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FROM: Northern States Pwr Minneapolis, Mn L O Mayer	DATE OF DOC 12-16-75	DATE REC'D 12-19-75	LTR XXX	TWX	RPT	OTHER
TO: Mr Ziemann	ORIG one signed	CC	OTHER	SENT NRC PDR XX SENT LOCAL PDR XX		
CLASS / UNCLASS XXXXX / PROP INFO	INPUT	NO CYS REC'D 1	DOCKET NO: 50-263			

DESCRIPTION:
Ltr re our 8-27-75 ltr.....trans the following:

ENCLOSURES:
Addl info concerning Relief Valve Line Restraints inside Torus...(40 cys encl rec)

PLANT NAME: Monticello

FOR ACTION/INFORMATION 12-20-75 ehf

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NORTHERN STATES POWER COMPANY

MINNEAPOLIS, MINNESOTA 55401

December 16, 1975

Mr. D. L. Ziemann, Chief
Operating Reactors Branch #2
Division of Reactor Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Ziemann

MONTICELLO NUCLEAR GENERATING PLANT
Docket No. 50-263 License No. DPR-22

Relief Valve Line Restraints Inside Torus

Your letter dated August 27, 1975 requested that an analysis be performed to confirm the adequacy of relief valve line restraints inside the torus at the Monticello Nuclear Generating Plant. Your letter also requested that an inspection of the relief valve lines and their restraints inside the torus be conducted for indications of damage or degradation.

Attached is a report entitled, "Structural Analysis of Safety/Relief Valve Discharge Line Restraints Within Torus." The report demonstrates that loadings on the restraints will not exceed yield during a relief valve opening event.

This report, along with our letter to you dated October 17, 1975, on the same subject, should provide the information requested in your letter dated August 27, 1975. The restraint loadings were obtained from the Bechtel Power Corporation's current dynamic load model. This model will be refined by the results of the Safety/Relief Valve test program planned as part of the Mark I Containment Long-Term Program

Yours very truly,

L. O. Mayer

L.O. Mayer, PE
Manager, Nuclear Support Services

LOM/LLT/deb

cc: J. G. Keppler
G. Charnoff
MPCA--attn: J. W. Ferman

Structural Analysis of Safety/Relief Valve Discharge Line Restraints Within Torus

1. Introduction

Monticello has eight relief valves and discharge lines. The lines inside the torus are identical and equally spaced around the torus. The layout and detailed restraint design inside the torus is as shown on attached drawings (enclosures 1 and 2). The lines inside the drywell are not identical so the analysis was based on the shortest line which provides the largest loads on the torus supports.

2. Methods of Analysis

a. Computer Code for Calculation of Relief Valve Discharge Flow Transients

The code is based on a non-steady, one dimensional flow analysis. The flow along the discharge pipe axis is divided into three regions; steam flow region, an air flow region and a water flow region. The steam flow through the relief valve, causes the air originally in the pipe to flow (undergoing compression) in the direction of the water slug at the downstream end of the pipe. This in turn induces a water flow at the discharge end of the pipe. These three flows are treated separately while satisfying the proper conditions at the interfaces. Steam and air are treated as perfect gases and water compressibility is accounted for.

No condensation is assumed. Frictional losses are taken into consideration while gravitational terms have been neglected in the analysis.

The solution of the basic equations (continuity, momentum and energy) governing the flow is carried out using the method of characteristics. A finite difference solution using a specified time interval scheme for the distance time grid has been adapted for the numerical computations. In this scheme, the pipe is divided into a suitable number of nodes at which the code determines the time changes of the following set of flow variables; velocity, pressure, sonic speed and density.

Starting from the initial conditions (no flow in the pipe) the code computes the flow variables at each node at the end of the first time step. Incrementing the time and using these conditions new values are obtained at the end of a new time step, etc.

The code models the valve flow as an upstream boundary condition. It considers the valve opening time as well as the valve opening characteristics (valve area - time and valve flow coefficient-opening dependence). The steam/air interface is tracked at each time step. Also, the location of the air/

water interface is determined at each time step. The downstream boundary condition models the water flow through the pipe vent to the suppression pool. It allows for possible exit loss.

The code determines the time at which water clearing ends. This instant marks the substitution of the downstream end condition by a different model, a ram's head--attached air bubble model. The use of this downstream boundary is continued until all the air originally in the pipe is discharged out of the pipe. At this instant, a developing steam jet model is adapted as downstream end boundary condition. This growing steam jet is continued until it reaches a steady state at which time a steady jet model is assumed at the downstream end boundary.

The code in its current form has been used to predict Quad Cities test data (NEDO-10859). A good agreement was obtained between the calculated values and the test data both in the magnitude and time phase of the pressure trace up to the end of water slug clearing. Less favorable agreement prevailed during the attached air bubble and the developing steam jet phases. Quad Cities test data indicate that the conditions leading to the most severe pipe loading occur during the initial phase of the transient, i.e., during the water slug clearing phase. Accordingly, it has been decided to use the code in its current form to predict piping forcing functions only to the end of water clearing.

The program development effort is being continued to resolve the discrepancies encountered during the post water slug clearing. Current plans call for checking the code results with more test data, when available.

b. The structural analysis was based on the American Institute of Steel Construction (AISC) Specification for the Design, Fabrication and Erection of Structural Steel for Buildings - Sixth Edition.

c. Dynamic Load Factor

A dynamic load factor was calculated and used for the loads imposed on the restraints.

3. Results

a. The basic parameters used in the analysis are as follows:

1) Safety/Relief Valve

Manufacturer:	Target Rock
Model:	67F
Set Pressure:	1068 psig
Accumulation:	3%
Flow Coefficient, K:	.8 @ 100% OPEN
ASME Rated Flow:	879,571 lbm/hr
Valve Opening Time:	0.035 sec

2) Discharge Piping Inside Torus

Size:	10" Sch 80
Material:	A106 Gr B except for pipe stub in vent header, which is A333 Gr 6

3) Torus Condition

Water Temperature:	130F
Air Temperature:	130F
Water Level Elevation:	909.46 ft.
Initial Water Depth:	9.985 ft.

b. The results of the analysis are shown graphically on Figures 1 and 2. Note that the maximum net force on run J-K is 36 kips.

c. The forcing function shown in Figures 1 and 2 was utilized in the computer code STARDYNE 3 to determine the resulting stress in the relief valve discharge line and restraints. The results of this analysis are as follows:

Peak Bending Stress in RV restraint	27,000 psi at Restraint B
Peak Stress in Pipe	20,000 psi

The design yield stress for the RV restraints (ASTM A36) is 36,000 psi (lowest actual material yield stress from the certified material test reports is 42,000 psi). The peak stress in the RV restraints is 75% of design yield stress and 64% of actual yield stress.

The code allowable stress as determined by the AISC-6th Edition, for this type of design is 22,000 psi. The predicted stresses are well below yield stress but above code allowable.

The SRV test program, planned as part of the MKI Containment Long Term Program will be used to verify the calculated fluid flow forcing functions and determine the resulting stresses on the RV restraints.

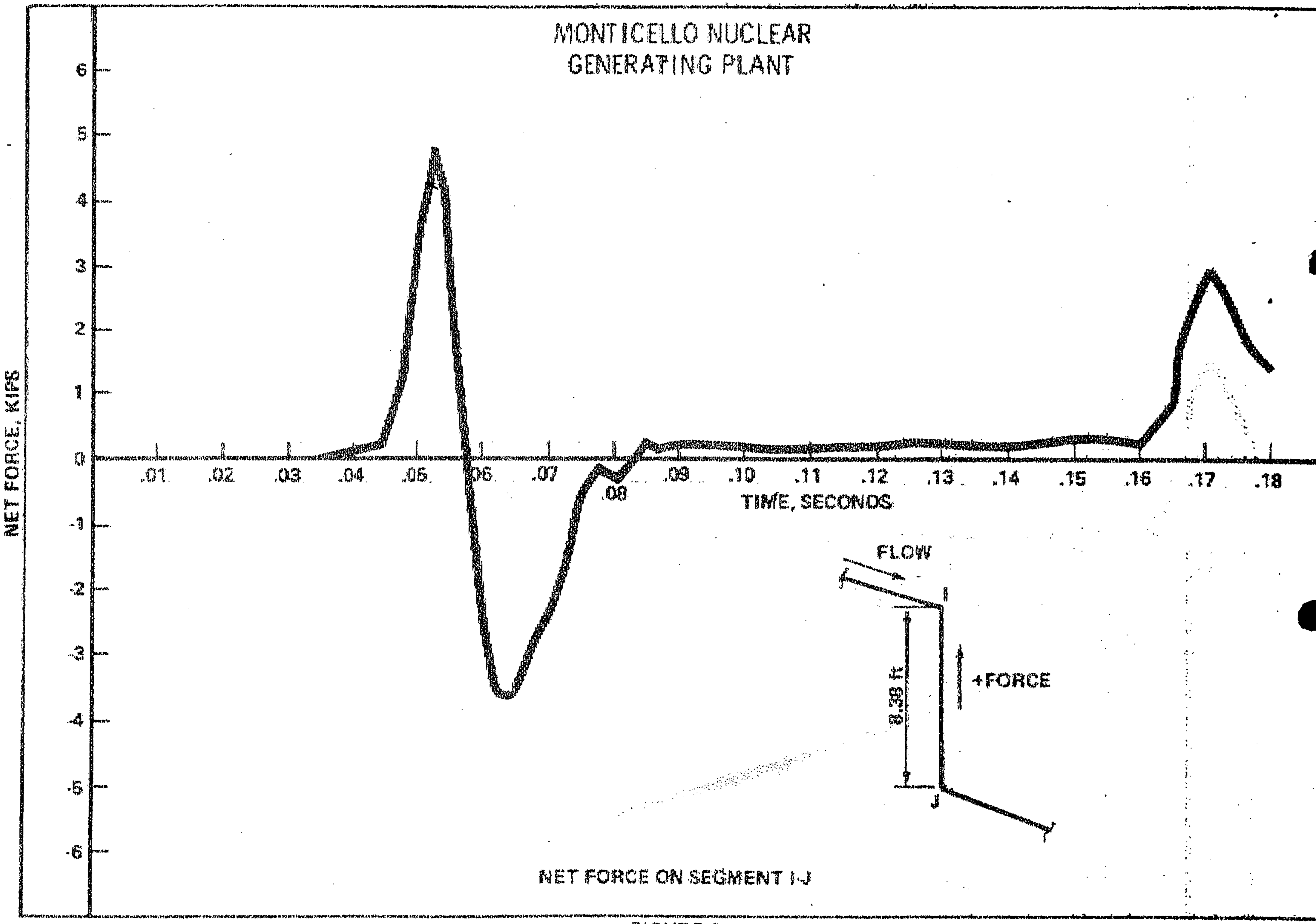
4. <u>Limitations and Conclusions</u>

a. Limitations--

The analysis only considered the effects of water-slug clearing. Possible concurrent effects such as pool swell, an operational basis earthquake or safe shutdown earthquake are not included (but deemed to be very small compared to the primary loads.)

b. Conclusions--

The calculated loads on the restraints are below the design yield stress for ASTM A-36 material.



C10000804-01

FIGURE 1

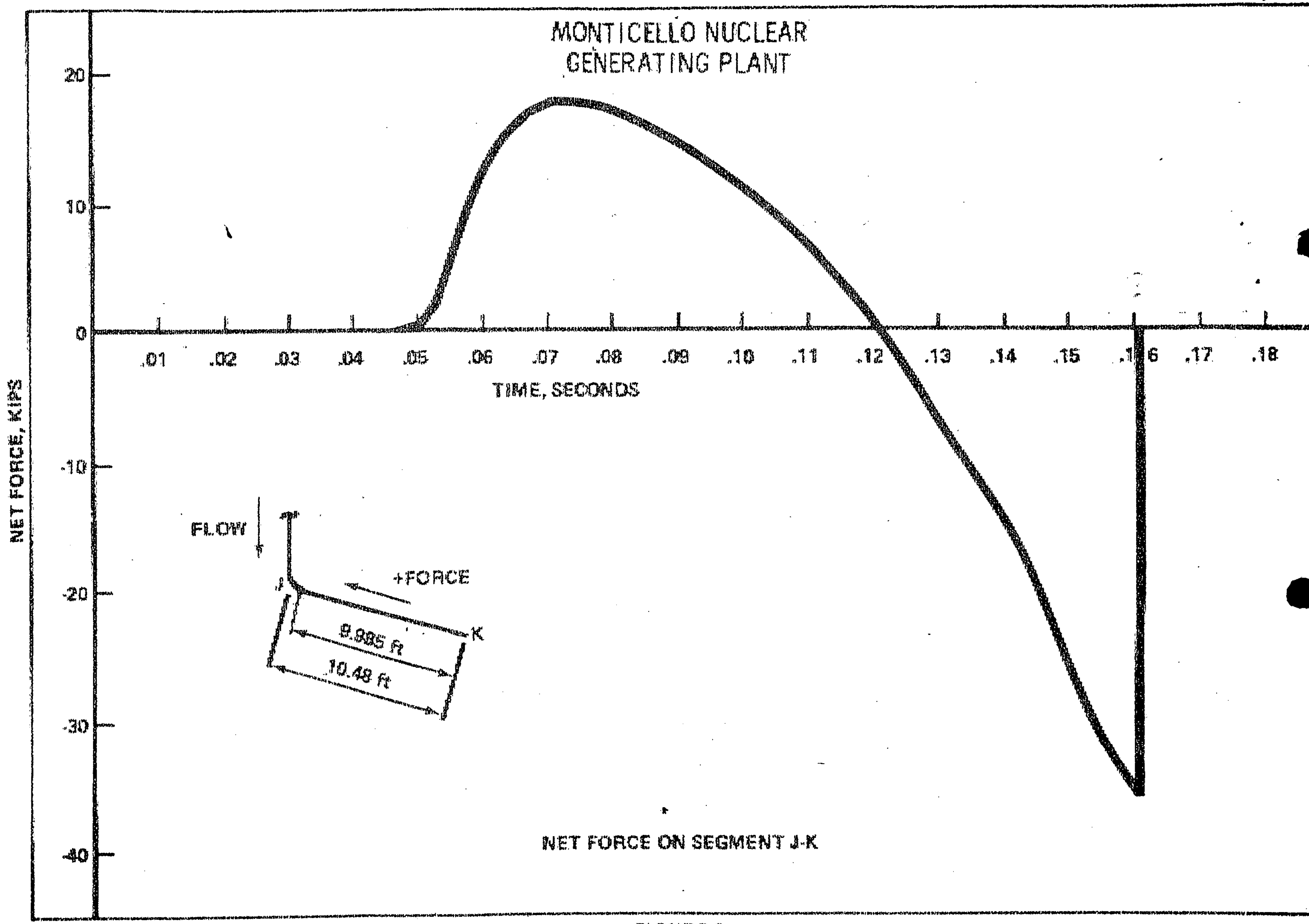


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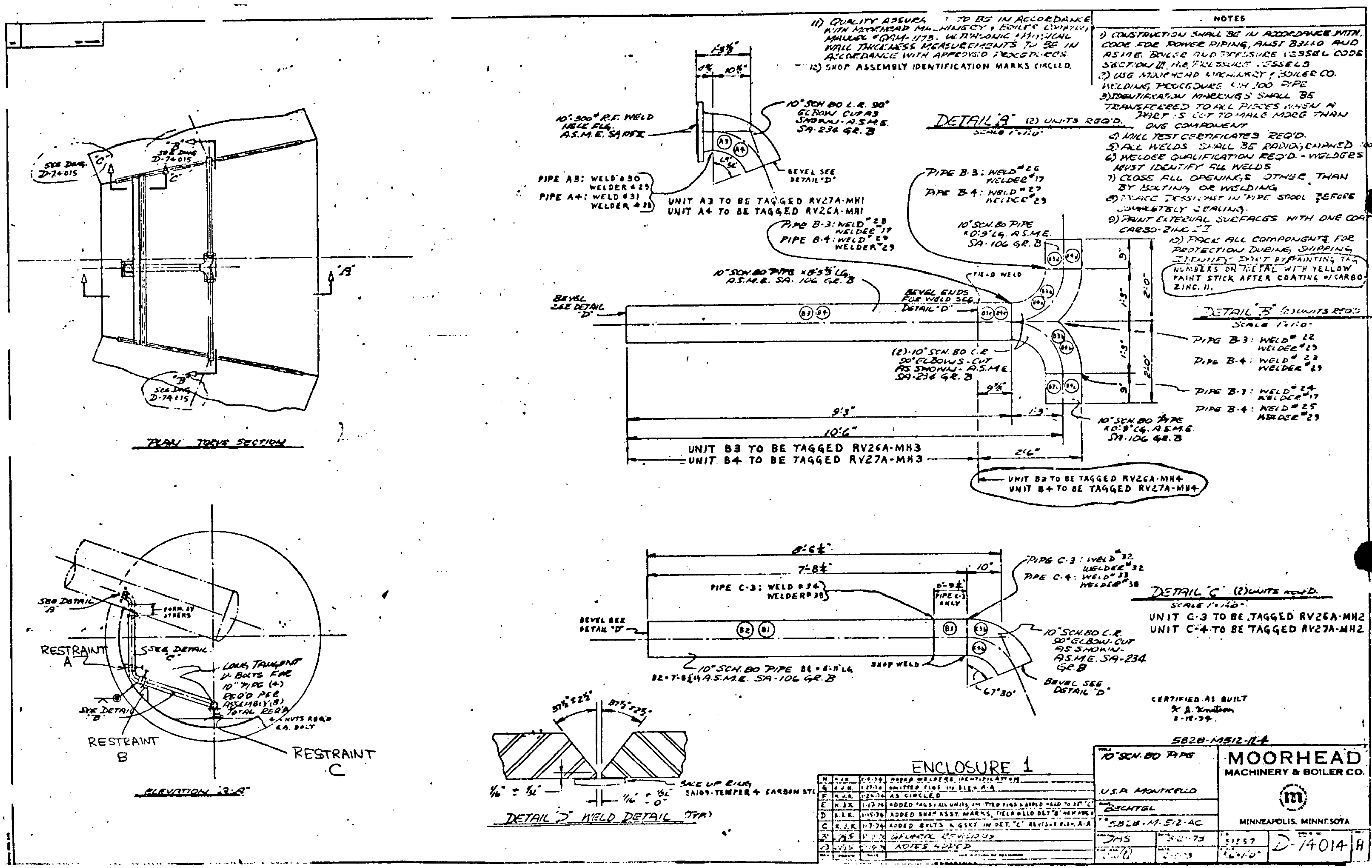
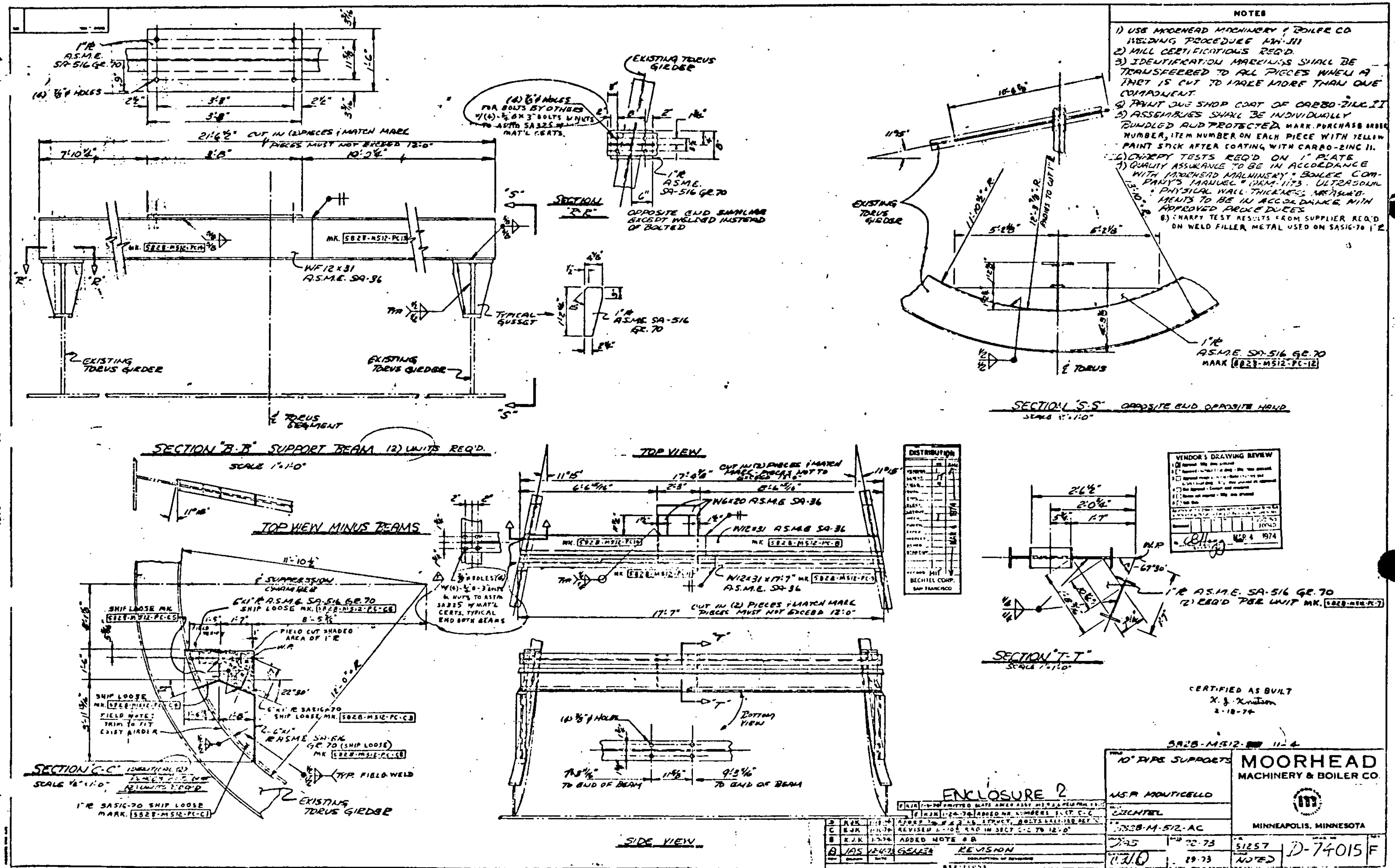
FIGURE 2



NOTES
1) CONSTRUCTION SHALL BE IN ACCORDANCE WITH CODE FOR POWER PIPING, ANSI B31.1 AND ASME BOILER AND PRESSURE VESSEL CODE
2) USE MOORHEAD MACHINERY & BOILER CO. WELDING PROCEDURE
4) MILL TEST CERTIFICATES REQ'D.
5) ALL WELDS SHALL BE RADIOGRAPHED
6) WELDER QUALIFICATION REQ'D. - WELDERS MUST IDENTIFY ALL WELDS
7) CLOSE ALL OPENINGS OTHER THAN BY BOLTING OR WELDING
9) PAINT EXTERNAL SURFACES WITH ONE COAT CARBO-ZINC 11
12) SHOP ASSEMBLY IDENTIFICATION MARKS CIRCLED.
DETAIL "A" (2) UNITS REQ'D.
UNIT A3 TO BE TAGGED RV27A-MH1
UNIT A4 TO BE TAGGED RV26A-MH1
DETAIL "B" (2) UNITS REQ'D.
UNIT B3 TO BE TAGGED RV26A-MH3
UNIT B4 TO BE TAGGED RV27A-MH3
UNIT B3 TO BE TAGGED RV26A-MH4
UNIT B4 TO BE TAGGED RV27A-MH4
DETAIL "C" (2) UNITS REQ'D.
UNIT C-3 TO BE TAGGED RV26A-MH2
UNIT C-4 TO BE TAGGED RV27A-MH2
PLAN TORUS SECTION
ELEVATION "A-A"
RESTRAINT A
RESTRAINT B
RESTRAINT C
DETAIL "D" WELD DETAIL (TYP)
ENCLOSURE 1
CERTIFIED AS BUILT
10" SCH. 80 PIPE
U.S.A. MONTICELLO
BECHTEL
MOORHEAD MACHINERY & BOILER CO.
MINNEAPOLIS, MINNESOTA
D-74014


NOTES
1) USE MOORHEAD MACHINERY & BOILER CO WELDING PROCEDURE MW-311
2) MILL CERTIFICATIONS REQ'D.
3) IDENTIFICATION MARKINGS SHALL BE TRANSFERRED TO ALL PIECES WHEN A PART IS CUT TO MAKE MORE THAN ONE COMPONENT.
4) PAINT ONE SHOP COAT OF CARBO-ZINC II
5) ASSEMBLIES SHALL BE INDIVIDUALLY BUNDLED AND PROTECTED. MARK PURCHASE ORDER NUMBER, ITEM NUMBER ON EACH PIECE WITH YELLOW PAINT STICK AFTER COATING WITH CARBO-ZINC 11.
6) CHARPY TESTS REQ'D ON 1" PLATE
7) QUALITY ASSURANCE TO BE IN ACCORDANCE WITH MOORHEAD MACHINERY & BOILER COMPANY'S MANUEL • QAM-1173. ULTRASONIC • PHYSICAL WALL THICKNESS MEASUREMENTS TO BE IN ACCORDANCE WITH APPROVED PROCEDURES
8.) CHARPY TEST RESULTS FROM SUPPLIER REQ'D ON WELD FILLER METAL USED ON SA516-70 1" R
SECTION "B-B" SUPPORT BEAM (2) UNITS REQ'D.
SCALE 1"=1'-0"
21'-6½" CUT IN (2) PIECES & MATCH MARK PIECES MUST NOT EXCEED 12'-0"
WF 12 x 31 A.S.M.E. SA-36
EXISTING TORUS GIRDER
TYPICAL GUSSET
1" R A.S.M.E. SA-516 GR.70
(4) ⅞" ϕ HOLES
SECTION "R-R"
OPPOSITE END SIMILAR EXCEPT WELDED INSTEAD OF BOLTED
(4) ⅞" ϕ HOLES FOR BOLTS BY OTHERS W/(4)-¾" ϕ x 3" BOLTS & NUTS TO ASTM SA325 W/ MAT'L CERTS.
SECTION "S-S" OPPOSITE END OPPOSITE HAND
SCALE 1"=1'-0"
EXISTING TORUS GIRDER
RADIUS TO CUT 1" R
1" R A.S.M.E. SA-516 GR.70 MARK 5828-M512-PC-12
℄ TORUS
℄ TORUS SEGMENT
TOP VIEW MINUS BEAMS
℄ SUPPRESSION CHAMBER
6x1" R A.S.M.E. SA-516 GR.70 SHIP LOOSE MK. 5828-M512-PC-C6
FIELD CUT SHADED AREA OF 1" R
SHIP LOOSE MK. 5828-M512-PC-C4
FIELD NOTE: TRIM TO FIT EXIST GIRDER
TYP. FIELD WELD
1" R SA516-70 SHIP LOOSE MARK 5828-M512-PC-C1
EXISTING TORUS GIRDER
SECTION "C-C"
SCALE ½"=1'-0"
TOP VIEW
W6x20 A.S.M.E. SA-36
W12x31 A.S.M.E. SA-36
W12x31 x 17'-7" MK 5828-M512-PC-5 A.S.M.E. SA-36
CUT IN (2) PIECES & MATCH MARK PIECES MUST NOT EXCEED 12'-0"
(4) ⅞" ϕ HOLES
TO END OF BEAM
BOTTOM VIEW
SIDE VIEW
DISTRIBUTION
BECHTEL CORP. SAN FRANCISCO
VENDOR'S DRAWING REVIEW
MAR 4 1974
SECTION "T-T"
SCALE 1"=1'-0"
1" R A.S.M.E. SA-516 GR.70 (2) REQ'D PER UNIT MK. 5828-M512-PC-7
CERTIFIED AS BUILT
2-18-74
5828-M512- 11-4
ENCLOSURE 2
ADDED NOTE # 8
REVISION
10" PIPE SUPPORTS
N.S.P. MONTICELLO
BECHTEL
5828-M-512-AC
MOORHEAD MACHINERY & BOILER CO.
MINNEAPOLIS, MINNESOTA
51257
NOTED
D-74015
F