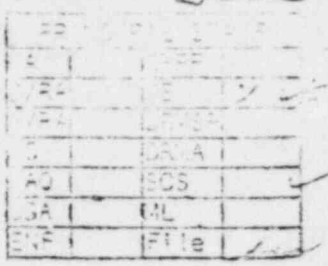
HVAC File

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555



NOV 17 1983

MEMORANDUM FOR: R. J. Bosnak, Chief
Mechanical Engineering Branch, DE

FROM: D. Terao
Mechanical Engineering Branch, DE

THRU: H. L. Brammer, Section Leader
Mechanical Engineering Branch, DE

SUBJECT: TRIP REPORT SUMMARY FOR MIDLAND HVAC DESIGN AUDIT (TAC #141433)

Reference: Memo from DTerao to RBosnak dated October 28, 1983

On October 27, 1983, the staff met with the applicant for the Midland plant to discuss the resolutions of the unresolved items from our previous HVAC audit held on October 5-7, 1983.

The details of the meeting are attached to this memorandum. At the conclusion of the meeting, there were no unresolved items remaining. Our final safety evaluation will be provided to DL under a separate cover memo within the next few weeks.

D. Terao

D. Terao
Mechanical Engineering Branch
Division of Engineering

cc: R. Vollmer, DE
J. Knight, DE
T. Novak, DE
E. Adensam, DL
D. Hood, DL
M. Miller, DL
H. Brammer, DE
W. Little, RIII
D. Danielson, RIII
F. Hawkins, RIII
W. LaFave, DSI
C. Sellers, DE

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Furthermore, generic design tables provided in the design guide were based on a material yield stress of 36 ksi. The staff's concern was that for Midland, the design specification (7220-M-151A) for HVAC installation specifies that the HVAC duct material A526 and A527 be provided with a minimum yield stress of 30 ksi. It should be noted that the ASTM material specification for A526 and A527 does not require a minimum yield strength. Thus, the staff requested that the applicant demonstrate that, for Midland, the empirical formula was used with a material yield strength of 30 ksi and that the generic design guide tables were not used for Midland.

The applicant provided the staff with several randomly selected calculations which used the design guide to calculate the HVAC duct stresses. These calculations were selected from the approximately 170 duct spans which exceeded the eight feet criteria and are listed in Attachment A to this report. The staff noted that the spans for rectangular ducts varied between 8.83 feet and 11.08 feet and a calculation for a circular duct qualified a span of 16 feet. All the calculations used a yield stress of 30 ksi for the duct material. Thus, based on our review of the calculations, the staff concluded that the applicant has used the appropriate yield stress (30 ksi) for the duct material which is in accordance with the Midland design specification (M-151A) and that the generic design guide tables were not used.

2) Review of Calculation for HVAC Duct Inside Containment

During our previous visit, the staff noted that two large diameter circular ductwork were routed vertically along the inside of the containment wall (forming an inverted U-shape and criss-crossing at the apex of the containment). The staff expressed concern about the structural integrity of the duct and supports where the eight feet span criteria appeared to have been exceeded. The containment spray lines were routed in front of the ductwork and failure of the ductwork or supports could have impacted the containment spray lines.

The HVAC system noted by the staff is known as the dome air mixing system. The maximum diameter of the circular duct is 28 inches. The duct span between supports is 9' - 6".

Subsequent to our previous visit, the applicant discovered that they could not find the original support calculations for the HVAC dome air mixing system. The applicant found a copy of the original calculation which had not been formally issued. However, the calculation was based on old (superseded) seismic building response spectra. As a result, the applicant performed new calculations to supersede the original calculations. The calculations were based on the revised seismic response spectra. The new calculations used an SSE peak acceleration of 5.85 g. The calculation verified that the stresses in the ductwork and supports are acceptable.

Staff Design Review and Audit of the Midland HVAC System

On October 27, 1983, the staff from RIII and NRR met with representatives from Consumers Power Company and Bechtel Power Corporation at the Midland Plant site to discuss the design of the Midland HVAC system. The specific purpose of this meeting was to discuss the unresolved items from the previous HVAC system design audit held on October 5-7, 1983. The following four unresolved items which evolved from the Mechanical Engineering Branch (MEB) area of review were discussed at the meeting. The four unresolved items were as follows:

(1) It was not evident that Bechtel was properly using the design guide for HVAC ductwork to qualify the ductwork when the span between supports exceeded eight feet.

(2) The seismically supported round HVAC ductwork which are not safety-related that are routed vertically along the containment wall appeared to have duct spans exceeding the eight feet criteria.

(3) The expansion anchor bolts in the HVAC support baseplates appeared to be the most limiting component in the HVAC structural design. Prying action of the baseplate on the bolts have been ignored according to the design guide for HVAC supports.

(4) The qualification of the HVAC duct flange bolts (3/8" diameter) had not been properly documented for the applicable loadings.

The resolution of the above four items are discussed in detail in the following paragraphs:

1) Use of HVAC Design Guide for Ductwork

The design procedure entitled, "Design Guide for Nuclear Power Plant Seismic Category I Rectangular HVAC Ducts (DRAFT)," dated April 15, 1978 states that the minimum yield strength of the HVAC ductwork material (A526 or A527) should be 36 ksi. The design guide provides an empirical formula for the calculation of the required duct sheet thickness, t, in its Equation 7.3. The equation is as follows:

$$t = 2.5 \left(\frac{E}{fy}\right)^{\frac{1}{4}} \left(\frac{P}{Fa}\right) \frac{(a)(c)}{(a + c)}$$

where: t = sheet thickness
E = modulus of elasticity
fy = material yield stress
P = design pressure
Fa = allowable stress
a = duct width
c = stiffener spacing

3) Expansion Anchor Bolts for HVAC Supports

In the procedure, "Design Guide for HVAC Supports (DRAFT)," Calculation No. 3471(Q), it was stated that for expansion anchor bolts, the prying action of the baseplate was to be ignored. This item was identified in an internal audit conducted by the applicant on February 21, 1983 and was considered an unresolved item.

Bechtel explained that the civil/structural criteria (AISC) is used for HVAC support design. Expansion anchor bolt capacity is based on manufacturer's data and testing. A safety factor of four or five is added to the bolt allowable to account for slippage. Bechtel does not use ASME Subsection NF for HVAC support design. Many HVAC expansion anchors were installed prior to the issuance of IE Bulletin 79-02. However, IE Bulletin 79-02 addressed only pipe supports (not building steel). Consequently, no redesign of other (non-piping) supports which were designed to building steel criteria was undertaken. The AISC, ACI-318 and ACI-349 criteria does not address prying action of baseplate on bolt loads. However, Bechtel noted that ACI does address prying action of steel-to-steel connections. The steel-to-steel prying action is also addressed in the AISC Code (8th Edition).

Bechtel contacted other engineering offices and found that no one is considering prying action for embedded anchor bolts for non-piping supports. Bechtel further gave the staff a copy of a letter from the AISC which states that the effect of any prying action with a steel-concrete connection would be small (see Attachment B). Bechtel referred to testing performed by TVA on expansion anchor bolts. The testing concluded that the ultimate strength of the anchor is not reduced with the effects of baseplate prying included. Thus, Bechtel concluded that because the concrete is relatively soft compared to steel, the effects of the baseplate prying action will be small. In addition, the slippage of the bolt does not degrade the ultimate anchorage capacity even though preload might be lost.

The staff asked the applicant what type of anchor bolts are used for the Midland plant. Bechtel stated that only Hilti and Redheads are used. For Redheads, only a 7/8" diameter bolt is used because Hilti does not make a 7/8" diameter bolt. All other bolt sizes are supplied by Hilti. Bechtel noted that Hilti has provided an end designator on their bolts. A stamped letter designates the length of the bolt. (e.g. an "O" designation is used for an 8½" long bolt). Consequently, use of incorrect or substitute bolts can be verified. Additionally, if a low-strength bolt were substituted for the high-strength anchor bolt, the torque requirements specified in Specification C-305 (see Attachment C) would assure an initial preload stress in the bolts of approximately 30 ksi. Thus, the allowable design load in the bolt is assured in the preload. The staff has not yet determined what the significance of the prying action would be for expansion anchor bolts in baseplates other than piping supports. We will address the prying action and the adequacy of the expansion anchor bolts in our final safety evaluation report.

4) Calculation for Duct Flange Bolts

The 3/8" bolts used in the companion flange connections of the HVAC ductwork were qualified by Bechtel in Calculation No. 34-323(Q) revision 0 dated October 14, 1983. The calculation concluded that assuming one bolt is effective in each corner of the flange, the bolt has adequate strength to accommodate the applicable loads and load combinations. The staff found the calculation to be based on conservative assumptions and the results appeared to show an adequate design margin. It should be noted that prying action (steel-to-steel) was considered in the calculation per AISC (8th Edition). A summary of the design margin for the maximum bolt loads for several duct sizes are shown in Attachment D.

A list of meeting attendees is included in Attachment E to this report.

ATTACHMENT A

List of Documents Reviewed at 10/17/83 Meeting

1) Calculations for HVAC duct with span exceeding 8 feet.

Calculation No.	Revision
34-309(Q)	0
34-300(Q)	0
34-299(Q)	0
34-293(Q)	0
34-292(Q)	0
34-256(Q)	0
34-250(Q)	0
34-241(Q)	0
34-212(Q)	0

2) Calculation for Dome Air Mixing Supports and Ductwork
Calc. No. Q21B (5.137)(Q), Revision 1, dated 10/27/83.

3) Calculation for Companion Flange Bolt Load
Calc. No. 34-323(Q), Revision 0, dated 10/14/83

ATTACHMENT A

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Attachment B

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.
The Wrigley Building / 400 North Michigan Avenue / Chicago, Illinois 60611-4185 / 312 • 670 2400

September 22, 1983

Mr. Theodore E. Johnson
Bechtel Associates Professional Corporation
P. O. Box 1000
Ann Arbor, MI 48106

Dear Mr. Johnson:

I have your letter of July 20, 1983 addressed to Mr. Milek. Mr. Milek has retired from AISC.

You are correct that AISC does not address the possibility of prying action on anchor bolts. The only tests that I am aware of have been with steel-to-steel connections.

It seems to me that any prying action with a steel-concrete connection would be small, if indeed, it exists. The concrete is quite soft compared to steel and would probably yield before significant prying forces developed.

I have never heard of any problem traceable to prying action with anchor bolts.

Sincerely,

Robert O. Disque

Robert O. Disque
Assistant Director
Technical Publications

ROD/jf

SEP 1983

CIVIL ENGINEERING - POWER ANN ARBOR				
129	INFO	ACT	INIT	DATE
Johnson, T.E.	✓			9/23
Sommer, D.	•			
Chang, H.				
Chen, J.				
Corotis, L.				
Elgaaly, M.				
Gobuty, W.				
Hantus, G.				
Nowak, W.				
Rotz, J.				
Shanmugavel, P.				
Tuveson, G.				
Varga, J.				
Patti				
File				

BS 340 01

TABLE 4.1

WEDGE AND STUD TYPE ANCHORS
IN REINFORCED CONCRETE**

Anchor Diameter (in.)	Torque at Installation Threads Not Lubricated(1) (ft-lb)	Test Torques (After Installation) (ft-lb)	Minimum Embedment Before Torquing (in.)	Minimum Embedment After Torquing (in.)	Minimum C/C* Spacing (in.)	Minimum Edge Distance (in.)	Minimum Clear Distance from the Edge of Embedment (in.)
1/4	5 - 10	5	1-1/8	1	3	1-1/2	**
3/8	25 - 35	20	1-5/8	1 1/8	4	2	**
1/2	35 - 55	30	2-1/4	2	5	3	**
5/8	130 - 160	80	2-3/4	2-1/2	6	3-1/2	**
5/8	130 - 160	80	4	3-3/4	6	3-1/2	**
3/4	240 - 270	135	3-1/4	2-7/8	7-1/2	4	**
3/4	240 - 270	135	4	3-5/8	7-1/2	4	**
3/4	240 - 270	135	5	4-5/8	7-1/2	4	**
7/8	275 - 325	165	4	3-1/2	9	5	**
7/8	275 - 325	165	5-1/2	5	9	5	**
1	425 - 475	240	4-1/2	4	10	6	**
1	425 - 475	240	6	5-1/2	10	6	**

*See Table 4.3 for blockwalls
**See Table 4.2
***Retroactive from April 23, 1976

NOTES:

1) These values give a torque range which was determined by testing anchors for the different concrete strengths used on the job (for 1/2", 5/8", 3/4", and 1" expansion anchors only).

2) Deleted

3) The minimum spacing and minimum edge distance may be reduced up to 50% with prior approval of project engineering.

4) For a given diameter, use longer minimum embedment length for installation, unless noted otherwise on the design documents or as approved by project engineering. Embedments shown in the design drawings are embedments before torquing.

*** Minimum embedments after torquing can be obtained by subtracting displacement length (in.) from the embedment lengths shown on the design drawing:

Bolt Diameter (in.)	1/4	3/8	1/2	5/8	3/4	7/8	1
Displacement Length (in.)	0.125	0.25	0.25	0.25	0.375	0.50	0.50

5) When an installed expansion anchor has been loosened and then retightened, the torque at installation shall apply for retightening the anchor, and embedment length after torquing shall be verified.

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Attachment D

Table of HVAC Duct Flange Bolt Loads

			FORCES IN BOLT @ SAFE "SHUTDOWN" EARTHQUAKE		
DUCT SIZE	SHEET THICKNESS	OPERATING PRESSURE IN W.G	MAX. TENSION IN BOLT OF COMPANION FLANGE	ALLOWABLE TENSION	Max. Calculated Load / Allowable Load
60" x 26"	16 GAGE	13"	1200 lb	2340 lb	0.51
60" x 60"	14 GAGE	13"	1900 lb	2340 lb	0.81
30" x 30"	18 GAGE	13"	586 lb	2340 lb	0.25
60" x 60"	16 GAGE	4"	840 lb	2340 lb	0.36

NAME	COMPANY
[illegible]	CPC [illegible]
BILL HEIBERGER	MPQAD
FRANK FRANZ	CPCo - [illegible]
Bob KUCHAREK	MPQAD
ARUN AMIN	BECHTEL AAO ENG..
D.T. Scribner	Bechtel
P.V. REGUPATHY	BECHTEL AAO ENG.
ROB BURG	BECHTEL LICENSING/[illegible]
Gary Tree	Bechtel Civil [illegible]
DAVE PERRY	CPCO ENGINEERING
[illegible]	[illegible]
STEVE SMITH	ZACK CO.
DENNIS ENGLAND	C.P.Co NU. LIC.
Frederick J Lounds	MPQAD - HVACA
JOEL ANDERSON	BECHTEL PROJ. ENG.
F. Hawkins	NRC
DAVID TEXAO	NRC / MEB
James A Balgar	CPCo SMO
[illegible]	[illegible]

A. Factor File

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

OCT 13 1983

MEMORANDUM FOR: Region III Files

FROM: F. C. Hawkins, Reactor Inspector, Division of Engineering

SUBJECT: MIDLAND HVAC ALLEGATIONS (INDIVIDUAL CC)

On September 26, 1983, a GAP representative verbally informed me that a former Bechtel employee at the Midland site had concerns regarding Bechtel's interface in the design and construction of the Midland HVAC system. GAP representatives later referred me to Mrs. B. Stamiris; stating that she personally knew the individual and could possibly persuade him to come forth with his concerns. During the ensuing conversations, Mrs. Stamiris stated that the individual would speak to the NRC with the following conditions: (1) no signed statement of any type would be provided, (2) confidentiality was to be strictly maintained, (3) the concerns were not to be treated as formal allegations and (4) information provided by the individual, of technical substance, was to be incorporated into the NRC's ongoing HVAC inspection effort at Midland.

Subsequently, on October 5, 1983, NRR representatives (D. Hood, D. Terao, W. LeFave) and I met with the individual to discuss his specific concerns. The issues raised by the individual concerned (1) the improper use of onsite design change methods, (2) incorrect installation of surface mounted plates, (3) an extensive proposed Control Room HVAC redesign, (4) excessive blowholes in the Control Room ductwork and (5) Bechtel's use of nondisclosure statements.

The individual recounted examples of each concern and referred names of fellow workers to us who could corroborate his statements and provide the necessary details. I interviewed those individuals at the site on October 6, 1983. None of the individuals interviewed could confirm the validity of Concern No.'s (2) or (4); therefore, no further action is planned for these two items.

The results of the interviews and the proposed NRC action to address each item of concern was discussed with Mrs. Stamiris on October 12, 1983. During that conversation, I again requested that she ask Individual CC to provide a copy of the nondisclosure statement referred to in Concern No. (5).

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She concurred with the proposed actions and stated that she would actively pursue obtaining a copy of the disclosure statement. Pending receipt of the statement, no further action on our part is planned with regard to Concern No. (5).

Per the agreement with Mrs. Stamiris and Individual CC, the results of our inspection of Concern No.s (1) and (3) will not be specifically documented and any actions taken by Region III will be accomplished as part of the ongoing special technical inspection documented in Reports No. 50-329/83-08; 50-330/83-08.

F. C. Hawkins
Reactor Inspector

cc: G. Roy
J. Harrison
W. Key
R. Gardner
W. Little
L. Spessard
E. Pawlik

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

Hawkins

SEP 2 1983

Docket No. 50-329
Docket No. 50-330

Ms. Mary Sinclair
5711 Summerset Drive
Midland, MI 48640

Dear Ms. Sinclair:

As you know, we have begun the onsite inspection of the Zack Company's activities at Midland. The inspection effort includes a detailed review of affidavits and statements which contain items of concern expressed by present and past employees at the Midland facility. This review will enable us to effectively conduct an onsite inspection of the individuals' concerns where appropriate.

In your letter of April 18, 1983 to Mr. Keppler, you passed on to us concerns of an anonymous worker at the Midland site regarding engineering design activities by Zack. Since the information in your letter is very general, we contacted you to request that you ask the anonymous individual to supply us with further details. In a conversation with Mr. J. J. Harrison of this office on August 3, 1983, you indicated that you had no way to contact the individual, but would advise him to contact us when you are next telephoned by him.

8309070264

At the present time, the information in your letter is too general to pursue by an inspection; therefore, we can take no further action on this matter. Should the individual contact us and provide greater details, we will pursue his concerns. Please contact Mr. Duane Danielson (312-932/2610) of my staff with any questions you may have.

Sincerely,

"Original Signed by R. L. Spessard"

R. L. Spessard, Director
Division of Engineering

cc: DMB/Document Control Desk (RIDS)
Resident Inspector, RIII
The Honorable Charles Bechhoefer, ASLB
The Honorable Jerry Harbour, ASLB
The Honorable Frederick P. Cowan, ASLB
The Honorable Ralph S. Decker, ASLB
William Paton, ELD
Michael Miller
Ronald Callen, Michigan
Public Service Commission
Myron M. Cherry
Barbara Stamiris
Mary Sinclair
Wendell Marshall
Colonel Steve J. Gadler (P.E.)
Howard Levin (TERA)
Billie P. Garde, Government
Accountability Project
Lynne Bernabei, Government
Accountability Project
James W. Cook
Consumers Power Company

RIII	RIII	RIII	RIII	RIII	RIII	RIII
Hawkins/bk	Danielson	Little	Spessard	Lewis	Davis	Keppler
08/31/83		9/1	9/2	9/2	9/2/83	9/2