	DUCTILITY CHECK
	BASE MOUNTED SUPPORTS ARE CONSIDERED NON-DUCTILE. A LATERAL LOAD CHECK IS REQUIRED.
6.4 SQT. 8.3.4	LATERAL LOAD CHECK
	UNDER HORIZONTAL SEISMIC LOADING, THE ANCHOR BOLT IS THE WEAKEST SUPPORT ELEMENT. FOR LOADING IN THE SIDE-TO-SIDE DIRECTION (PERPENDICULAR TO THE CONDUIT RUN;) THERE IS A MOMENT ARM OF 3" FROM THE EDGE OF THE BASE ANGLE TO THE CENTERLINE OF THE ANCHOR BOLT. FOR LOADING IN THE FRONT-TO-BACK DIRECTION (PARALLEL TO THE CONDUIT RUNS), THE MOMENT ARM IS ONLY 1.5".
	IF THE LOADS MUST BE RESISTED SOLELY BY CANTILEVER BENDING OF THE VERTICAL MEMBER, THEN THE FRONT-TO-BACK CASE WOULD GOVERN. HOWEVER, THE SEISMIC REVIEW TEAM JUDGED THAT EVEN ASSUMING NO MOMENT CAPACITY AT THE FLOOR CONNECTION, THE CONDUIT/SUPPORT CONNECTIONS (U-BOLT AND CONDUIT CLAMPS) WILL ALLOW THE SERIES OF SUPPORTS TO ACT AS A MULTI-BAY FRAME RATHER THAN AS A SERIES OF INDEPENDENT CANTILEVERS. THEREFORE, ONLY SIDE-TO-SIDE MOTION NEED BE EVALUATED FOR THE LATERAL LOAD CHECK.

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SUBJECT AEP / A46 LAR'S JOB No. 89C1570 SHEET 6 OF 9

DC COOK UNIT 1

LAR-011

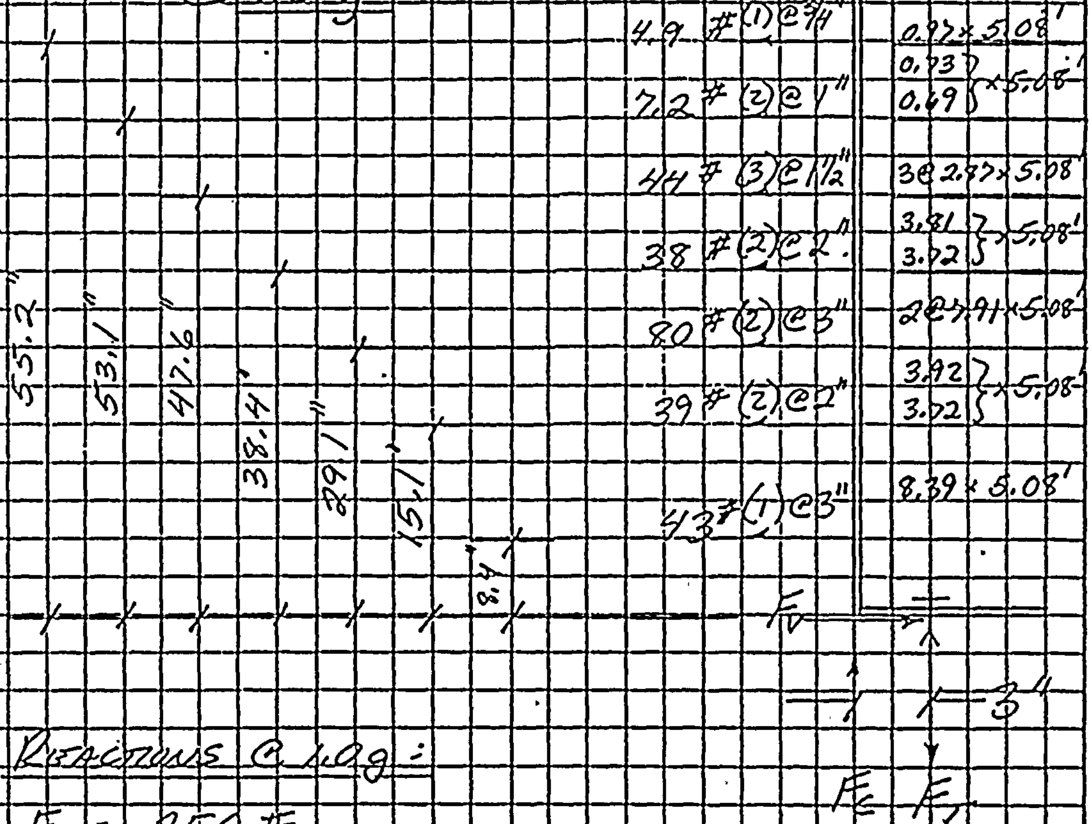
(PASS ID# RACE 101, LAR #1)

AUX BLDG EL 586'

REVISIONS: 0 CCF 5/10/94 A.K. 5/26/94

REF. LATERAL LOAD CHECK (CONT'D)

NOTE: LOADS SHOWN ARE @ 1.0 g



REACTIONS @ 1.0 g:

$F_{V_{1g}} = 256\ \#$

$$3F_T = \left.\begin{array}{l} 4.9\ (55.2) \\ +\ 7.2\ (53.1) \\ +\ 44\ (47.6) \\ +\ 38\ (38.4) \\ +\ 80\ (29.1) \\ +\ 39\ (15.1) \\ +\ 43\ (8.4) \end{array}\right\} = 7495\ \text{IN-LB}_{1g} = M_{1g}$$

$F_{T_{1g}} = F_{C_{1g}} = 2500\ \#$

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CLIENT ABP JOB No. 89C1570 SHEET 7 OF 9

SUBJECT A46 LAR'S
DC COOK UNIT 1
LAR-011
(PASS ID# RAE5101, LAR #1)
AUX BLDG EL. 586'

REVISIONS
0 CCF 5/10/94
A.K. 5/26/94

REF. LATERAL LOAD CHECK (CONT'D)

IMPOSING A HORIZONTAL SEISMIC ACCELERATION OF 0.63g: (SEE SECTION 5.2 OF THIS CALCULATION)

$F_V = 161^{\#}$

$F_T = F_C = 1575^{\#}$

$M_{MAX} = 4722$ IN-LB

COMBINE DEAD LOAD AND LATERAL LOAD:

$F_V = 161^{\#}_{LL}$

$F_T = 128^{\#}_{DL} + 1575^{\#}_{LL} = 1.70K$

$F_C = 384^{\#}_{DL} + 1575^{\#}_{LL} = 1.96K$

$M_{MAX} = 599^{IN-\#}_{DL} + 4722^{IN-\#}_{LL} = 5.32$ IN-K

CHECK ANCHOR BOLT:

FOR 5/8" CONCRETE ANCHOR, TIGHTNESS CHECK OK:

$V_{ALL} = 2.28K \quad P_{ALL} = 1.66K$

6.4 APP C C.2.11 USING BI-LINEAR FORMULATION FOR SHEAR/TENSION INTERACTION:

$V/V_{ALL} = 161/2280 < 0.3$,

$\therefore P/P_{ALL} \leq 1.0 \Rightarrow 1700/1660 \simeq 1.0$

$\therefore$ OK

(INT = 1.02)

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SUBJECT ABPI JOB No. 89C1570 SHEET 8 OF 9

A46 LAR'S
DC COOK UNIT 1
LAR-011
(PASS ID# RACG101, LAR#1)
AUX BLDG EL 586'

REVISIONS
0 CCF 5/10/94
A.K. 5/26/94

REF LATERAL LOAD CHECK (CONT'D)

CHECK ∡ 3×3×1/4 IN BENDING:

$f_b = M_{MAX}/S = 5.32/0.577$

$= 9.22 KSI < 0.9F_y = 32.4 KSI$

(INT = 0.28) ∴ OK

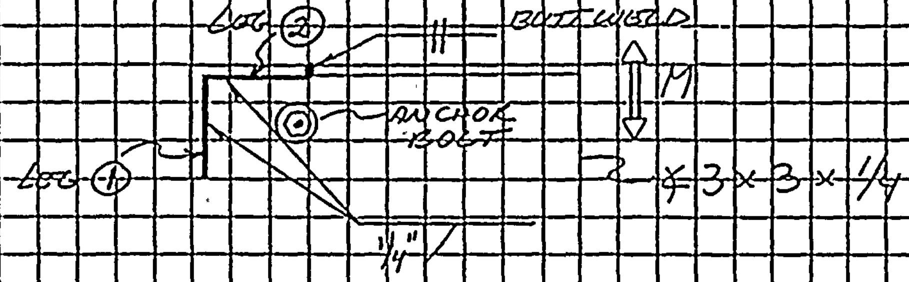
CHECK BEARING ON EDGE OF ∡ 3×3×1/4:

$F_c/A = 1.96/(.25 \times 3) = 2.6 KSI$ LOW

∴ OK

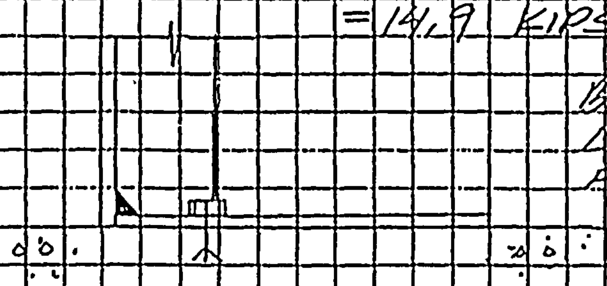
CHECK WELD @ BASE OF ∡ 3×3×1/4:

CONNECTION IN PLAN:



SHEAR CAPACITY OF ONE LEG OF
1/4" FILLET = .707(.25×2.75)(30.6 KSI)
1.7×18 KSI

= 14.9 KIPS.



BY INSPECTION,
LEG (1) OF THE 1/4"
FILLET WELD IN
COMBINATION
WITH THE BUTT
WELD IS
SUFFICIENT TO TRANSFER
LOADS TO THE ANCHORAGE

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CLIENT AEP JOB No. 89C1570 SHEET 9 OF 9

SUBJECT A46 LAR'S

DC COOK UNIT 1

LAR-011

(PASS ID# RACE 101, LAR #1)

AUX BLDG. EL. 586'

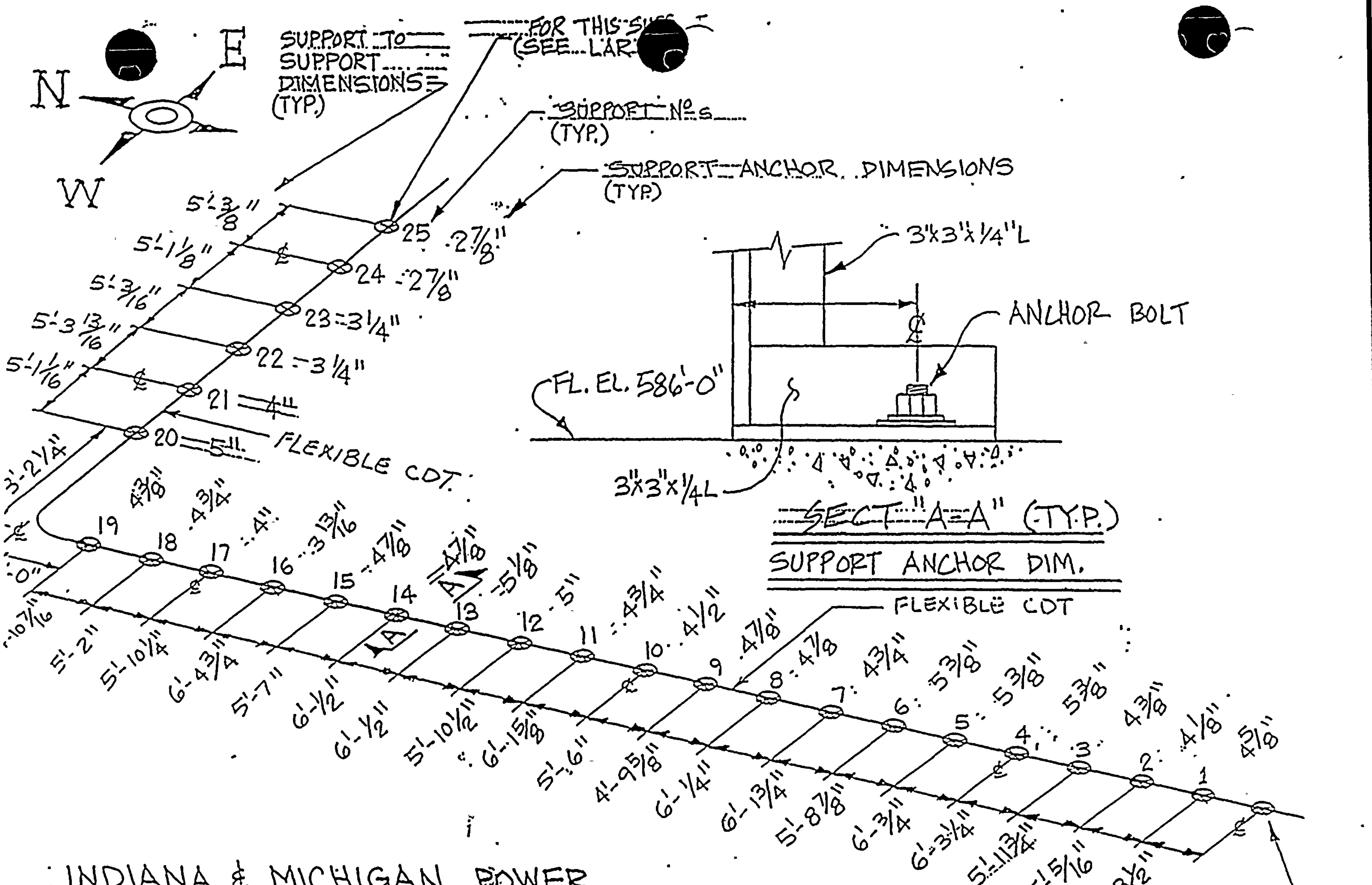
REVISIONS

0 CLF 5/10/94

A.K. 5/26/94

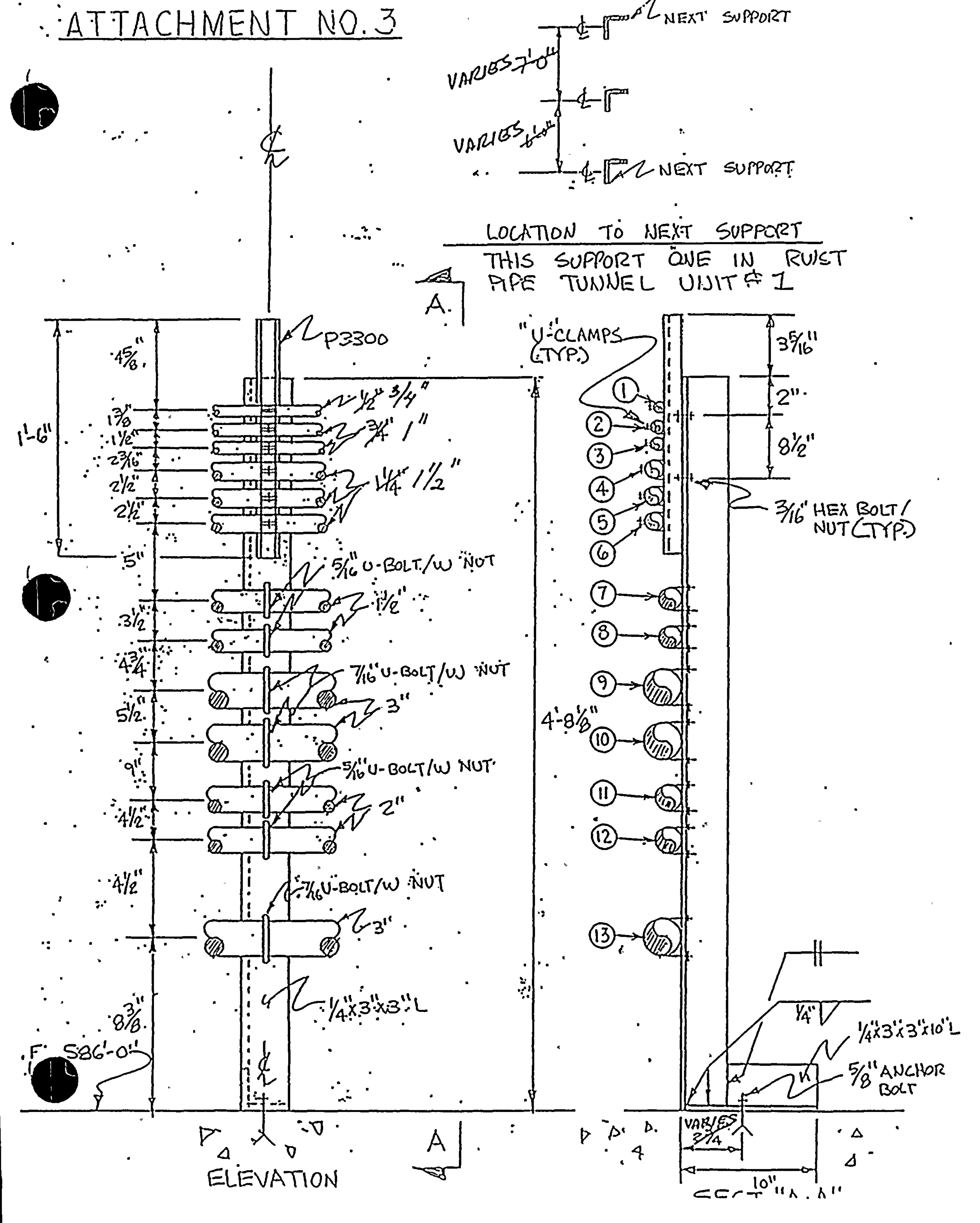
REF. CONCLUSION

THIS SUPPORT SATISFIES THE LIMITED ANALYTICAL REVIEW REQUIREMENTS OF REF 6.4 AND IS THEREFORE CONSIDERED TO BE SEISMICALLY ADEQUATE.



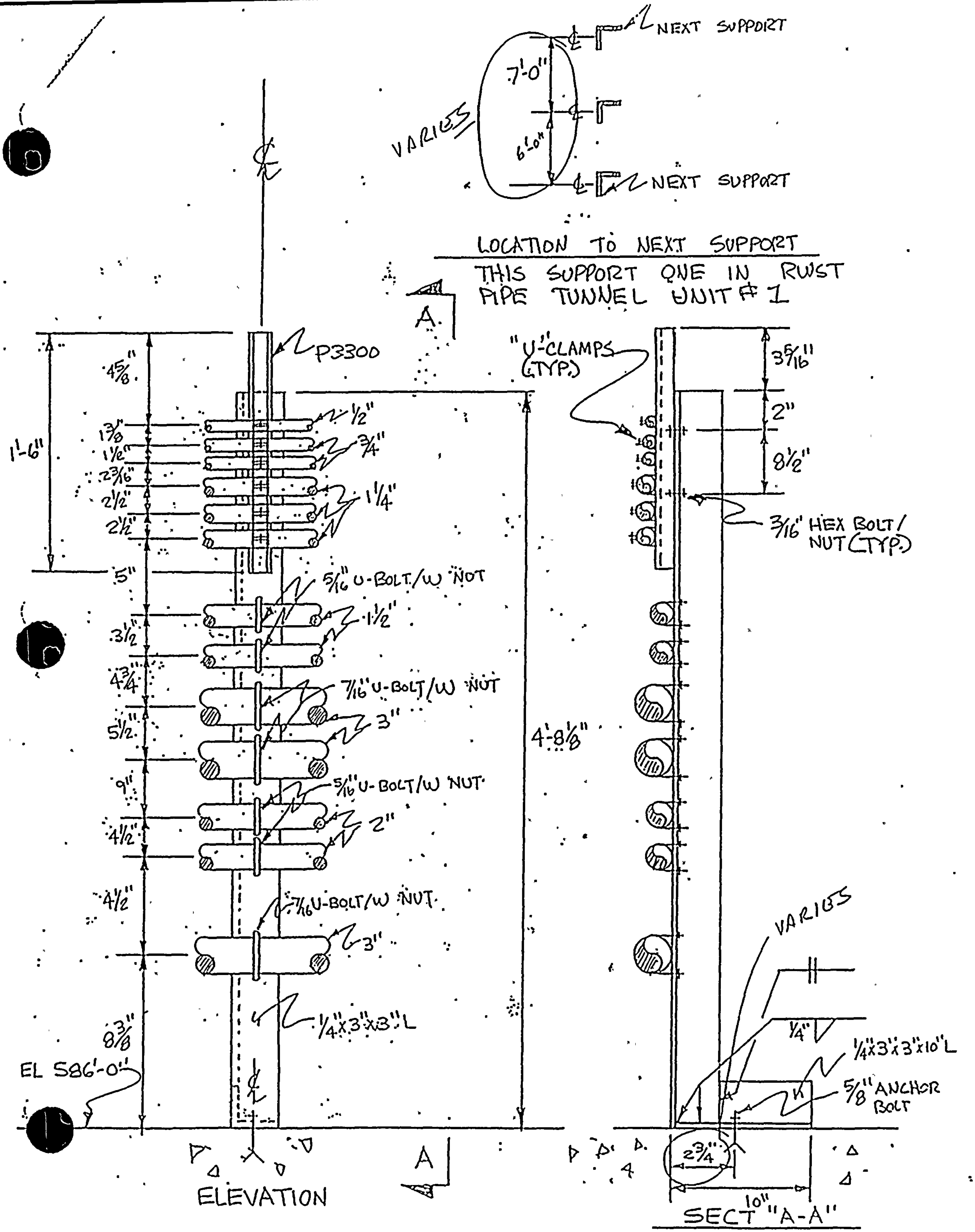
INDIANA & MICHIGAN POWER
DONALD C. COOK NUCLEAR PLANT
DR. BY. M. MARSH DATE 1-19-94
EL. 586'-0" BUILDING AUX.
LOCATION RWST. CST. PIPE TUNNEL UNIT # 1

ATTACHMENT NO. 3



ATTACHMENT NO. 1
COOK NUCLEAR PLANT
A-46 RACEWAY EVALUATIONS
LAR011

CONDUIT NO. (SEE ATTACH.3)	CONDUIT SIZE AND TYPE	CABLE TYPE AND SIZE IN CONDUIT	POUNDS PER FOOT OF CONDUIT AND CABLE	BASIS FOR WEIGHT CALCULATION (SEE LISTED ATTACH. NOS.)
1	3/4" EMT	1-12/C #12 XLA	0.97	5 & 7C
2	1" EMT	2-2T/C #16	0.73	5 & 8B
3	1" EMT	1-STP #16	0.69	5 & 13B
4	1 1/2" RIGID STEEL	1-4/C #7/18	2.87	6 & 7C
5	1 1/2" RIGID STEEL	1-4/C #7/18	2.87	6 & 7C
6	1 1/2" RIGID STEEL	1-4/C #7/18	2.87	6 & 7C
7	2" RIGID STEEL	1-3TC #4 1-1/C #4	3.81	6, 9, & 10
8	2" RIGID STEEL	1-4/C #12	3.72	6 & 7C
9	3" RIGID STEEL	1-3TC #2/0 1-1/C #2	7.91	6, 9, & 10
10	3" RIGID STEEL	1-3TC #2/0 1-1/C #2	7.91	6, 9, & 10
11	2" RIGID STEEL	1-3TC #2 1-1/C #4	3.92	6, 9, & 10
12	2" RIGID STEEL	1-4/C #12	3.72	6 & 7C
13	3" RIGID STEEL	1-3TC #4/0 1-1/C #2/0	8.39	6, 9, & 10



NEXT SUPPORT
7'-0"
VARIES
6'-0"
NEXT SUPPORT
LOCATION TO NEXT SUPPORT
THIS SUPPORT ONE IN RUST
PIPE TUNNEL UNIT #1
A
P3300
1'-6"
4 5/8
1 3/8"
1 1/2"
2 3/16"
2 1/2"
2 1/2"
1/2"
3/4"
1 1/4"
5"
5/16" U-BOLT/W NUT
1 1/2"
3 1/2"
4 3/4"
7/16" U-BOLT/W NUT
3"
5 1/2"
9"
5/16" U-BOLT/W NUT
2"
4 1/2"
4 1/2"
7/16 U-BOLT/W NUT
3"
1/4"x3"x3"L
8 3/8"
EL 586'-0"
4'-8 1/8"
ELEVATION
"U"-CLAMPS (TYP.)
3 5/16"
2"
8 1/2"
3/16" HEX BOLT/NUT (TYP.)
VARIES
1/4"
1/4"x3"x3"x10"L
5/8" ANCHOR BOLT
2 3/4"
10"
SECT "A-A"

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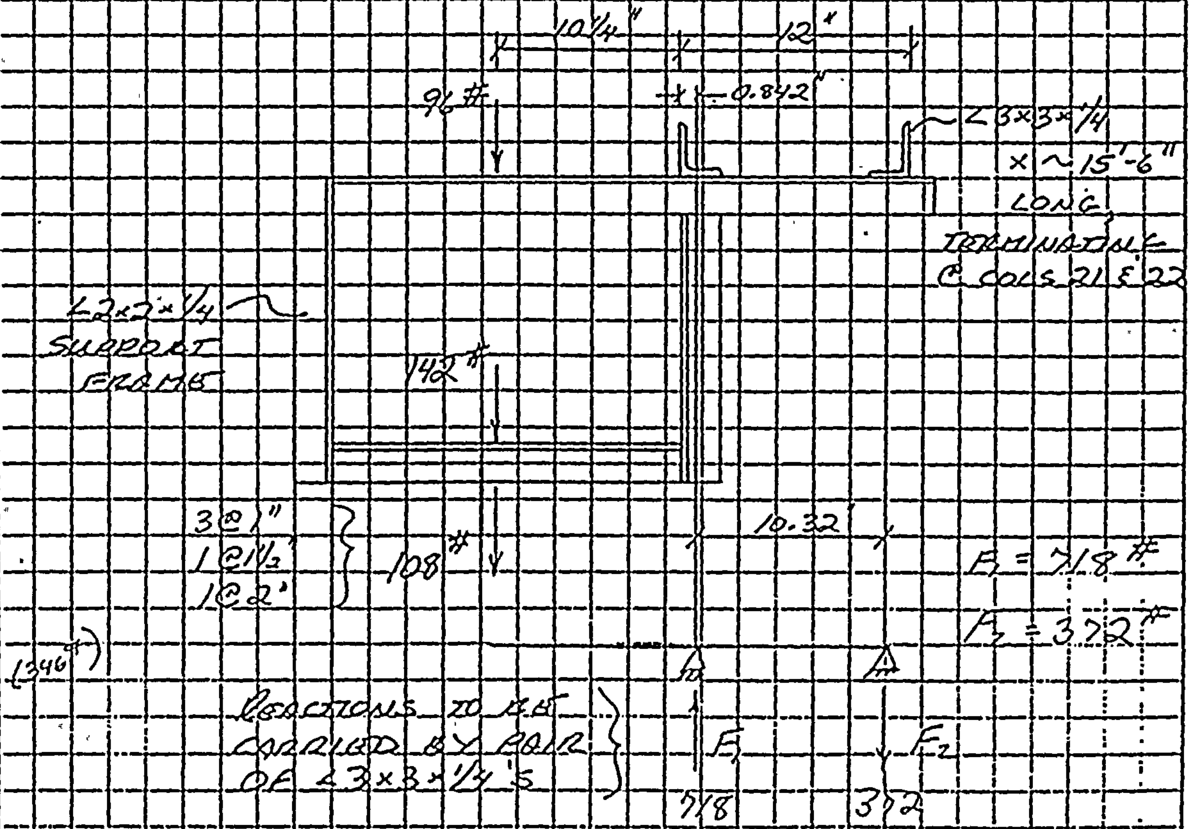
CLIENT AEP JOB No. 89C1570 SHEET 1 OF 3

SUBJECT A46 LAR'S
DC COOK UNIT 2
LAR-022
(PASS ID# RACE-003, LAR #2)
CONTAINMENT EL. 612'

REVISIONS
0 CCF 5/5/94
A.K. 5/26/94

REF	
	LOAD CALCULATIONS
PASS	TRIBUTARY LENGTH IS BASED ON DISTANCE BETWEEN COLS 21 AND 22 OF 15'-6", AS THIS IS THE LONGER OF THE TWO COLUMN SPANS WHERE THIS SUPPORT CONFIGURATION APPEARS.
	TRIBUTARY LENGTH = 15'-6"/2 = 7 3/4'
6.19 & 6.14	CONDUIT AND CABLE TRAY WEIGHTS: USE ACTUAL CONDUIT AND CABLE TRAY WEIGHTS AS PROVIDED BY REF. 6.19, SEE FINAL PAGE OF THIS LAR. WHERE ACTUAL WEIGHTS ARE NOT PROVIDED, USE GENERIC VALUES PER REF. 6.14.
6.4 SECT 8.3.1	DEAD LOAD CHECK



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CLIENT AEP JOB No. 89C1570 SHEET 2 OF 3

SUBJECT A46 LAR'S

DC COOK UNIT 2

LAR-022

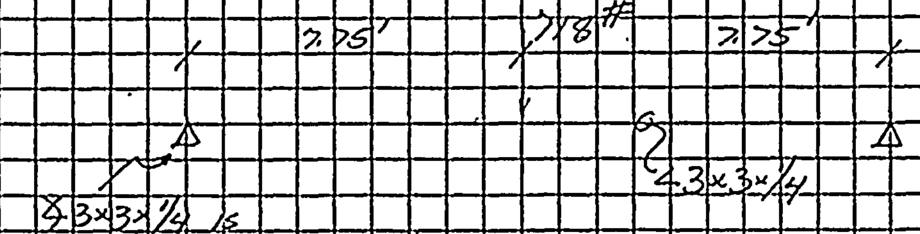
(PASS ID# RACE-003, LAR #2)

CONTAINMENT EL. 612'

REVISIONS 0 CCF 5/5/94 A.K. 5/26/94

REF. DEAD LOAD CHECK (CONT'D)

LOOK AT ∠3×3×1/4'S:



∠3×3×1/4 IS WELDED TO ∠2×2×1/4'S @ COLS → ASSUME PINNED

$M_{MAX} = 718(7.75)(12)/4 = 16.7$ K-IN

$M/S = 16.7/0.577 = 28.9$ KSI $= f_b$

6.1 pp. 5-309 TO 5-313 FOR ∠ 3×3×1/4, ALLOWABLE COMP. BENDING STRESS IS THE SMALLER OF:

$F_b = 0.60 F_y = 21.6$ KSI

OR

$F_b = \left[0.95 - 0.50\sqrt{F_y/F_{ob}}\right] F_y$

$$F_{ob} = \frac{85{,}900}{\left(\frac{l}{b}\right)^2} C_b \left[\sqrt{1 + 0.78\left(\frac{l t}{b^2}\right)^2} - 1\right]$$

$l = 15.5' \times 12 = 186''$

$t = 0.25''$

$b = 3''$

$C_b = 1.0$

$$F_{ob} = \frac{85{,}900}{\left(\frac{186}{3}\right)^2} 1.0 \left[\sqrt{1 + 0.78\left(\frac{186 \times .25}{3^2}\right)^2} - 1\right]$$

$F_{ob} = 22.3\ [3.67] = 82$

$F_b = \left[.95 - .5\sqrt{36/82}\right] F_y = 0.62 F_y$

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CLIENT AEP JOB No. 89C1570 SHEET 3 OF 3

SUBJECT A46 LAR'S
DC COOK UNIT 2
LAR-022
(PASS ID# RACE-003, LAR #2)
CONTAINMENT EL 612'

REVISIONS
0 CCF 5/5/94
A.K. 5/24/94

REF. DEAD LOAD CHECK (CONT'D)

THEREFORE USE F_b = 21.6 KSI, AND PER SECTION 5.2.2a, INCREASING f_b BY 1.25:

1.25 (28.1) = 36.1 > 21.6 ∴ FAILS

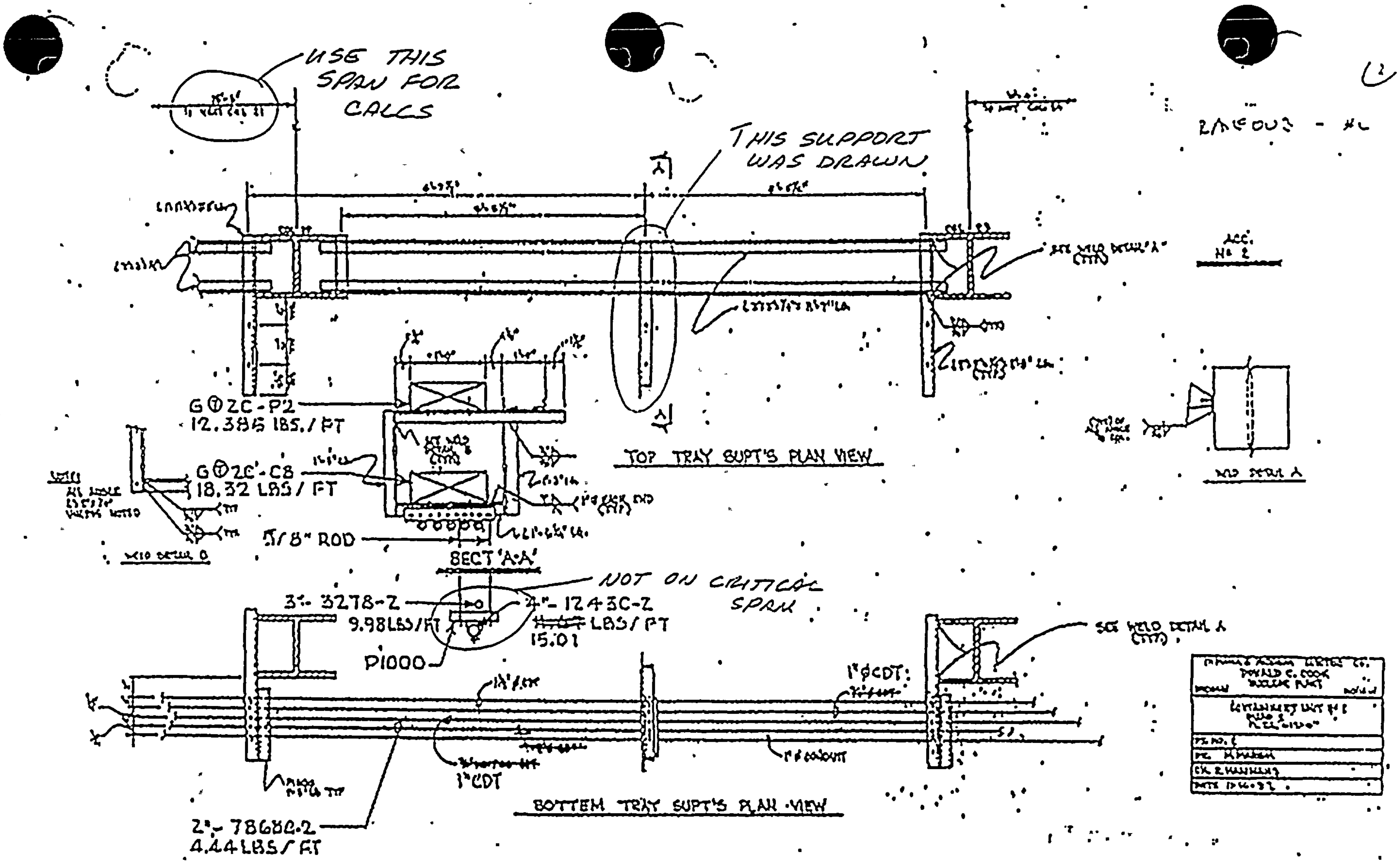
(INT = 1.7)

THIS SUPPORT IS AN OUTLIER

NO FURTHER ANALYSIS WILL BE PERFORMED. THIS SUPPORT, BY INSPECTION, WILL NOT SATISFY THE VERTICAL CAPACITY CHECK OR THE LATERAL LOAD CHECK.

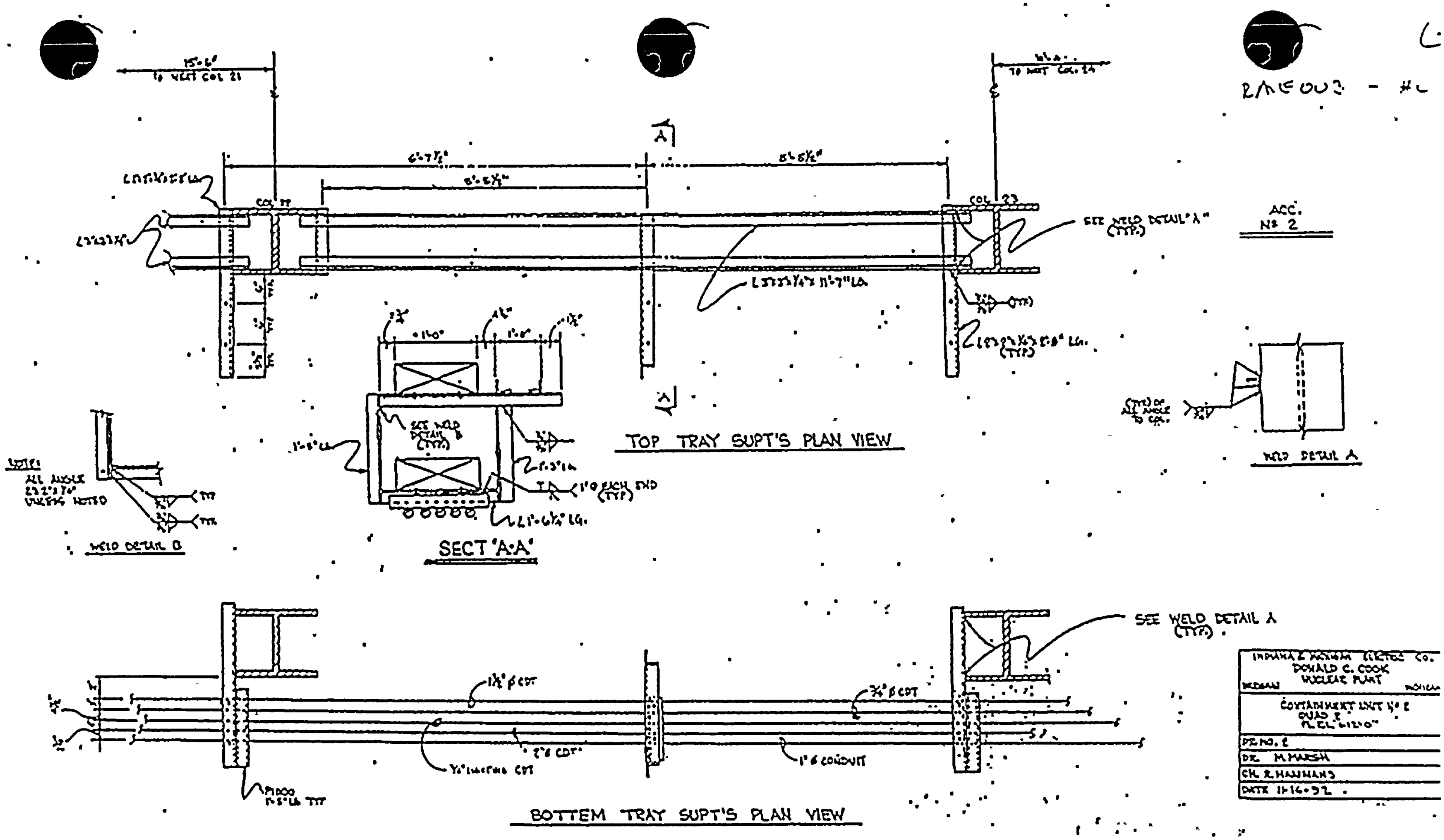
CONCLUSION

THIS SUPPORT FAILS TO SATISFY THE EVALUATION CRITERIA OF REF. 6.4 FOR THE DEAD LOAD CASE DUE TO EXCESSIVE BENDING STRESS IN THE ∠'S 3×3×1/4 AND IS THEREFORE AN OUTLIER



ACTUAL WEIGHTS FOR LAR#22

IDENTIFICATION OF 1" & 1 1/2" ø CD'B UNKNOWN



ACC. Nº 2
SEE WELD DETAIL "A" (TYP.)
TOP TRAY SUPT'S PLAN VIEW
WELD DETAIL A
SECT 'A-A'
WELD DETAIL B
SEE WELD DETAIL A (TYP.)
1" Ø CONDUIT
BOTTEM TRAY SUPT'S PLAN VIEW
DONALD C. COOK
NUCLEAR PLANT
DR. M.MARSH

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SUBJECT AEP JOB No. 89C1570 SHEET 1 OF 3

A46 LAR'S
DC COOK UNIT 2
LAR-023
(PASS ID # RACE 003, LAR # 3)
CONTAINMENT EL. 612'

REVISIONS: 0 CCF 5/6/94 A.K. 5/25/94

REF LOAD CALCULATIONS

PASS TOTAL LENGTH OF CABLE TRAY AND CONDUIT SUPPORTED BY THREE BRACKETS IN UNISON = DISTANCE BETWEEN EACH BRACKET PLUS 5' UNSUPPORTED LENGTH TOP AND BOTTOM (MAX UNSUPPORTED SPAN IS 10') =

$$L = 5' + 2'-6\tfrac{1}{2}'' + 3'-0'' + 5' \simeq 16\ FT$$

CONDUIT WEIGHTS:

3/4" = 1.3 #/FT × 16' = 21 #

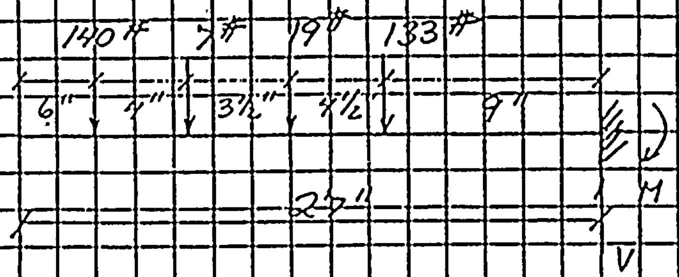
1 1/2" = 3.5 #/FT × 16' = 56 #

CABLE TRAY WEIGHTS:

25 PLF × 16 FT = 400 #

6.4 SECT. 8.3.1 DEAD WEIGHT CHECK

THE THREE BRACKETS WILL RESIST THE APPLIED LOAD NEARLY EQUALLY, SO ONE THIRD OF THE LOAD WILL BE APPLIED TO ONE BRACKET TREATED AS A CANTILEVER. NOTE THAT TREATING THE BRACKET AS A CANTILEVER IS CONSERVATIVE AS THERE IS LIKELY TO BE SIGNIFICANT FRAME ACTION BETWEEN THE SUPPORTS.



V = 299 #

M = 4513 IN-#

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SUBJECT AEP JOB No. 89C1570 SHEET 2 OF 3

A46 LAR'S
DC COOK UNIT 2
LAR -023
(PASS 1DF RACE 003, LAR #3)
CONTAINMENT EL. 612'

REVISIONS		
0	CCF 5/6/94	A.K. 5/25/94

REF. DEAD WEIGHT CHECK (CONT'D)

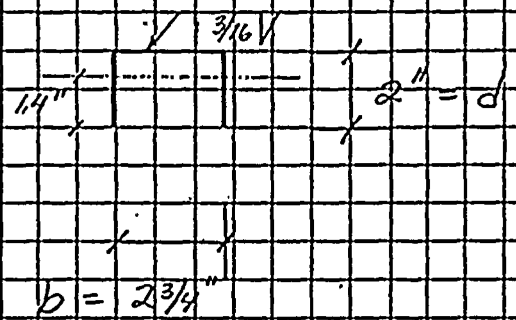
CHECK BENDING IN ∠ 2×2×1/4 :-

6.1
p.5-311
SECT 5.1
p.5-312
SECT 5.2.1a

$M/S = 4513/0.247 = 18.3\ KSI < 23.8\ KSI$
∴ OK
(INT. = 0.77)

CHECK WELD @ BUILDING STEEL

SIMPLIFY WELD AS FOLLOWS:



6.5
SECT. 7.4
TABLE 5

PROPERTIES OF WELD AS LINE:

$$S_{W_{TOP}} = \frac{2b+d^2}{3} = \frac{2\cdot 2\tfrac{3}{4}+2^2}{3} = 3.17\ IN^2$$

$$S_{W_{BOT}} = \frac{d^2(2b+d)}{3(b+d)} = \frac{2^2(2\cdot 2\tfrac{3}{4}+2)}{3(2\tfrac{3}{4}+2)} = 2.11\ IN^2$$

FOR 3/16" FILLET: $S = 2.11\,(.0021)(3/16) = 0.28\ IN^3$

$M/S = 4513/0.28 = 16.1\ KSI < 18\ KSI$
∴ OK

(INT = 0.90)

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SUBJECT AEP JOB No. 89C1570 SHEET 3 OF 3

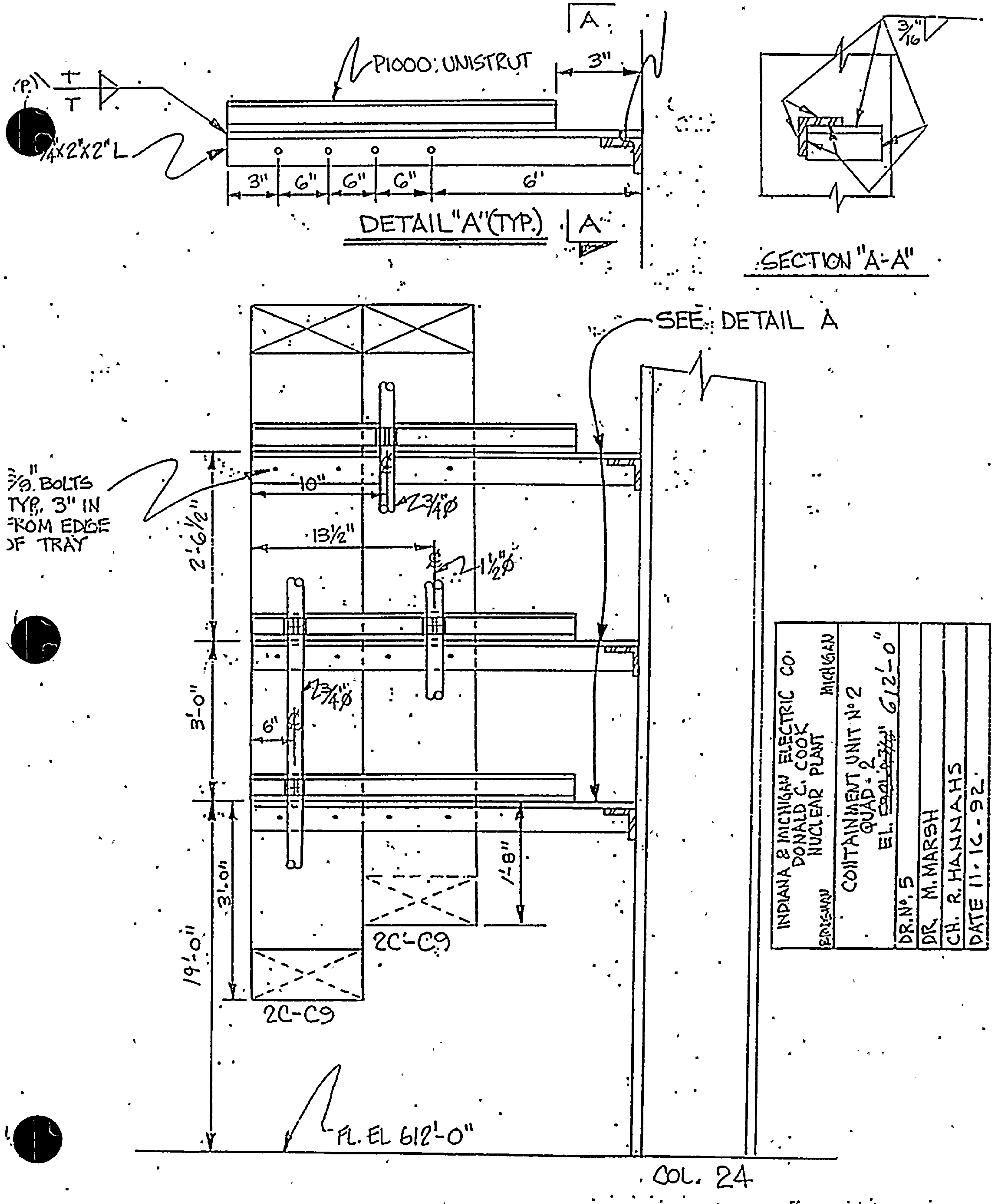
A46 LAR'S
DC COOK UNIT 2
LAR-023
(PASS ID# RACE 003, LAR#3)
CONTAINMENT EL. 612'

REVISIONS
0 CCF 5/6/94
A.K. 5/25/94

REF	DEAD WEIGHT CHECK (CONT'D)
6.4 SECT. 8.3.1	THE DEAD WEIGHT CHECK IS THE ONLY CHECK REQUIRED FOR CABLE TRAY AND CONDUIT SUPPORTS DIRECTLY MOUNTED TO AN ADJACENT STRUCTURAL WALL. BUILDING COLUMNS ALSO PROVIDE RIGID SUPPORT. NO FURTHER ANALYSIS IS REQUIRED

CONCLUSION

THIS SUPPORT MEETS THE LIMITED ANALYTICAL REVIEW REQUIREMENTS OF REF. 6.4 AND IS CONSIDERED TO BE SEISMICALLY ADEQUATE.



ACCUMULATOR № 2 ROOM

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SUBJECT: AEP — JOB No. 89C1570 — SHEET 1 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID # RACE 004, LAR #3)
CONTAINMENT EL 598'

REVISIONS: 0 — CCF 5/11/94 — A.K. 5/25/94

REF — DEAD LOAD CHECK

PASS — TRIBUTARY LENGTH:

LOWER TRAYS = 6' (SPANS ARE 5½-6' THIS AREA)

MIDDLE TRAYS:

1ST SUPPORT FROM RIGHT: (6' + 5'-4")/2 = 5.7'
2ND " " " : (5'-4" + 3'-9")/2 = 4.5'
3RD " " " : (3'-9" + 5'-9")/2 = 4.8'
4TH " " " : (5'-9" + 6')/2 = 5.9'

UPPER TRAYS:

1ST SUPPORT FROM RIGHT: (6' + 5'-4")/2 = 5.7'
2ND " " " : (5'-4" + 9'-6")/2 = 7.4'
4TH " " " : (9'-6" + 6')/2 = 7.8'

(UPPER TRAYS NOT ATTACHED TO 3RD SUPPORT FROM RIGHT PER AS-BUILT)

CABLE TRAY WEIGHTS:

LOWER TRAYS: 25 PLF × 6' = 150#

MIDDLE TRAYS:

1ST SUPT (1M)	25 PLF ×	5.7'	=	143#
2ND SUPT (2M)	"	4.5'	=	113#
3RD SUPT (3M)	"	4.8'	=	120#
4TH SUPT (4M)	"	5.9'	=	148#

UPPER TRAYS:

1ST SUPT (1U)	25 PLF ×	5.7'	=	143#
2ND SUPT (2U)		7.4'	=	185#
4TH SUPT (4U)		7.8'	=	195#

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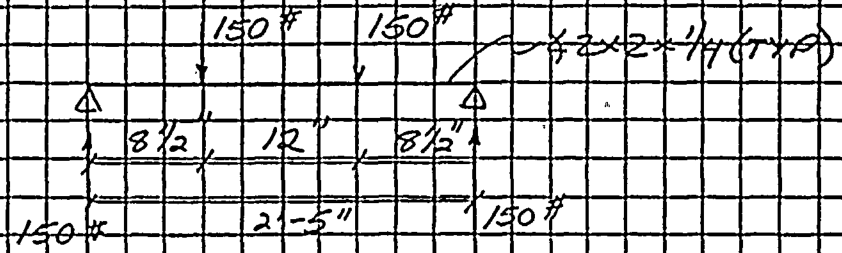
SUBJECT ABP JOB No. 89C1570 SHEET 2 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID# RACE 004, LAR#3)
CONTAINMENT EL. 598'

REVISIONS
0 CCF 5/11/94
A.K. 5/25/94

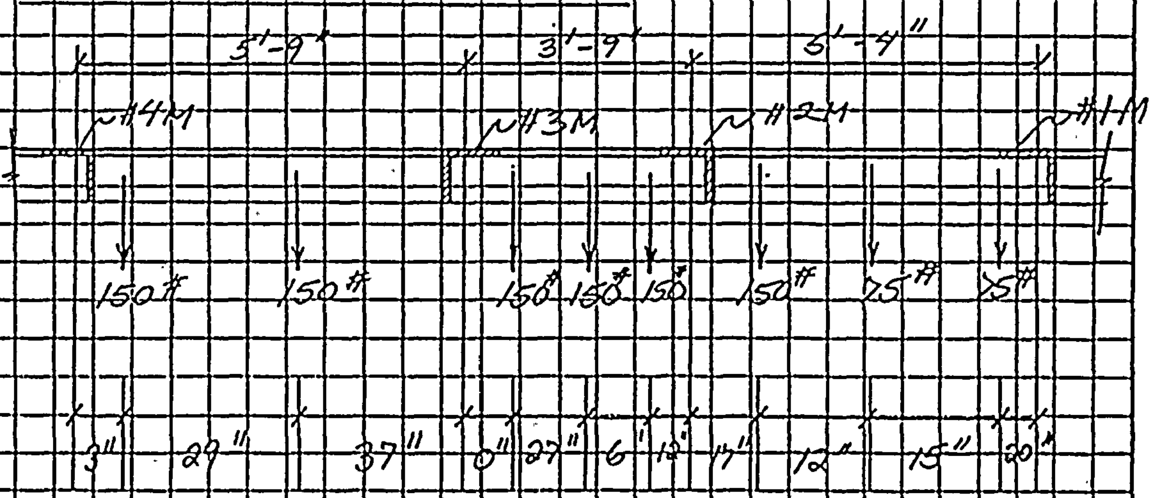
REF.	
	DEAD LOAD CHECK:
6.4 SECT. 8.3.1	LOWER TRAY SUPPORTS:
	WORST-CASE TRAPEZE MEMBER HAS 2'-5" SIMPLY SUPPORTED SPAN:



$M_{MAX} = 150(8.5) = 1280$ IN-LB

6.1 p. 5-311 SECT 5.1 p. 5-312 SECT 5.2.1a	$M_{MAX}/S = 1280/0.247 = 5.2$ KSI < 23.8 KSI ∴ OK
	AT THIS LEVEL, MEMBER STRESSES ARE TRIVIAL AND, BY INSPECTION, SO ARE THE WELDED ROD COUPLER ATTACHMENTS TO THE TRANSVERSE ∠3x3x1/4.

TRANSVERSE ∠3x3x1/4:



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SUBJECT AEP JOB No. 89C1570 SHEET 3 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID# RACE 004, LAR #3)
CONTAINMENT EL. 598'

REVISIONS: 0 — CCF 5/11/94, A.K. 5/25/94

REF. DEAD LOAD CHECK (CONT'D)

TRANSFER SHEAR ONLY TO SUPPORTS #1M, 2M, 3M, 4M:

$$V_{4M} = \frac{150(37+66)}{69} = 224^{\#}$$

$$V_{3M} = \underbrace{(150\times2-224)+\frac{150(12+18+45)}{45}}_{250} = 326^{\#}$$

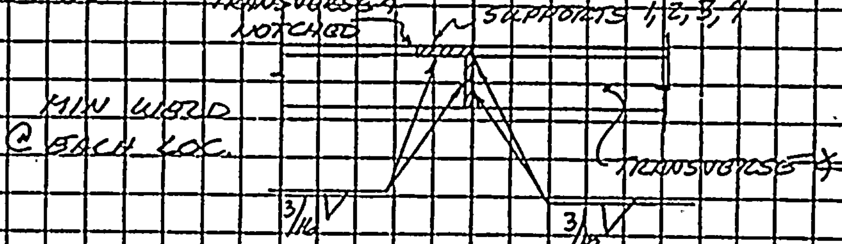
$$V_{2M} = \underbrace{(150\times3-250)+\frac{150(45)+75(20+35)}{64}}_{175} = 375^{\#}$$

$$V_{1M} = 150+2\times75-175 = 125^{\#}$$

LENGTH OF 3/16" FILLET REQUIRED @ TRANSVERSE ∠ TO SUPPORT 1M-4M ∠ CONNECTIONS:

$$L_{REQD} = \frac{375^{\#}}{.707(3/16)(18{,}000)} = 0.16''$$

ALL WELDS SUFFICIENT WITH WIDE MARGIN:



∠S = 3×3×1/4

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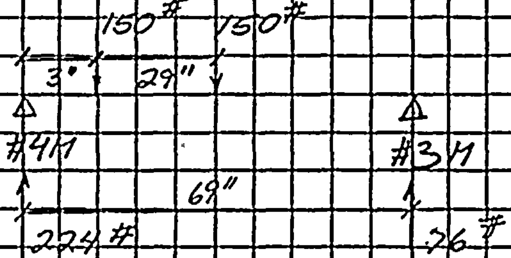
SUBJECT AEP JOB No. 89C1570 SHEET 4 OF 12

A46 LAR'S
DC Cook Unit 2
LAR-027
(PASS ID # RACE 004, LAR #3)
Containment El. 598'

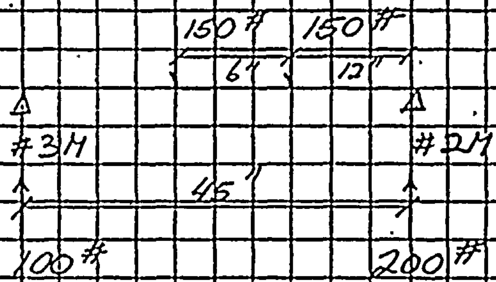
REVISIONS	
0	CCF 5/11/94
	A.K. 5/25/94

REF. DEAD LOAD CHECK (CONT'D)

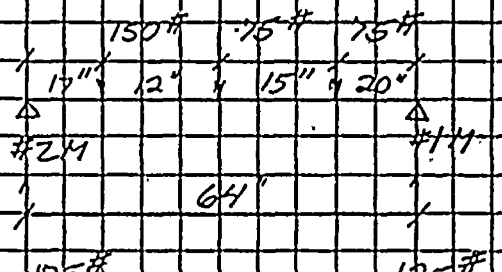
LOOK AT MOMENTS IN TRANSVERSE ∠ = (3x3x1/4)



$M_{MAX} = 76(37) = 2810$ IN-LB



$M_{MAX} = 200(18) - 150(6) = 2700$ IN-LB



$M_{MAX} = 175(29) - 150(12) = 3280$ IN-LB

$M/S = 3280/0.577 = 5.7$ KSI < 21.6 KSI

∴ OK

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SUBJECT AEP JOB No. 89C1570 SHEET 5 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID# RACE 004, LAR #3)
CONTAINMENT EL. 598'

REVISIONS
0 CCF 5/11/94
A.K. 5/25/94

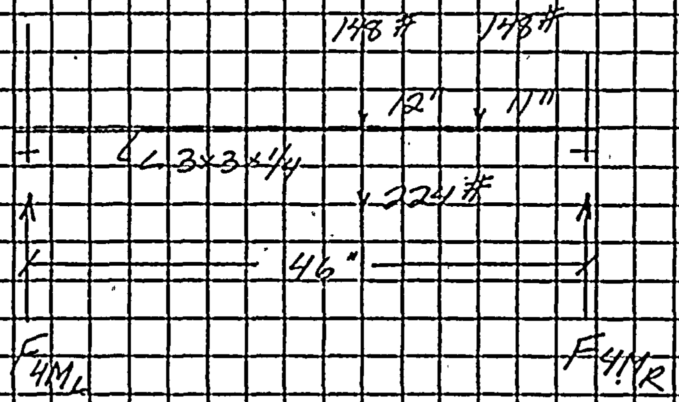
REF. DEAD LOAD CHECK (CONT'D)

MIDDLE TRAY SUPPORTS (SUPPORT MEMBERS #1M, 2M, 3M, 4M)

THESE MEMBERS SUPPORT THE TWO MIDDLE CABLE TRAYS AS WELL AS THE TRANSVERSE & REACTIONS FROM THE LOWER TRAYS. SUPPORTS 1M, 2M, AND 4M TRAPEZE-TYPE SUPPORTS. #3M IS A CANTILEVER BRACKET ATTACHED TO CONTAINMENT COL. 18.

ALL SUPPORTS ARE ≤ 3×3×1/4.
SUPPORTS 1, 2, AND 4 HAVE 3'-10" SPANS
SUPPORT # 3 IS 3'-3" LONG.

SUPPORT #4M (LOOKING AWAY FROM SUPT #3)



$F_{4M_L} = (148(11+23) + 224(23))/46$

$F_{4M_L} = 221$ LB

$F_{4M_R} = 299$ LB

$M_{MAX} = 5080$ IN-LB

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SUBJECT AEP JOB No. 89C1570 SHEET 6 OF 12

A46 LAR's
DC COOK UNIT 2
LAR-027
(PASS ID# RACE 004, LAR #3)
CONTAINMENT EL. 598'

REVISIONS
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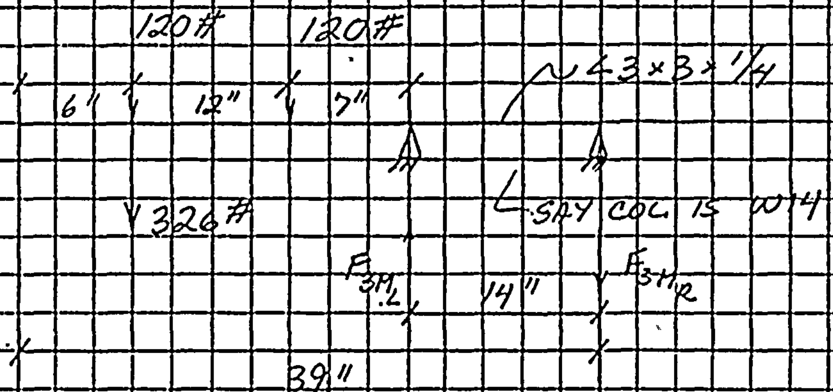
REF DEAD LOAD CHECK (CONT'D)

SUPPORT #3M (LOOKING AWAY FROM SUPT #2)



$F_{3M_L} = (120(21+32) + 326(32))/14$

$F_{3M_L} = 1200\#$

$F_{3M_R} = 634\#$

$M_{MAX} = 9310$ IN-LB

$M/S = 9310/0.577 = 16.1$ KSI < 21.6
(INT = 0.75)

WELD CAPACITY = (.707)(3/16)(3")(18 KSI)
= 7.2 K > 1200 LB
(INT = 0.17)

6.4 SECT. 8.3.1 THE DEAD LOAD CHECK IS THE ONLY CHECK REQUIRED FOR RIGIDLY SUPPORTED CANTILEVER BRACKETS. NO FURTHER ANALYSIS IS REQUIRED FOR THIS SUPPORT BRACKET.

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SUBJECT AEP JOB No. 89C1570 SHEET 7 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID# RACE 004, LAR # 3)
CONTAINMENT EL. 598'

REVISIONS
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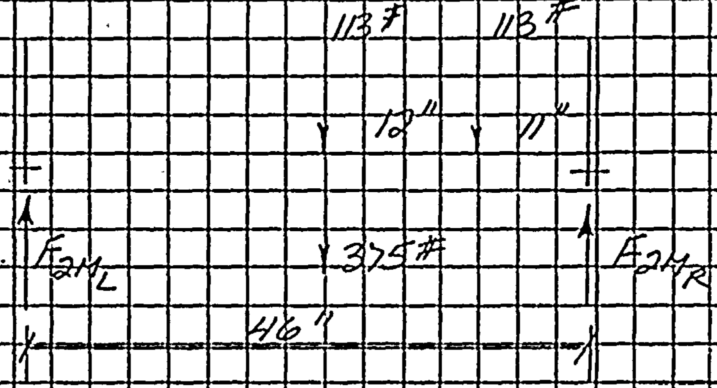
REF DEAD LOAD CHECK (CONT'D)

SUPPORT # 2M (LOOKING AWAY FROM SUPT # 1)



$F_{2M_L} = (113(11+23) + 375(23))/46$

$F_{2M_L} = 271\#$

$F_{2M_R} = 330\#$

$M_{MAX} = 6230$ IN-LB

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SUBJECT AEP JOB No. 89C1570 SHEET 8 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID# RACE 004, LAR #3)
CONTAINMENT EL. 598'

REVISIONS
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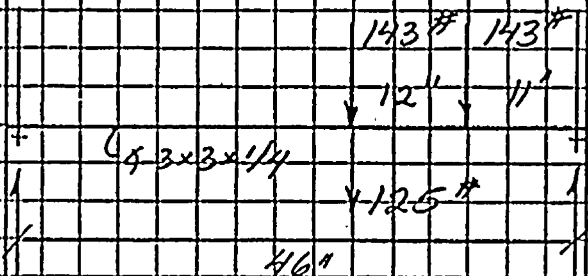
REF. DEAD LOAD CHECK (CONT'D)

SUPPORT #1M (LOOKING TOWARD SLOT #2)



$F_{1M_L} = (143(11+23) + 125(23))/46$

$F_{1M_L} = 168\#$

$F_{1M_R} = 243\#$

$M_{MAX} = 3860$ IN-LB

WORST CASE MOMENT, SUPPORTS #1M, 2M, 4M:

$M = 6230$ IN-LB (SUPPORT #2M)

$M/S = 6230/0.577 = 10.8$ KSI ≤ 21.6 KSI

∴ OK

(INT = 0.50)

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SUBJECT AEP JOB No. 89C1570 SHEET 9 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID# RACK 004, LAR #3)
CONTAINMENT EL. 598'

REVISIONS: 0 — CCF 5/11/94, A.K. 5/25/94

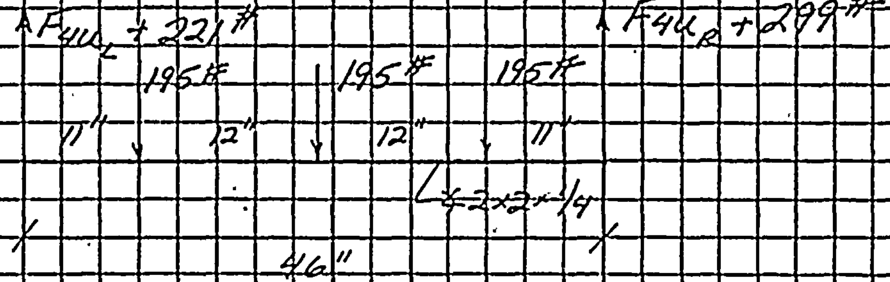
REF. — DEAD LOAD CHECK (CONT'D)

UPPER TRAY SUPPORTS (SUPPORT MEMBERS 1U, 2U, AND 4U)

THESE MEMBERS SUPPORT THE THREE UPPER CABLE TRAYS. ALL SUPPORTS ARE ∠ 2x2x1/4 WITH 3'-10" SPANS.

THE 5/8" THREADED RODS CARRY THE UPPER CABLE TRAY LOADS AND THE LOADS IMPOSED BY SUPPORT MEMBERS 1M, 2M AND 4M.

SUPPORT #4U.



F_{4U_L} = 293# = F_{4U_R}

GIL p. 5-311 Sect 5.1 — M_{MAX} = 293(23) − 195(12) = 4400 IN-LB

p. 5-312 Sect 5.2.1a — M/S = 4400/0.247 = 12.8 < 23.8 KSI (UNT = 0.75)

— NOTE — SUPPORT MEMBER 4U HAS THE GOVERNING BENDING MOMENT.

ANCHORAGE LOADS: F_{4L} = 514 #

F_{4R} = 592 #

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SUBJECT AEP JOB No. 89C1570 SHEET 10 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID# RACE004, LAR #3)
CONTAINMENT EL. 598'

REVISIONS
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REF. DEAD LOAD CHECK (CONT'D)

SUPPORT #2U

CABLE TRAY WGT = 3@185#

ANCHORAGE LOADS:

$$F_{2L} = 1.5(185) + \underbrace{F_{2H_L}}^{271} = 549\#$$

$$F_{2R} = 1.5(185) + \underbrace{F_{2H_R}}_{330} = 608\#$$

SUPPORT #1U

CABLE TRAY WGT = 3@143#

ANCHORAGE LOADS:

$$F_{1L} = 1.5(143) + \overbrace{F_{1H_L}}^{168} = 383\#$$

$$F_{1R} = 1.5(143) + \underbrace{F_{1H_R}}_{243} = 458\#$$

ANCHORAGE EVALUATION

ANCHOR POINTS 4L, 4R, 2L, 1L ARE 5/8" THREADED ROD INTO EMBEDDED UNISTRUT; ALLOWABLE PULLOUT = 2000 LB. MAX REACTION = 592 LB. (UNT = 592/2000 = 0.30)

ANCHOR POINTS 1R AND 2R ARE THREADED ROD TO UNSPECIFIED CONCRETE ANCHORS. USE IN TENSION BY DEADWGT ALLOWABLE OF 1.9 KIPS: MAX REACTION = 608 LB. (UNT = 608/1900 = 0.32)

∴ ANCHORAGE OK.

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SUBJECT AEP JOB No. 89C1570 SHEET 11 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID# RACE 004, LAR #3)
CONTAINMENT EL. 598'

REVISIONS: 0 CCF 5/11/94 A.K. 5/25/94

REF.	VERTICAL CAPACITY CHECK
6.4 Sect. 8.3.2	CHECK ANCHORAGE LOADS FOR 3× DL:
	MAX LOAD ON EMBEDDED UNISTRUT = 592 LB
	592 × 3 = 1780 < 2500# ∴ OK (INT = 0.71)
	MAX LOAD ON CONCRETE ANCHOR = 608 LB
	608 × 3 = 1820 < 1900# ∴ OK (INT. = 0.96)
6.4 Sect. 8.3.3	DUCTILITY CHECK
	ROD HANGER TRAPEZE SUPPORTS BEHAVE IN A DUCTILE MANNER UNDER HORIZONTAL EARTHQUAKE MOTION. PROCEED TO ROD HANGER FATIGUE EVALUATION.

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SUBJECT AEP JOB No. 89C1570 SHEET 12 OF 12

A46 LAR'S
DC COOK UNIT 2
LAR-027
(PASS ID # RACE 004, LAR#3)
CONTAINMENT EL. 598'

REVISIONS
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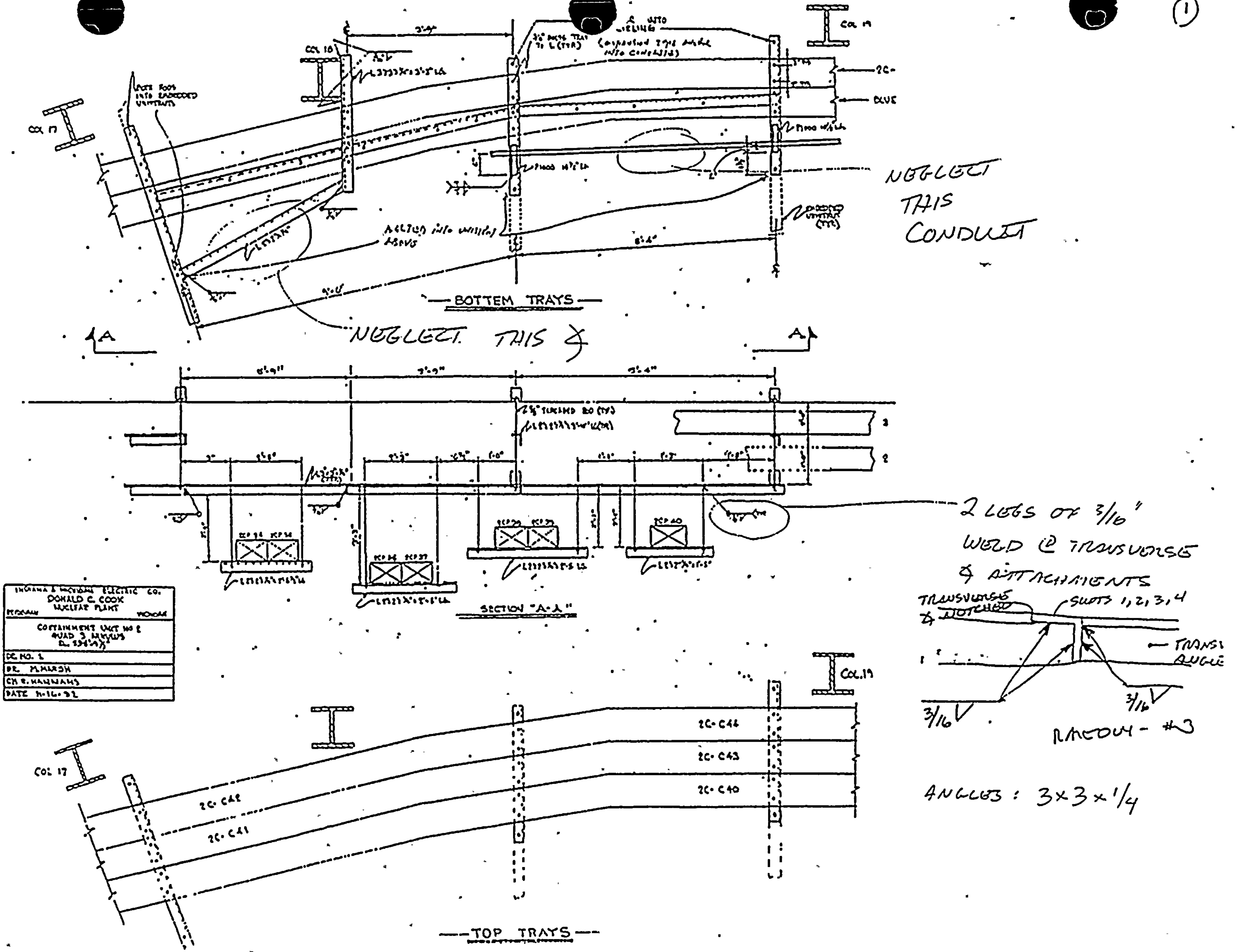
A.K. 5/25/94

REF.	ROD HANGER FATIGUE EVALUATION
6.4 SECT. 8.3.5	L = LENGTH OF ROD ABOVE TOP TIER = 24"
	W = TOTAL DEAD LOAD ON BOTH RODS - USE SUPPORT #2 = 549 + 608 = 1157 #
	USE FIGURE 8-13 OF REF. 6.4 (5/8" ROD) AND 0.75g ROD FATIGUE BOUNDING SPECTRUM (SEE SECTION 5.2 TO THIS CALCULATION).
	RESULT - THE ROD LENGTH / SUPPORT WEIGHT COMBINATION FALLS WITHIN THE ACCEPTABLE REGION OF THE FATIGUE EVALUATION SCREENING CHART.
	PER THE PASS, THIS TRAPEZE SUPPORT ARRANGEMENT IS UNIQUE. ALL THE CEILING THREADED ROD ATTACHMENTS ARE INTO EMBEDDED STRUT; i.e., NO WELDED COUPLER DETAIL. THEREFORE THERE IS NO NEED TO PERFORM THE "FIELD-THREADED" ROD EVALUATION (SEE SECTION 5.3 TO THIS CALCULATION) FOR THIS SUPPORT.

CONCLUSION

THIS SUPPORT SATISFIES THE LIMITED ANALYTICAL REVIEW CRITERIA OF REF. 6.4 AND IS THEREFORE CONSIDERED TO BE SEISMICALLY ADEQUATE.



COL 17
COL 18
COL 19
BOTTEM TRAYS
NEGLECT THIS CONDUIT
NEGLECT THIS ⊄
A
A
SECTION "A-A"
2 LEGS OF 3/16" WELD @ TRANSVERSE & ATTACHMENTS
TRANSVERSE & NOTCHED
SLOTS 1, 2, 3, 4
TRANS ANGLE
3/16
3/16
RACEWAY - #3
ANGLES: 3×3×1/4
DONALD C. COOK NUCLEAR PLANT
CONTAINMENT UNIT NO 2
DR. M.MARSH
2C-C42
2C-C41
2C-C44
2C-C43
2C-C40
TOP TRAYS

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SUBJECT AEP JOB No. 89C1570 SHEET 1 OF 4

A46 LAR'S
DC COOK UNIT 1
LAR-030
(PASS ID # RACE-131), LAR # 2)
CONTAINMENT EL. 603'-10"

REVISIONS: 0 CCF 5/11/94 A.K. 5/26/94

REF.	LOAD CALCULATIONS
6.17	CONDUIT 1A1 IS A 10" SCHED 40 PIPE.
6.1	WGT./FOOT = 40.48 LB.
6.14	BASED ON REF. 6.14, A CABLE FILL OF 40% BY VOLUME IS ASSUMED TO BE THE MAXIMUM FILL THAT WOULD BE USED.

THE ID OF A 10" SCHED 40 PIPE = 10.02 IN

$$A_i = (10.02)^2 \pi/4 = 78.8 \text{ IN}^2$$

THE CABLE DENSITY USED FOR THIS ANALYSIS IS BASED ON DATA PROVIDED IN REF. 6.14 FOR 4" RIGID CONDUIT:

$$\text{CABLE DENSITY} = \frac{\text{CABLE WGT}}{0.4 \times \frac{\pi}{4} D_i^2} = \frac{5.72 \#/FT}{\frac{\pi}{4}(4.026)^2(.4)}$$

$$\text{DENSITY} = 1.12 \ \#/FT/IN^2$$

40% OF INTERIOR VOLUME OF 10" SCHED 40

$$= 0.4(78.8) = 31.5 \text{ IN}^2$$

$\therefore$ WGT/FT OF 1A1 CONDUIT - CABLE ONLY

$$= 1.12(31.5)$$

$$= 35.3 \ \#/FT$$

TOTAL WEIGHT OF CONDUIT AND CABLE USED FOR THIS ANALYSIS:

$$40.48 + 35.3 \rightarrow \underline{76 \ \#/FT}$$

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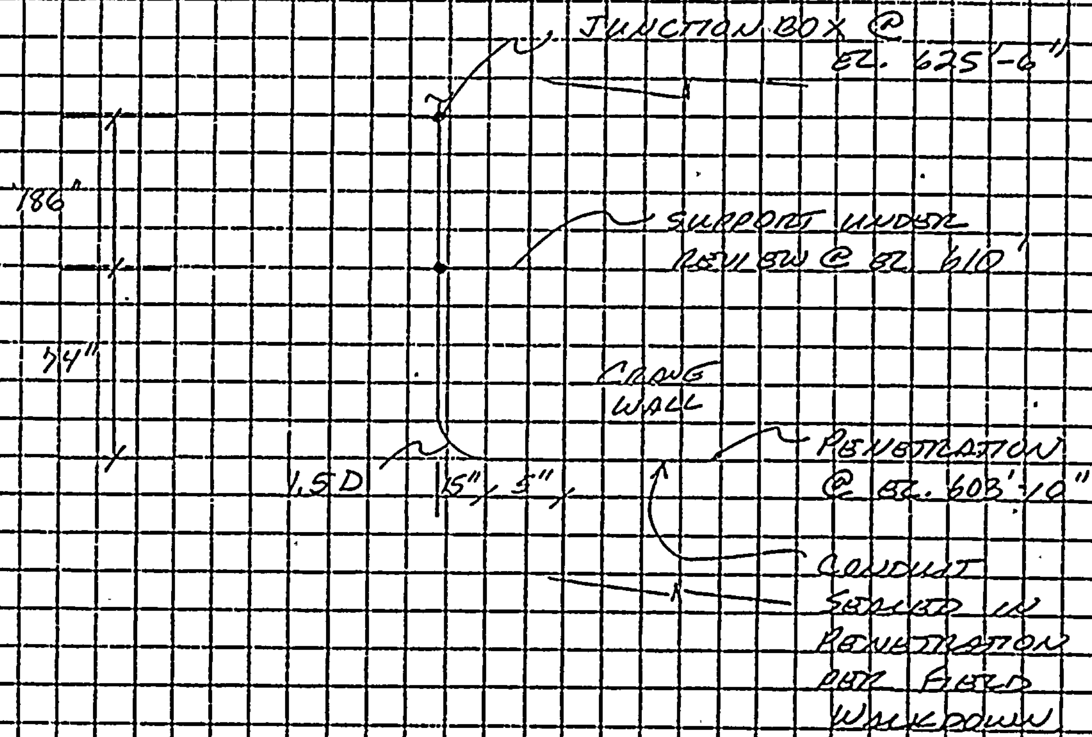
SUBJECT: AEP — JOB No. 89C1570 — SHEET 2 OF 4

A46 LAR's
DC COOK UNIT 1
LAR-030
(PASS ID# RACE 131, LAR # 2)
CONTAINMENT EL. 603'-10"

REVISIONS	
0	CCE 5/11/94
	A.K. 5/26/94

REF. DEAD LOAD CHECK

PASS THE GEOMETRY OF THE 10" CONDUIT UNDER REVIEW IS AS FOLLOWS:



PER THE GUIDELINES SET FORTH IN REF 6.4, THIS SUPPORT NEED ONLY BE CHECKED FOR DEAD LOAD BECAUSE THE SUPPORT IS RIGIDLY ATTACHED TO A STRUCTURAL WALL.

VERTICAL FORCE DUE TO DEAD WEIGHT WILL BE RESISTED BY THE CONDUIT ITSELF. THE SUPPORT UNDER REVIEW WILL PROVIDE THE LATERAL SUPPORT NECESSARY TO HOLD THE CONDUIT IN PLACE.

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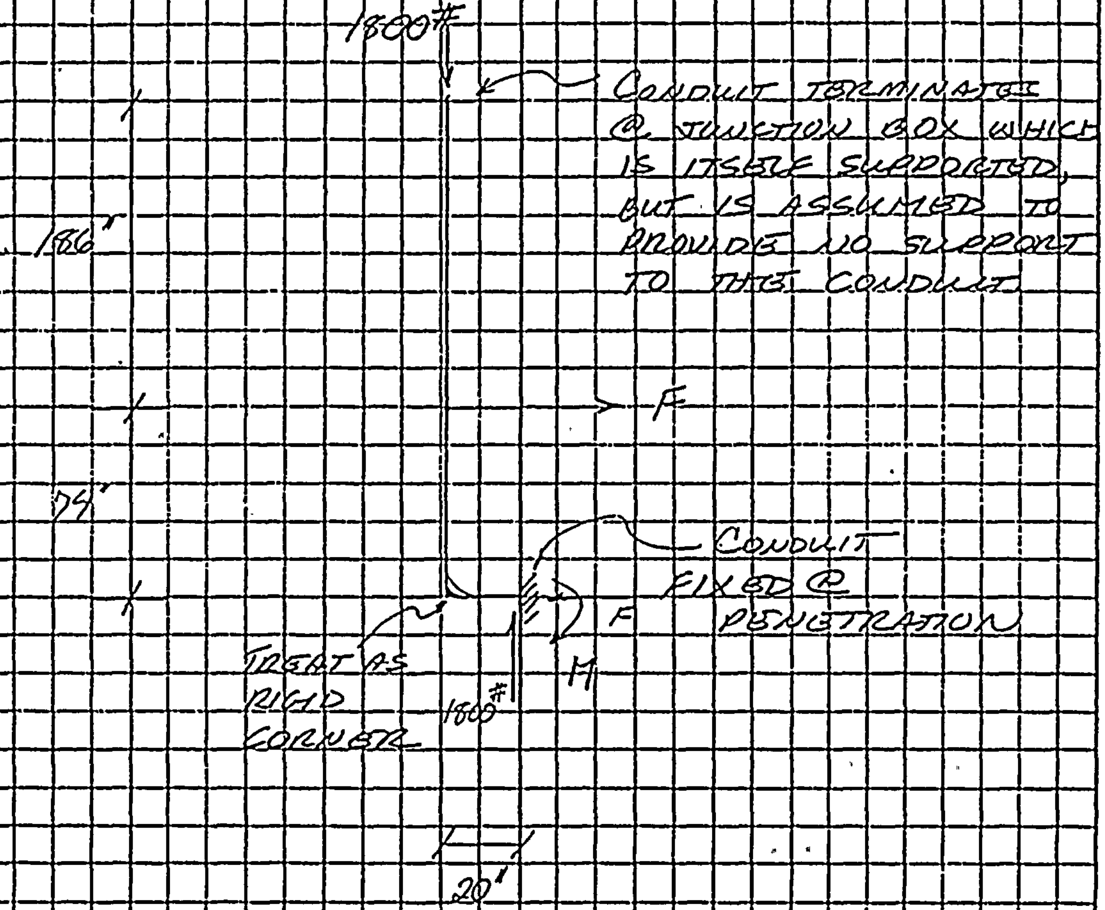
SUBJECT AEP JOB No. 89C1570 SHEET 3 OF 4

A46 LAR's
DC COOK UNIT 1
LAR-030
(PASS ID# RACE 131, LAR#2)
CONTAINMENT EL. 603'-10"

REVISIONS: 0 CCF 5/11/94 A.K. 5/26/94

REF.	DEAD LOAD CHECK (CONT'D)
	TOTAL WEIGHT OF CONDUIT TO JUNCTION BOX = (186" + 74" + 20")/12 × 76 #/FT ~ 1800 #



6.16 p. 23 — USING THE SOLUTION FOR FRAME 5 FROM REF 6.16:

$h = 20"$ $l = 74"$ $k = h/l = 0.270$

$P = 1800\#$ $N = 3k + 1 = 1.81$

$$M = Ph - \frac{3Phk}{2N} = 1800(20) - \frac{3(1800)(20)(.270)}{2(1.81)}$$

$$M = 36{,}000 - 8060 = 27{,}940 \text{ IN-LB}$$

$$F = 3Phk/2Nl = 8060/74 = \underline{\underline{109\#}}$$

SUBJECT AEP JOB No. 89C1570 SHEET 4 OF 4

A46 LAR's
DC COOK UNIT 1
LAR-030
(PASS ID# RACE 131, LAR #2)
CONTAINMENT EL. 603'-10"

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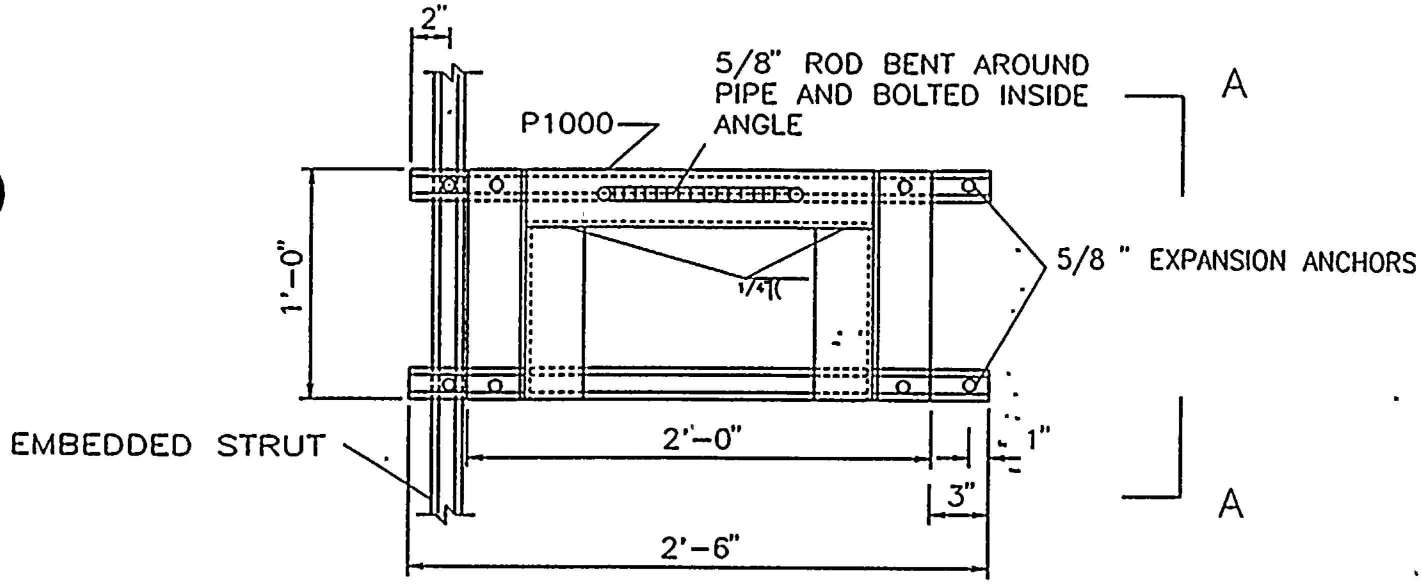
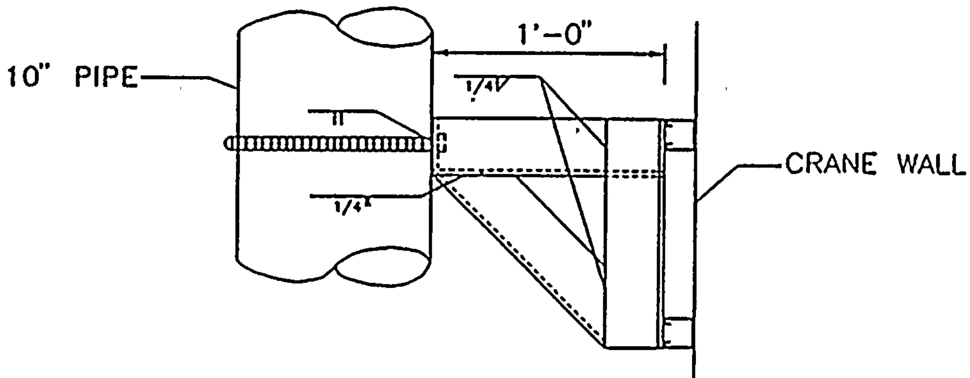
REF.	DEAD LOAD CHECK (CONT'D)
	CHECK BENDING IN 10" SCHED. 40 PIPE
6.1	$\frac{M}{S} = \frac{27940 \text{ IN-\#}}{29.9 \text{ IN}^3} = 0.93$ KSI
	VERY LOW
	THE 109# FORCE AT THE LATERAL RESTRAINT IS SMALL, AND THE SUPPORT IS OK BY INSPECTION.
6.4 SECT. 8.3.1	THE DEAD LOAD CHECK IS THE ONLY CHECK REQUIRED FOR CABLE TRAY AND CONDUIT SUPPORTS DIRECTLY MOUNTED TO A STRUCTURAL WALL. NO FURTHER ANALYSIS IS REQUIRED.

CONCLUSION

THIS SUPPORT SATISFIES THE LIMITED ANALYTICAL REVIEW CRITERIA OF REF 6.4 AND IS THEREFORE CONSIDERED TO BE ADEQUATE FOR SEISMIC LOADING.





VIEW A-A

- ALL ANGLES ARE 3X3X1/4
- PIPE PENETRATES CRANE WALL AT EL. 603'-10" AND RUNS UP INSIDE CRANE WALL TO A JUNCTION BOX AT EL. 625'-6". THERE IS A LATERAL SUPPORT AT EL. 610'. NO OTHER SUPPORTS EXCEPT PENETRATION AND JUNCTION BOX.
- PIPE LAYOUT SHOWN IN DRAWING 1-1460 (SEE SECTION 1X-1X AND DRAWING 1-1525).

UNIT 1, LOWER CONTAINMENT
CONDUIT 1A1: 10" PIPE

D. C. COOK
A-46 RACEWAY WALKDOWN
PASS ID#: RACE-131, LAR #2

CALCULATION USED TO RESOLVE
THE OUTLIER GENERATED BY
LAR #022

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CLIENT AEP JOB No. 89C1570 SHEET 1 OF 9

SUBJECT

OSVS - RACE003
- LAR022

REVISIONS
0 SA 8/29/94
A.K. 9/6/94

OBJECTIVE

LAR 022 EVALUATED A SUPPORT MID-WAY BETWEEN TWO RIGID SUPPORTS (WELDS TO BUILDING STEEL) THE EVALUATION SHOWED THAT THE MID-WAY SUPPORT COULD NOT MEET DEAD LOAD. THE TWO RIGID SUPPORTS ARE 15'-6" APART; WITHOUT THE MID-WAY SUPPORT THE GIP SPACING REQUIREMENT OF 10' IS NOT SATISFIED.

THIS CALCULATION RESOLVES THE OUTLIER BY DEMONSTRATING THAT COMBINED SYSTEM OF THE RACEWAYS (TRAYS & CONDUIT) AND THE MID-WAY SUPPORT ARE CAPABLE OF SPANNING THE DISTANCE BETWEEN THE TWO RIGID SUPPORTS.

CONCLUSION

THE FOLLOWING CALCULATION SHOWS THAT SYSTEM IS CAPABLE OF SPANNING THE 15'-6" BETWEEN RIGID SUPPORTS.

THE CHART ON PP. SHOWS THAT UNDER DEAD WEIGHT, THE BULK OF THE LOAD IS CARRIED BY THE STIFFEST ELEMENT - THE CONTROL TRAY, WHICH IS WITHIN ABOUT 20% OF ALLOWABLES. THE CHART ALSO SHOWS THAT THERE IS SIGNIFICANT RESERVE STRENGTH IN THE OTHER ELEMENTS - IF YIELDING IS ALLOWED TO OCCUR, THE SYSTEM CAN PROBABLY TAKE SEVERAL MULTIPLES OF THE DEAD WEIGHT BEFORE "FAILURE" OCCURS.

NOTE THAT PER THE GIP, NO CONSIDERATION OF SEISMIC LOADS WOULD BE NECESSARY IF THE SPAN BETWEEN RIGID SUPPORTS WAS ≤ 10'. THIS IS BECAUSE DUE TO THE INHERENT HIGH DAMPING IN THESE SYSTEMS, LITTLE DYNAMIC RESPONSE OCCURS. AS THIS SYSTEM HAS A SPAN

CLIENT AEP JOB No. 8961570 SHEET 2 OF 9

SUBJECT

OSVS - RACE ØØ3

- LAR Ø22

REVISIONS

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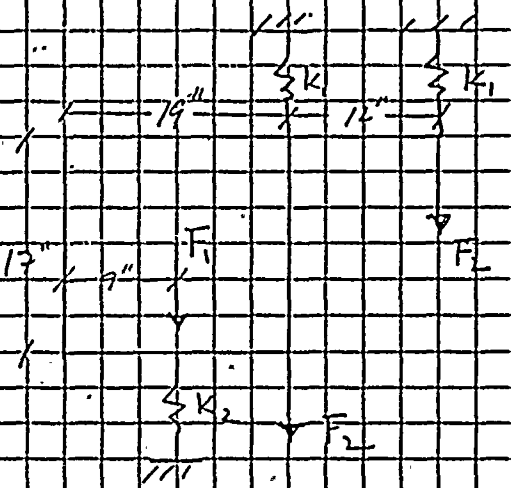
OF ABOUT 15' BTWN RIGID SUPPORTS AND IS LOW IN ELEVATION (THE TRAY SUPPORTS ARE WITHIN ABOUT 20' OF GRADE) THE SAME LOW LEVEL OF SEISMIC RESPONSE CAN BE ASSUMED AS THERE IS SIGNIFICANT MARGIN ABOVE DEAD LOAD (AS DISCUSSED ABOVE), THIS CONFIGURATION IS ACCEPTABLE

REFERENCES

1. DC COOK LAR EVALUATIONS
2. AISC, "MANUAL OF STEEL CONSTRUCTION", 8TH EDITION
3. S&A CALC # 82C200-02, REV 0, 9/30/83 "CABLETRAY TESTING - ANALYSIS & REPORT"
4. AISC, "MANUAL OF STEEL CONSTRUCTION - ALLOWABLE STRESS DESIGN" 9TH EDITION

ANALYSIS

THE CONFIGURATION AT THE MID-WAY SUPPORT IS AS SHOWN BELOW:



SEE REF 1, LAR #22 FOR THE DETAILS OF THE GEOMETRY

F_1 = 96# (TOP TRAY)
142# (BOTTOM TRAY)
108# (CONDUIT)
REF 2 25# (~8' OF 2x2x1/4 FRAMING)
371#

REF 2 F_2 = 36# (1/2 THE WEIGHT OF A 3x3x1/4 ∡ SPANNING 14.5')

K_1 = MID-SPAN STIFFNESS OF A 3x3x1/4 ∡, SIMPLY SUPPORTED, SPANNING 14.5'

REF 2 $= \frac{48EI}{L^3} = \frac{48(29E6)(1.24)}{(14.5 \times 12)^3} = 328$

K_2 = MIDSPAN STIFFNESS OF SS 15.5' POWER TRAY
+ " I&C TRAY
+ " 2" CONDUIT
+ " 1.5" CONDUIT
+ " 3 1" CONDUIT

CLIENT AEP JOB No. 89C1570 SHEET 4 OF 9

SUBJECT

OSVS - RACE003

LAR022

REVISIONS: 0 SA 8/29/94; A.K. 9/6/94

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SEE NOTE BELOW

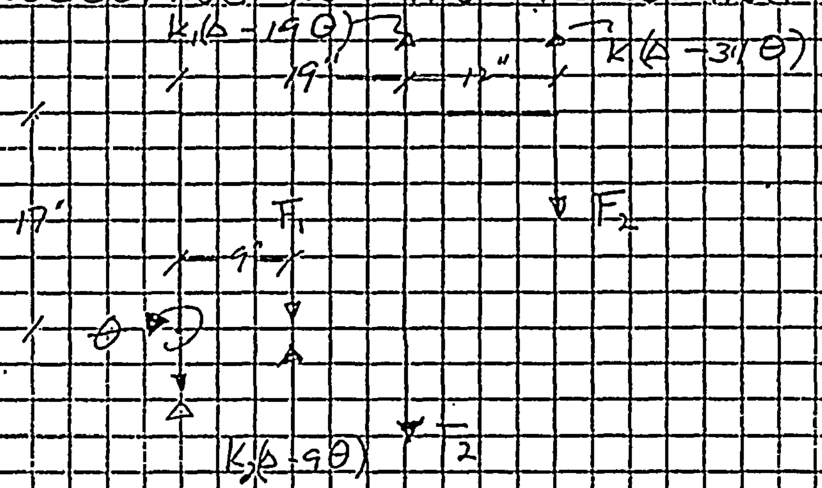
$$K_2 = \frac{48}{(15.5 \times 12)^3} \left[\begin{array}{l} 1.3 \times 10^7 \text{ lb-in}^2 \text{ (EI of POWER TRAY)} \\ +1.4 \times 10^8 \text{ lb-in}^2 \text{ (EI of I;C TRAY)} \\ +1.9 \times 10^7 \text{ lb-in}^2 \text{ (EI OF 2" SCH 40 PIPE)} \\ +0.9 \times 10^7 \text{ lb-in}^2 \text{ (" 1.5" ")} \\ +0.8 \times 10^7 \text{ lb-in}^2 \text{ (" 3/4" ")} \end{array} \right]$$

$= 1410$ lb/in

NOTE: THE STIFFNESS OF TRAYS (2C-P2 IS A POWER (MESH) TRAY 2C-08 IS A CONTROL (SOLID) TRAY) IS FROM S;A CALC 82C200-02 (REF) THE STIFFNESSES ARE BASED ON STATIC TESTS OF TRAYS DONE AS PART OF AN EFFORT TO DEVELOP AN EVALUATION CRITERIA FOR RACEWAYS DUE TO APPENDIX R MODS.

THE PROPERTIES OF SCH 40 PIPE ARE FROM REF 2.

UNDER THE APPLIED LOADS (F_1 : F_2), THE MID-WAY SUPPORT WILL DISPLACE AND ROTATE AS A RIGID BODY. THE DISPLACEMENT : ROTATION CAN BE DEFINED BY THE DISPLACEMENT AND ROTATION OF THE LOWER LEFT CORNER, RESULTING IN THE FOLLOWING:



Δ : θ CAN BE FOUND BY SUMMING FORCES : MOMENTS:

ΣF:

$$K_2(\Delta-9\theta)+K_1(\Delta-19\theta)+K_1(\Delta-31\theta)=F_1+2F_2$$

$$(2K_1+K_2)\Delta-(50K_1+9K_2)\theta=F_1+2F_2$$

ΣM (ABOUT F_1):

$$10K_1(\Delta-19\theta)+22K_1(\Delta-31\theta)=10F_2+22F_2$$

$$32K_1\Delta-872K_1\theta=32F_2$$

$$K_1\Delta-27.3K_1\theta=F_2$$

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CLIENT AEP JOB No. 89C1570 SHEET 6 OF 9

SUBJECT
OSVS - RACE003
- LAR022

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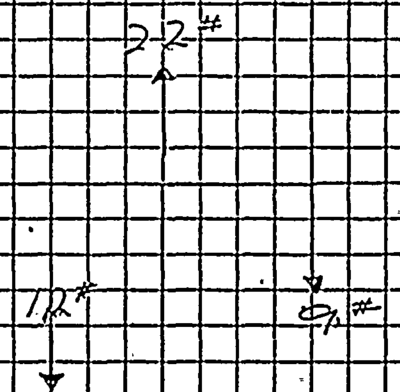
PLUG IN VALUES ; SOLVE :

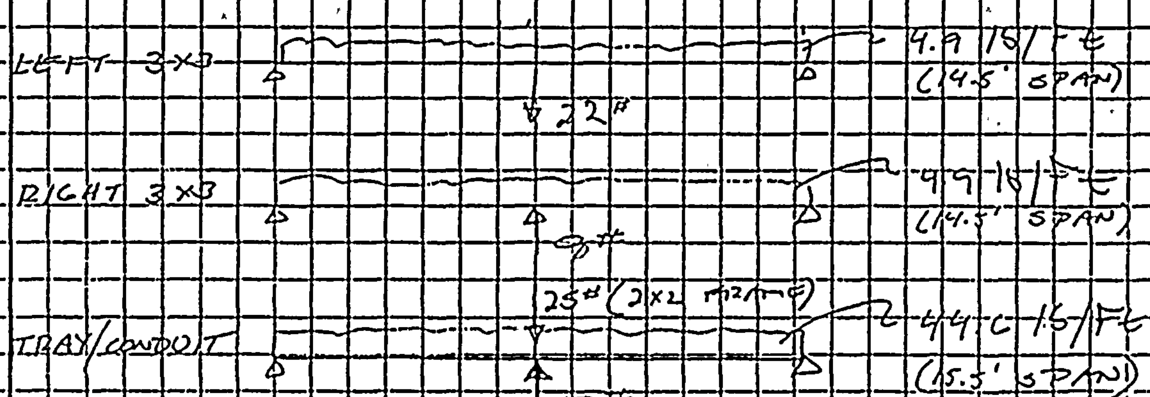
$$2065\,\Delta - 29090\,\theta = 443$$
$$328\,\Delta - 8954\,\theta = 36$$

$$\Delta = \frac{\begin{vmatrix} 443 & -29090 \\ 36 & -8954 \end{vmatrix}}{\begin{vmatrix} 2065 & -29090 \\ 328 & -8954 \end{vmatrix}} = 0.326$$

$$\theta = \frac{\begin{vmatrix} 2065 & 443 \\ 328 & 36 \end{vmatrix}}{\left| \text{(same)} \right|} = 0.00793$$



THIS MEANS THAT THE LEFT 3x3 CARRYS 22# IN ADDITION TO ITS DEAD WEIGHT ; THE OTHER 3x3 AND THE TRAY/CONDUIT ARE "LIGHTENED" BY 9# & 12# RESPECTIVELY.



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CLIENT AEP JOB No. 89C1570 SHEET 7 OF 9

SUBJECT
OSYS - RACE003
- LAR022

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CHECK ELEMENT LOADS:

ELEMENT	MAXIMUM MOMENT	ALLOWABLE MOMENT	F.S.
3×3×1/4 ∠	2510 (1)	9800 (6)	3.9
I/C TRAY	12400 (2)	15000 (7)	1.2
POWER TRAY	1150 (4)	9800 (4)	8.6
2" CONDUIT	1680 (3)	12000 (8)	7.1
1.5" CONDUIT	800 (4)	7000 (9)	8.8
1" CONDUIT	240 (5)	2900 (10)	12.1

(1) $\frac{(4.9)(14.5)^2}{8} + \frac{(22)(14.5)}{4} = 209'^{\#} = 2510''^{\#}$

(2) TOTAL MID-SPAN MOMENT:

$\frac{(44.6)(15.5)^2}{8} + \frac{(25+12)(15.5)}{4} = 1390'^{\#}$
$= 16700''^{\#}$

APPORTION BY RELATIVE STIFFNESS:

$\frac{1.4}{.13+1.4+.19+.09+.08} \times 16700 = 12400''^{\#}$

(3) $\frac{.19}{(1.89)} \times 16700 = 1680''^{\#}$

(4) $\frac{.09}{1.89} \times 16700 = 800''^{\#}$

(5) $\frac{.08/3}{1.89} \times 16700 = 240''^{\#}$

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CLIENT AEP JOB No. 89C1570 SHEET 8 OF 9

SUBJECT OSVS - RACE Ø03 - LARØ22

REVISIONS: 0 SA 8/29/94; A.K. 9/6/94

REF 1 LAR 22, P7.3 — (6) ALLOWABLE STRESS : 21.6/1.25 = 17 KSI
SECTION MODULUS : .577 IN³

REF 2 P1-45 — ALLOWABLE MOMENT : (17)(.577) = 9800 ″#

(7) FROM REF 3, P6/39, THIS IS A FAIRLY CONSERVATIVE VALUE AS THE TRAY WAS LOADED BEYOND THIS POINT; WHILE IT "SOFTENED" (DUE TO CROSS-SECTION DISTORTION) IT DID NOT FAIL OR SHOW SIGNIFICANT DISTRESS.

REF 2 P1-89 — (8) ALLOWABLE STRESS : 0.6 (36 KSI) = 21.6 KSI
SECTION MODULUS : 0.561

ALLOWABLE MOMENT : (21.6)(.561) = 12000 ″#

REF 2 P1-89 — (9) ALLOWABLE STRESS : 21.6 KSI
SECTION MODULUS : 0.326

ALLOWABLE MOMENT : (21.6)(.326) = 7000 ″#

REF 2 P1-89 — (10) ALLOWABLE STRESS : 21.6 KSI
SECTION MODULUS : 0.133

ALLOWABLE MOMENT : (21.6)(.133) = 2900 ″#

(11) $\frac{.13}{1.89} \times 16700 = 1150$ ″#

(12) FROM REF 3, P28/39, THE TRAY FAILS AT THE POINT OF MAXIMUM SHEAR; SHEAR ALLOWABLE IS 210 LBS. FOR ~~A~~ THE CASE OF UNIFORM LOAD, THE RATIO OF M_{max} TO V_{max} IS :

$$\frac{wL^2}{8} \Big/ \frac{wL}{2} = L/4$$

$$\text{ALLOWABLE MOMENT} = 210 \left(\frac{(15.5 \times 12)}{4}\right) = 9800 \text{ ″\#}$$

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CLIENT AEP JOB No. 89C1570 SHEET 9 OF 9

SUBJECT

OSVS - RAZE003
- LAR022

REVISIONS
0 SA 8/29/94
A.K. 9/6/94

CHECK THE LOAD @ THE RIGID SUPPORTS

• TRIBUTARY LENGTH = $\frac{15'-6'' + 12'-1''}{2}$ = 13.8'

TOTAL LOAD = 13.8 × 44.6 + 25 + 12
= 628 #

LOAD ON BOTTOM ANGLE
= $628 \left(1 - \frac{.13}{1.89}\right)$ = 585 #

M_{max} = 585# × 9" = 5265 "#
f_b = 5270 / .247 = 21.3 KSI

• REF 4, SECTION 5.1.1 .
b/t = 2/.25 = 8 ≤ $65/\sqrt{F_y}$ = $65/\sqrt{36}$ = 10.8
∴ F_b = 0.66 F_y = 0.66 (36) = 23.8 KSI

REF 4, SECTION 5.2
TRAY/CONDUIT PROVIDE RESTRAINT AGAINST LAT-TOR BUCKLING ∴ 5.2.1a APPLIED

$\frac{F_b}{f_b} = \frac{23.8}{21.3}$ = 1.12 > 1.0 (OK)

PROCEDURE USED TO ADDRESS
THE OUTLIER GENERATED BY
LAR #005

1. Introduction and Summary

The prying-action detail documented in Plant Area Summary Sheet RACE103 and analyzed in Limited Analytical Review LAR005 resulted in an outlier. Per the Outlier Seismic Verification Sheet, the recommended resolution to this outlier is to walk-down the plant and document all occurrences of this detail, screen the specific configuration of each detail using an acceptance criteria based on the LAR requirements, and modify those occurrences that do not meet the criteria. This document addresses the first part of this resolution - the walkdown and screening. The screening criteria is described in Section 2, the screening walkdown documentation is contained in Section 3.

This walkdown was performed by the Seismic Review Team members that did the bulk of the original raceway walkdown: I. C. Huang (AEPSC) and Stephen Anagnostis (S&A). The walkdown included all the areas of the plant covered in the raceway walkdown except for the Unit 1 containment above El 650 and inside the crane wall below El 650, as the unit was operating (the Unit 1 containment annulus was included). Based on the original raceway walkdown and that this walkdown of the Unit 2 containment did not find any significant occurrences of the prying-action detail, the SRT concluded that the Unit 1 containment does not contain any significant occurrences of the prying-action detail.

The results of this walkdown is summarized in Table 1. The first column contains the walkdown worksheet number (the worksheets are in Section 3), the second column describes the location of the hangers with the prying-action detail, and the third column states whether the hangers passed or failed the screening criteria. About 50 hangers with the prying-action detail were found (note that some worksheets cover more than one hanger). Twelve of those hangers failed the screening criteria. All of the hangers that failed are located in one area of the plant - the Unit 1 Vestibule and the adjacent section of the Unit 1 Reactor Cable Tunnel.

Table 1. Summary of the Prying Action Detail screening walkdown.

Worksheet #	Hanger Location	Pass/Fail
1-092694-1	Aux1, El 596, RCT Quad 3 North Hangers 9, 10, 11 along the right wall counting from door 1-DR-AUX323.	Pass
1-092694-2	Aux1, El 596, RCT Quad 4 Hangers 5, 6, 7, 8, 9 on the left wall counting from door 1-DR-AUX329.	Pass
1-092694-3	Aux1, El 596, RCT Quad 4 Directly across the hall from penetration 1-CEP-4P5	Fail [1]
1-092694-4	Aux1, El 596, RCT Quad 4 Adjacent to penetration 1-CEP-4P5.	P3ass
1-092694-5	Aux1, El 596, RCT Quad 1 Two hangers across the hallway from penetration 1-CEP-1P5 One hanger near MCC 1-CT-BN	Pass
1-092694-6	Aux1, El 596, RCT Quad 1 Upper platform, 1st hanger on right facing door 1-DR-AUX467	Pass [2]
1-092694-7	Aux1, El 596, RCT Quad 1 Upper platform, first 3 hangers on left facing door 1-DR-AUX467	Pass [3]
1-092694-8	Aux1, El 596, RCT Quad 1 Upper platform, first hanger on right off the edge of the platform.	Fail
2-092794-1	Aux2, El 596, RCT Quad 3 South Near 2-VRS-2200 (Upper Cntmt RMS "B" Data Acq Module)	Pass
2-092794-2	Aux2, El 596, RCT Quad 1 Upper platform, two hangers about 3 hangers away from Door 2-DR-AUX468.	Pass

1-092794-3	Aux1, El 609, 4kV Area Above 600V Bus IIA	Pass
1-092794-4	Aux1, El 609, Transformer Room One hanger above 1-DGTAB and one hanger at the right side of the entrance.	Pass
1-092794-5	Aux1, Auxiliary Cable Vault 15' south of the hatch	Pass [4]
2-092894-1	Aux2, El 573 6' south of gate 2-GT-AUX1013 (U2 Rx Coolant Drain Pump Room)	Pass
2-092894-2	Aux2, El 573 South end of the hallway common to both units.	Pass
1-092894-3	Aux1, El 609, elevated area adjacent to the control room cable vault Above 12HV-ACA-FLT-3	Pass
2-092894-4	Aux2, El 609 Near Miscellaneous Rack 2-H-H	Pass
2-092894-5	Aux2, El 609 Above cabinet 2-BITH2	Pass
1-092894-6	Aux1, El 612, Vestibule, upper platform leading to RCT Next to 1-DR-AUX467	Pass [5]
1-092894-7	Aux1, El 612, Vestibule, upper platform leading to RCT 3rd hanger on left from the edge of the platform	Pass
1-092894-8	Aux1, El 612, Vestibule, upper platform leading to RCT 4th hanger on left from the edge of the platform	Pass
1-092894-9	Aux1, El 612, Vestibule, upper platform leading to RCT 2nd hanger on right from the edge of the platform	Fail [6]
1-092894-10	Aux1, El 612, Vestibule 4 hangers along the containment wall just before the upper platform leading to the RCT.	Fail
1-092894-11	Aux1, El 612, Vestibule The hanger above the west end of 1-HE-22 and the next hanger west. The two or three hangers south of these running along the block wall.	Fail [7]
2-092894-12	Aux2, El 612, Vestibule, upper platform leading to RCT 4th hanger on right from the edge of the platform	Pass
2-092894-13	Aux2, El 633 Hangers between the Containment Auxiliaries Panel and 2-MSI-1.	Pass
2-092994-1	Cont2, El 598, Annulus Several hangers near Column 1, Az 63, Quad 1	Pass

[1] The angle is "clipped" to the embedded channel with the edge of a washer bolted into the embedded channel. Repair by drilling a hole through the angle and rebolting.

[2] This case doesn't meet the screening criteria, but was judged acceptable as the span between the two adjacent supports is <= 10', so GIP requirements would be met even if this support was removed. Note that the adjacent hanger would then have a tributary length of 8' (5' on one side and 3' on the other) and a load per rod of 640#. This load satisfies the allowables of 2000# for DL and 2500# for 3DL as specified in the LAR calculation.

[3] This case doesn't meet the screening criteria for 3DL, but was judged acceptable as the r/c wall on one side and a large pipe, and platform steel and handrail on the other side will prevent any significant lateral motion.

[4] This case doesn't meet the screening criteria, but was judged acceptable as the span between the two adjacent supports is <= 10', so GIP requirements would be met even if this support was removed. Note that the adjacent hanger would then have a tributary length of 7' (4.5' on one side and 3.5' on the other) and a load per rod of 440#. This load satisfies the allowables of 2000# for DL and 2500# for 3DL as specified in the LAR calculation.

[5] This case doesn't meet the screening criteria, but was judged acceptable as the span between the two adjacent supports is 9' (<= 10'), so GIP requirements would be met even if this support was removed. Note that the adjacent hanger would then have a tributary length of 7.5' (4.5' on one side and 3' on the other) and a load per rod of 600#. This load satisfies the allowables of 2000# for DL and 2500# for 3DL as specified in the LAR calculation.

[6] Both rods on this hanger do not meet the screening criteria (this hanger was the subject of LAR #5, which initiated this effort).

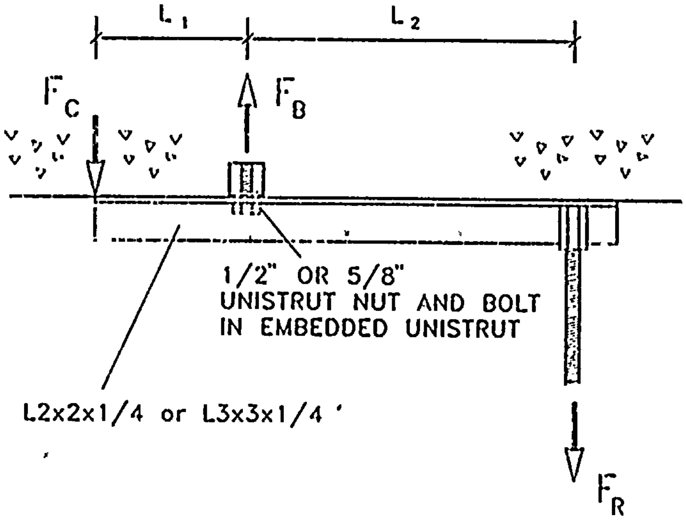
[7] The two hangers above 1-HE-22 probably need both rod anchorages to be modified - these two hangers are on either side of a removable concrete hatch. The rods furthest from the corners of the hatch were clearly visible (and do not meet the criteria), the rods nearest the corner were not easily visible but look like they will also require modification.

The rods immediately adjacent to the block wall of two or three hangers running along the block wall were not clearly visible, but do not look like they will meet the screening criteria.

2. Screening Criteria

2.1 Criteria Development

This criteria is for evaluating the D. C. Cook cable tray hanger anchorage detail shown below for seismic adequacy in accordance with GIP procedures (Ref. 1).



F_C = Bearing force on concrete
F_R = Tensile load in threaded rod
F_B = Tensile load on Unistrut bolt

Force in Unistrut bolt: $F_B = F_R(1 + L_2/L_1)$ => $F_R = F_B/(1+ L_2/L_1)$

Maximum moment in angle: $M_{MAX} = F_R L_2$ => $F_R=M_{MAX}/L_2$

In this detail, bending stresses in the angle and pullout force on the Unistrut bolt will each limit the capacity of the anchorage. The equations above show that the bending moment in the angle is related to L_2, while the force in the Unistrut bolt is related to the ratio of L_2 to L_1. As the ratio L_2/L_1 increases, the lever action on the Unistrut bolt increases for a given rod load F_R.

<u>Load Cases and Hanger Applicability:</u>

The anchorage detail above is used on rod-hung trapeze hangers. For trapeze-type supports, which may swing laterally during an earthquake, the GIP requires both a Dead Load Check and a Vertical Capacity Check (3 x DL) of the anchorage. The vertical capacity check ensures that there is extra design margin in the anchorage to account for additional loads due to support displacement.

This detail is also used on wall-mounted brackets to provide vertical support at the cantilevered end. These supports are directly attached to building structure and are not free to move during an earthquake. Per GIP procedures, only a Dead Load Check is necessary for these supports.

Allowable angle bending stresses:

Bending stresses in angles are calculated in accordance with the AISC specification for single-angle members, Ref. 2. Per Section 5.2.1b of the specification, the calculated bending stress, f_B, is:

$$f_B = 1.25M/S = 1.25F_RL_2/S$$

where S is the geometric section modulus of the angle section.

For the Dead Load Check, the working stress allowables given in Ref. 2 are used. Per Sections 5.1 and 5.2 of Ref. 2, the allowable bending stress is 0.66 F_Y for 2x2x1/4 L's, and 0.6 F_Y for 3x3x1/4 L's. For the 3 x DL Check, an allowable bending stress of $0.9F_Y$ is used for both angle sections. The bending stress, f_B, and the stress limits are summarized as follows:

f_B	=	$1.25F_RL_2/(0.247)$	$\leq 0.66\ F_Y$	for L2x2x1/4,	DL Case
	=	$1.25F_RL_2/(0.577)$	$\leq 0.60\ F_Y$	for L3x3x1/4,	DL Case
	=	$1.25F_RL_2/(0.247)$	$\leq 0.90\ F_Y$	for L2x2x1/4,	3DL Case
	=	$1.25F_RL_2/(0.577)$	$\leq 0.90\ F_Y$	for L3x3x1/4,	3DL Case

Allowable Unistrut bolt pullout load:

Allowable pullout loads for the Unistrut bolt are summarized below (see Ref 3 for discussion):

1/2" bolt	2000 lb,	DL Case
5/8" bolt	2000 lb,	DL Case
1/2" bolt	2000 lb,	3DL Case
5/8" bolt	2500 lb,	3DL Case

Criteria Summary:

Limits for L_2 and L_2/L_1 for a given F_R are listed below for all combinations of angle size, Unistrut bolt size, and load case.

DL case, bending in L2x2x1/4:
$1.25F_RL_2/S \leq 0.66F_y$ => $L_2 \leq 0.66\ (36{,}000)(0.247)/(1.25F_R)$ => $L_2 \leq 4690/F_R$

DL case, bending in L3x3x1/4:
$1.25F_RL_2/S \leq 0.60F_y$ => $L_2 \leq 0.60\ (36{,}000)(0.577)/(1.25F_R)$ => $L_2 \leq 9970/F_R$

3DL case, bending in L2x2x1/4:
$3x1.25F_RL_2/S \leq 0.9F_y$ => $L_2 \leq 0.90\ (36{,}000)(0.247)/(1.25x3F_R)$ => $L_2 \leq 2130/F_R$

3DL case, bending in L3x3x1/4:
$3x1.25F_RL_2/S \leq 0.9F_y$ => $L_2 \leq 0.90\ (36{,}000)(0.577)/(1.25x3F_R)$ => $L_2 \leq 4990/F_R$

DL case, pullout of 1/2" Unistrut bolt:

$F_R(1+L_2/L_1) \leq 2000$ lb => $L_2/L_1 \leq (2000/F_R)-1$

DL case, pullout of 5/8" Unistrut bolt:

$F_R(1+L_2/L_1) \leq 2000$ lb => $L_2/L_1 \leq (2000/F_R)-1$

3DL case, pullout of 1/2" Unistrut bolt:

$3F_R(1+L_2/L_1) \leq 2000$ lb => $L_2/L_1 \leq (667/F_R)-1$

3DL case, pullout of 5/8" Unistrut bolt:

$3F_R(1+L_2/L_1) \leq 2500$ lb => $L_2/L_1 \leq (833/F_R)-1$

The equations above are summarized in table form below:

			LOAD CASE			
F_R	ANGLE	UNISTRUT	DL		3DL	
(LB)	SIZE	BOLT SIZE	L_2 (IN., MAX)	L_2/L_1(MAX)	L_2 (IN., MAX)	L_2/L_1(MAX)
F_R	2x2x1/4	1/2"	4690/ F_R	$(2000/F_R)-1$	2130/ F_R	$(667/F_R)-1$
		5/8"	4690/ F_R	$(2000/F_R)-1$	2130/ F_R	$(833/F_R)-1$
	3x3x1/4	1/2"	9970/ F_R	$(2000/F_R)-1$	4990/ F_R	$(667/F_R)-1$
		5/8"	9970/ F_R	$(2000/F_R)-1$	4990/ F_R	$(833/F_R)-1$

2.2 References

1. "Generic Implementation Plan Procedure (GIP), for Seismic Verification of Nuclear Plant Equipment", Revision 2A, March, 1993, Seismic Qualification Utility Group.

2. "Specification for Allowable Stress Design of Single-Angle Members," from Section 5 of the AISC Manual of Steel Construction, Allowable Stress Design, Ninth Edition, American Institute of Steel Construction, Inc. Chicago, IL, 1989.

3. LAR criteria document

2.3 Screening Charts

Screening charts for F_R in increments of 25 lb up to 800 lb. appear on the following pages.

SCREENING CHART FOR $F_R \leq 100$ LB

F_R (LB)	ANGLE SIZE	UNISTRUT BOLT SIZE	LOAD CASE DL L_2 (IN., MAX)	DL L_2/L_1 (MAX)	3DL L_2 (IN., MAX)	3DL L_2/L_1 (MAX)
25	2x2x1/4	1/2"	188	79.0	85.2	25.7
		5/8"	188	79.0	85.2	32.3
	3x3x1/4	1/2"	399	79.0	200	25.7
		5/8"	399	79.0	200	32.3
50	2x2x1/4	1/2"	93.8	39.0	42.6	12.3
		5/8"	93.8	39.0	42.6	15.7
	3x3x1/4	1/2"	199	39.0	99.8	12.3
		5/8"	199	39.0	99.8	15.7
75	2x2x1/4	1/2"	62.5	25.7	28.4	7.9
		5/8"	62.5	25.7	28.4	10.1
	3x3x1/4	1/2"	133	25.7	66.5	7.9
		5/8"	133	25.7	66.5	10.1
100	2x2x1/4	1/2"	46.9	19.0	21.3	5.7
		5/8"	46.9	19.0	21.3	7.3
	3x3x1/4	1/2"	99.7	19.0	49.9	5.7
		5/8"	99.7	19.0	49.9	7.3

SCREENING CHART FOR $F_R \leq 200$ LB

F_R (LB)	ANGLE SIZE	UNISTRUT BOLT SIZE	LOAD CASE: DL L_2 (IN., MAX)	DL L_2/L_1 (MAX)	3DL L_2 (IN., MAX)	3DL L_2/L_1 (MAX)
125	2x2x1/4	1/2"	37.5	15.0	17.0	4.3
		5/8"	37.5	15.0	17.0	5.7
	3x3x1/4	1/2"	79.8	15.0	39.9	4.3
		5/8"	79.8	15.0	39.9	5.7
150	2x2x1/4	1/2"	31.3	12.3	14.2	3.4
		5/8"	31.3	12.3	14.2	4.6
	3x3x1/4	1/2"	66.5	12.3	33.3	3.4
		5/8"	66.5	12.3	33.3	4.6
175	2x2x1/4	1/2"	26.8	10.4	12.2	2.8
		5/8"	26.8	10.4	12.2	3.8
	3x3x1/4	1/2"	57.0	10.4	28.5	2.8
		5/8"	57.0	10.4	28.5	3.8
200	2x2x1/4	1/2"	23.5	9.0	10.7	2.3
		5/8"	23.5	9.0	10.7	3.2
	3x3x1/4	1/2"	49.9	9.0	25.0	2.3
		5/8"	49.9	9.0	25.0	3.2

SCREENING CHART FOR $F_R \leq 300$ LB

F_R (LB)	ANGLE SIZE	UNISTRUT BOLT SIZE	LOAD CASE: DL L_2 (IN., MAX)	DL L_2/L_1 (MAX)	3DL L_2 (IN., MAX)	3DL L_2/L_1 (MAX)
225	2x2x1/4	1/2"	20.8	7.9	9.5	2.0
		5/8"	20.8	7.9	9.5	2.7
	3x3x1/4	1/2"	44.3	7.9	22.2	2.0
		5/8"	44.3	7.9	22.2	2.7
250	2x2x1/4	1/2"	18.8	7.0	8.5	1.7
		5/8"	18.8	7.0	8.5	2.3
	3x3x1/4	1/2"	39.9	7.0	20.0	1.7
		5/8"	39.9	7.0	20.0	2.3
275	2x2x1/4	1/2"	17.1	6.3	7.7	1.4
		5/8"	17.1	6.3	7.7	2.0
	3x3x1/4	1/2"	36.3	6.3	18.1	1.4
		5/8"	36.3	6.3	18.1	2.0
300	2x2x1/4	1/2"	15.6	5.7	7.1	1.2
		5/8"	15.6	5.7	7.1	1.8
	3x3x1/4	1/2"	33.2	5.7	16.6	1.2
		5/8"	33.2	5.7	16.6	1.8

SCREENING CHART FOR $F_R \leq 400$ LB

F_R (LB)	ANGLE SIZE	UNISTRUT BOLT SIZE	LOAD CASE: DL L_2 (IN., MAX)	DL L_2/L_1 (MAX)	3DL L_2 (IN., MAX)	3DL L_2/L_1 (MAX)
325	2x2x1/4	1/2"	14.4	5.2	6.6	1.1
		5/8"	14.4	5.2	6.6	1.6
	3x3x1/4	1/2"	30.7	5.2	15.4	1.1
		5/8"	30.7	5.2	15.4	1.6
350	2x2x1/4	1/2"	13.4	4.7	6.1	0.9
		5/8"	13.4	4.7	6.1	1.4
	3x3x1/4	1/2"	28.5	4.7	14.3	0.9
		5/8"	28.5	4.7	14.3	1.4
375	2x2x1/4	1/2"	12.5	4.3	5.7	0.8
		5/8"	12.5	4.3	5.7	1.2
	3x3x1/4	1/2"	26.6	4.3	13.3	0.8
		5/8"	26.6	4.3	13.3	1.2
400	2x2x1/4	1/2"	11.7	4.0	5.3	0.7
		5/8"	11.7	4.0	5.3	1.1
	3x3x1/4	1/2"	24.9	4.0	12.5	0.7
		5/8"	24.9	4.0	12.5	1.1

SCREENING CHART FOR $F_R \leq 500$ LB

F_R (LB)	ANGLE SIZE	UNISTRUT BOLT SIZE	LOAD CASE DL L_2 (IN., MAX)	DL L_2/L_1 (MAX)	3DL L_2 (IN., MAX)	3DL L_2/L_1 (MAX)
425	2x2x1/4	1/2"	11.0	3.7	5.0	0.6
		5/8"	11.0	3.7	5.0	1.0
	3x3x1/4	1/2"	23.5	3.7	11.7	0.6
		5/8"	23.5	3.7	11.7	1.0
450	2x2x1/4	1/2"	10.4	3.4	4.7	0.5
		5/8"	10.4	3.4	4.7	0.9
	3x3x1/4	1/2"	22.2	3.4	11.1	0.5
		5/8"	22.2	3.4	11.1	0.9
475	2x2x1/4	1/2"	9.9	3.2	4.5	0.4
		5/8"	9.9	3.2	4.5	0.8
	3x3x1/4	1/2"	21.0	3.2	10.5	0.4
		5/8"	21.0	3.2	10.5	0.8
500	2x2x1/4	1/2"	9.4	3.0	4.3	0.3
		5/8"	9.4	3.0	4.3	0.7
	3x3x1/4	1/2"	19.9	3.0	10.0	0.3
		5/8"	19.9	3.0	10.0	0.7

SCREENING CHART FOR $F_R \leq 600$ LB

F_R (LB)	ANGLE SIZE	UNISTRUT BOLT SIZE	LOAD CASE DL L_2 (IN., MAX)	DL L_2/L_1 (MAX)	3DL L_2 (IN., MAX)	3DL L_2/L_1 (MAX)
525	2x2x1/4	1/2"	8.9	2.8	4.1	0.3
		5/8"	8.9	2.8	4.1	0.6
	3x3x1/4	1/2"	19.0	2.8	9.5	0.3
		5/8"	19.0	2.8	9.5	0.6
550	2x2x1/4	1/2"	8.5	2.6	3.9	0.2
		5/8"	8.5	2.6	3.9	0.5
	3x3x1/4	1/2"	18.1	2.6	9.1	0.2
		5/8"	18.1	2.6	9.1	0.5
575	2x2x1/4	1/2"	8.2	2.5	3.7	0.2
		5/8"	8.2	2.5	3.7	0.4
	3x3x1/4	1/2"	17.3	2.5	8.7	0.2
		5/8"	17.3	2.5	8.7	0.4
600	2x2x1/4	1/2"	7.8	2.3	3.6	0.1
		5/8"	7.8	2.3	3.6	0.4
	3x3x1/4	1/2"	16.6	2.3	8.3	0.1
		5/8"	16.6	2.3	8.3	0.4

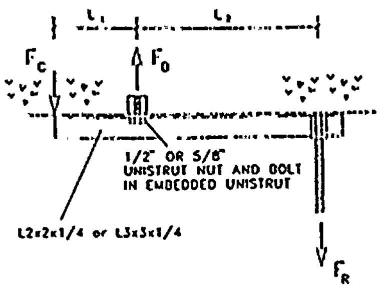
SCREENING CHART FOR $F_R \leq 700$ LB

F_R (LB)	ANGLE SIZE	UNISTRUT BOLT SIZE	LOAD CASE DL L_2 (IN., MAX)	DL L_2/L_1 (MAX)	3DL L_2 (IN., MAX)	3DL L_2/L_1 (MAX)
625	2x2x1/4	1/2"	7.5	2.2	3.4	0.0
		5/8"	7.5	2.2	3.4	0.3
	3x3x1/4	1/2"	16.0	2.2	8.0	0.0
		5/8"	16.0	2.2	8.0	0.3
650	2x2x1/4	1/2"	7.2	2.1	3.3	0.0
		5/8"	7.2	2.1	3.3	0.3
	3x3x1/4	1/2"	15.3	2.1	7.7	0.0
		5/8"	15.3	2.1	7.7	0.3
675	2x2x1/4	1/2"	6.9	2.0	3.2	-0.0
		5/8"	6.9	2.0	3.2	0.2
	3x3x1/4	1/2"	14.8	2.0	7.4	-0.0
		5/8"	14.8	2.0	7.4	0.2
700	2x2x1/4	1/2"	6.7	1.9	3.0	-0.0
		5/8"	6.7	1.9	3.0	0.2
	3x3x1/4	1/2"	14.2	1.9	7.1	-0.0
		5/8"	14.2	1.9	7.1	0.2

SCREENING CHART FOR $F_R \leq 800$ LB

F_R LB)	ANGLE SIZE	UNISTRUT BOLT SIZE	LOAD CASE			
			DL		3DL	
			L_2 (IN., MAX)	L_2/L_1(MAX)	L_2 (IN., MAX)	L_2/L_1(MAX)
725		5/8"	6.5	1.8	2.9	0.1
	3x3x1/4	1/2"	13.8	1.8	6.9	N/A
		5/8"	13.8	1.8	6.9	0.1
750	2x2x1/4	1/2"	6.3	1.7	2.8	N/A
		5/8"	6.3	1.7	2.8	0.1
	3x3x1/4	1/2"	13.3	1.7	6.7	N/A
		5/8"	13.3	1.7	6.7	0.1
775	2x2x1/4	1/2"	6.1	1.6	2.7	N/A
		5/8"	6.1	1.6	2.7	0.0
	3x3x1/4	1/2"	12.9	1.6	6.4	N/A
		5/8"	12.9	1.6	6.4	0.0
800	2x2x1/4	1/2"	5.9	1.5	2.7	N/A
		5/8"	5.9	1.5	2.7	0.0
	3x3x1/4	1/2"	12.5	1.5	6.2	N/A
		5/8"	12.5	1.5	6.2	0.0

2.4 Anchorage Evaluation Worksheet



Hanger Identification and Location: ______________________________

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____

Span:________________ Estimated load on threaded rod, F_R:________________.

ESTIMATED CABLE TRAY AND CONDUIT WEIGHTS, PLF	
ITEM	PLF
CABLE TRAYS	25
1/2" CONDUIT	1.1
3/4" CONDUIT	1.3
1" CONDUIT	2.0
1.5" CONDUIT	3.5
2" CONDUIT	4.9
3" CONDUIT	11.1
4" CONDUIT	16.6

Calculations:______________________________

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FIELD DATA:

Angle size:____________ Unistrut Bolt Size:____________

Lengths: L_1____________ L_2____________ L_2/L_1____________

LIMITING VALUES FROM SCREENING CHART FOR F_R=__________LB:			
DL CASE		3 X DL CASE (IF APPLICABLE)*	
Max L_2__________ Actual L_2__________ PASS: YES_____NO_____	Max L_2/L_1__________ Actual L_2/L_1__________ PASS: YES_____NO_____	Max L_2__________ Actual L_2__________ PASS: YES_____NO_____	Max L_2/L_1__________ Actual L_2/L_1__________ PASS: YES_____NO_____

*3xDL case N/A for wall mounted brackets.

3. Screening Walkdown Worksheets

Worksheet #	Hanger Location
1-092694-1	Aux1, El 596, RCT Quad 3 North Hangers 9, 10, 11 along the right wall counting from door 1-DR-AUX323.
1-092694-2	Aux1, El 596, RCT Quad 4 Hangers 5, 6, 7, 8, 9 on the left wall counting from door 1-DR-AUX329.
1-092694-3	Aux1, El 596, RCT Quad 4 Directly across the hall from penetration 1-CEP-4P5
1-092694-4	Aux1, El 596, RCT Quad 4 Adjacent to penetration 1-CEP-4P5.
1-092694-5	Aux1, El 596, RCT Quad 1 Two hangers across the hallway from penetration 1-CEP-1P5 One hanger near MCC 1-CT-BN
1-092694-6	Aux1, El 596, RCT Quad 1 Upper platform, 1st hanger on right facing door 1-DR-AUX467
1-092694-7	Aux1, El 596, RCT Quad 1 Upper platform, first 3 hangers on left facing door 1-DR-AUX467
1-092694-8	Aux1, El 596, RCT Quad 1 Upper platform, first hanger on right off the edge of the platform.
2-092794-1	Aux2, El 596, RCT Quad 3 South Near 2-VRS-2200 (Upper Cntmt RMS "B" Data Acq Module)
2-092794-2	Aux2, El 596, RCT Quad 1 Upper platform, two hangers about 3 hangers away from Door 2-DR-AUX468.
1-092794-3	Aux1, El 609, 4kV Area Above 600V Bus IIA
1-092794-4	Aux1, El 609, Transformer Room One hanger above 1-DGTAB and one hanger at the right side of the entrance.
1-092794-5	Aux1, Auxiliary Cable Vault 15' south of the hatch
2-092894-1	Aux2, El 573 6' south of gate 2-GT-AUX1013 (U2 Rx Coolant Drain Pump Room)
2-092894-2	Aux2, El 573 South end of the hallway common to both units.
1-092894-3	Aux1, El 609, elevated area adjacent to the control room cable vault Above 12HV-ACA-FLT-3
2-092894-4	Aux2, El 609 Near Miscellaneous Rack 2-H-H
2-092894-5	Aux2, El 609 Above cabinet 2-BITH2
1-092894-6	Aux1, El 612, Vestibule, upper platform leading to RCT Next to 1-DR-AUX467
1-092894-7	Aux1, El 612, Vestibule, upper platform leading to RCT 3rd hanger on left from the edge of the platform
1-092894-8	Aux1, El 612, Vestibule, upper platform leading to RCT 4th hanger on left from the edge of the platform
1-092894-9	Aux1, El 612, Vestibule, upper platform leading to RCT 2nd hanger on right from the edge of the platform
1-092894-10	Aux1, El 612, Vestibule 4 hangers along the containment wall just before the upper platform leading to the RCT.
1-092894-11	Aux1, El 612, Vestibule The hanger above the west end of 1-HE-22 and the next hanger west. The two or three hangers south of these running along the block wall.
2-092894-12	Aux2, El 612, Vestibule, upper platform leading to RCT 4th hanger on right from the edge of the platform
2-092894-13	Aux2, El 633 Hangers between the Containment Auxiliaries Panel and 2-MSI-1.
2-092994-1	Cont2, El 598, Annulus Several hangers near Column 1, Az 63, Quad 1