S

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 660780

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental ☐ Direct Revision ☒ Change ECN ☐ Temporary ☐ Standby ☐ Supersedure ☐ Cancel/Void ☐	Jaka, Omar M., ISE, S7-24, 372-2322	☒ Yes ☐ No	6/28/00
	6. Project Title/No./Work Order No.: DESIGN REVIEW REP., CONCRETE COVER BLOCK REPLACED BY STEEL PLATE	7. Bldg./Sys./Fac. No.: See 13a.	8. Approval Designator: SQ
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.): RPP-5416 Rev. 1	10. Related ECN No(s).: ECN-660753	11. Related PO No.: N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Completed	12d. Restored to Original Condition (Temp. or Standby ECNs only)
☐ Yes (fill out Blk. 12b) ☒ No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? ☒ Yes ☐ No

Revise the Formal Design Review Report for U-109 and U-105 Cover Plate to include Design Review of 7 additional Cover Plate modifications by similarity and comparison:

1) U-103
2) AX-101
3) A-101
4) SX-105
5) S-A VALVE PIT
6) S-C VALVE PIT
7) SX-A VALVE PIT

This ECN is covered by Categorical Exclusion USQ# TF-96-0690 Rev. 2 items 5,6,9

14a. Justification (mark one)	14b. Justification Details
Criteria Change ☒ Design Improvement ☐ Environmental ☐ Facility Deactivation ☐ As-Found ☐ Facilitate Const. ☐ Const. Error/Omission ☐ Design Error/Omission ☐	Design verification of 7 additional cover plates were evaluated against previously approved cover plate for U-109 pump pit as per subsec 4.1.2 of sec 4.24 of HNF-IP-0824 vol. IV. This modification will not result in a change to exposure > 1 person-REM (Whole Body) or 10 person-REM (extremities) for the installation, maintenance and operation of the life of the modification. NEPA screening not required-administrative change.

15. Distribution (include name, MSIN, and no. of copies)

OM Jaka	S7-24
WF Zuroff	S7-24
MR Koch	S7-24
TJ Volkman	S7-34
LL Penn	S7-07
LA Flowers	S7-07
KJ Hull	T4-07
DK DeFord	S7-24
KR Ellingson	S7-24

RELEASE STAMP

DATE: HANFORD RELEASE
STA: 4 ID: 2
JUL 27 2000

A-7900-013-2 (10/97)

A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 660780

16. Design Verification Required	17. Cost Impact — ENGINEERING		17. Cost Impact — CONSTRUCTION		18. Schedule Impact (days)	
☒ Yes	Additional ☐	$ N/A	Additional ☐	$ N/A	Improvement ☐	N/A
☐ No	Savings ☐	$ N/A	Savings ☐	$ N/A	Delay ☐	N/A

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐
Vendor Information	☐	Operating Procedure	☐	Electric Circuit Schedule	☐
OM Manual	☐	Operational Safety Requirement	☐	ICRS Procedure	☐
FSAR/SAR	☐	IEFD Drawing	☐	Process Control Manual/Plan	☐
Safety Equipment List	☐	Cell Arrangement Drawing	☐	Process Flow Chart	☐
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☐	Tickler File	☐
Environmental Report	☐	Inspection Plan	☐	None	☒
Environmental Permit	☐	Inventory Adjustment Request	☐		☐

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number/Revision
N/A	N/A	N/A

21. Approvals

	Signature	Date		Signature	Date
Design Authority	WF Zuroff [signature]	7/26/00	Design Agent		
Cog. Eng.	DK DeFord [signature]	7/17/00	PE		
Cog. Mgr.	MR Koch [signature]	7/17/00	QA		
QA	TJ Volkman [signature]	7/17/00	Safety		
Safety	LA Flowers [signature]	7/20/00	Design		
Environ.	LL Penn [signature]	7/17/00	Environ.		
Other	OM Jaka [signature]	7/17/00	Other		
FAC. Cog	KJ Hull [signature]	7/19/00			

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

DESIGN REVIEW REPORT, CONCRETE COVER BLOCK REPLACED BY STEEL PLATE

O. M. Jaka
CH2MHILL HANFORD GROUP, INC
Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 660780 UC:
Org Code: 74D00 Charge Code: 103361
B&R Code: Total Pages: ~~56~~ 57 d 7-27-00.

Key Words: 241-U-109, 241-U-105, 241-U-103, 241-AX-101, 241-A-101, 241-SX-105, 241-S-A, 241-S-C, 241-SX-A, DESIGN REVIEW REPORT, COVER PLATE, FSAR

Abstract: The design for the steel cover plates to replace concrete cover blocks for U-109 was reviewed and approved in a design review meeting. The design for steel plates to replace concrete blocks were reviewed and approved by comparison and similarity with U-109 for the following additional pits: 241-U-105, 241-U-103, 241-AX-101, 241-A-101, 241-SX-105, 241-S-A, 241-S-C, 241-SX-A.

Release Approval 7/26/00 Date

DATE: HANFORD RELEASE
STA: 4 ID: 2
JUL 27 2000
Release Stamp

Approved For Public Release

RECORD OF REVISION	(1) Document Number RPP-5416	Page 1

(2) Title
DESIGN REVIEW REPORT, CONCRETE COVER BLOCK REPLACED BY STEEL PLATE

Change Control Record

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	Authorized for Release (6) Cog. Mgr. Date
0	(7) EDT 624852	MA White	MR Koch 12/15/99
1	ECN 660753, Direct Revision. Replaced cover block with steel plate for U-105.	DK Deford	MR Koch 6/27/00
2 RS	ECN 660780, Direct Revision. Modified 7 additional cover plates.	D. Deford	M. R. Koch 7/26/00

TABLE OF CONTENTS

1.0 Scope

A design review meeting was held to review ECN 648492. During the review meeting all RCR comments were reviewed and dispositioned to the satisfaction of the reviewers. This review covered the modification of the existing Safety Class 1" Carbon Steel (CS) Cover Plate over the Saltwell Pump Pit for 241-U-109 tank and also adding additional 2" CS plate for shielding purposes. Modification of this 1" plate was needed to cut four additional slots for inserting the electrical wire connection from the PIC (Pumping and Instrumentation Control) Skid and to provide a 8"X6" hole to insert a sensor for the Flammable Gas Monitor (FGM).

A design review of ECN 648484 to modify existing 1" plate and add 2" steel plate is done of 241-U-105 by comparison with 241-U-109 cover plates, which has the same size cover plates.

A design review for CS cover plates to replace concrete cover blocks is done by similarity and comparison with 241-U-109 cover plates for the following pits: 241-U-103, 241-AX-101, 241-A-101, 241-SX-105, 241-S-A, 241-S-C, and 241-SX-A.

The FSAR, HNF-SD-WM-SAR-067 Rev. 1, Table 3.4.2.9-3 identifies cover blocks (or Cover Plates for Saltwell Pumping) as Safety Class to knockdown spray leak and to limit the release of waste aerosols into the atmosphere. Pit covers are also a mitigative feature for other accidents and provides radiation protection (i.e. shielding) for facility workers.

NOTE: The following are documents relevant to a particular cover plate modification. Those without a document number are included as appendices to this design review report. [See Table of Contents for a description of appendices.]

Documents Reviewed:

1) ECN-648492, Install 2" shielding Plate & Modify 1" cover plate on 241-U-109.
2) USQ TF-99-0229, Rev. 5, Install Saltwell Pumps and Jumpers, 241-U Tank Farm, Modify Cover Plate
3) RPP-5989, Rev. 0, Radiological Design Review Screening-Saltwell Pumping at 241-U-109 Pump Pit.
4) Calculations for structural Integrity of steel cover plate dated: 11/9/99.

Documents for cover plates at U-105 and U-103:

1) ECN-648484, Install 2" Shielding Plate: 241-U-105
2) RPP-6641, Rev. 0, Radiological Design Review Screening-Saltwell Pumping at 241-U-105 Pump Pit.
3) USQ TF-99-0229, Rev. 4, Install Saltwell Pumps and Jumpers, 241-U Tank Farm, Modify Cover Plate (for U-105)
4) **Calculations for structural Integrity of steel cover plate U-105 and U-103 dated: 3/11/99.**
5) **ECN-648470, Install 2" Shielding Plate: 241-U-103**
6) **RPP-6640, Rev. 0, Radiological Design Review Screening-Saltwell Pumping at 241-U-103 Pump Pit.**

7) USQ TF-99-0229, Rev. 3, Install Saltwell Pumps and Jumpers, 241-U Tank Farm, Modify Cover Plate (for U-103)

Documents for cover plates at AX-101:

1) ECN-659244, Fab and Install Cover Plate on Distributor Pit AX-101
2) RPP-5844, Rev. 0, Radiological Design Review Screening-Saltwell Pumping at 241-AX-101 Pump Pit.
3) USQ TF-00-0128 Rev. 3, Replace 1" and add 2" Steel Plate on Distributor Pit AX-101
4) Calculations for structural Integrity of steel cover plate AX-101, 3/14/00.

Documents for cover plates at A-101:

1) ECN-652568, Replace 241-A-101 Pit Cover blocks by 2" Steel Cover Plate
2) RPP-6642, Rev. 0, Radiological Design Review Screening- 2" Carbon Steel Cover Plate Installation at 241-A-101 Pump Pit
3) USQ TF-99-9950, Rev. 0, Replace Cover Block by 2" Steel Plate on Distributor Pit for Saltwell Pumping Tank A-101
4) Structural calculations for A-101 cover plate dated: 2/25/00.

Documents for cover plates at SX-105:

1) ECN-638579, Replace 241-SX-105 Distributor Pit Cover block by Steel Plate
2) RPP-6162, Rev. 0, Radiological Design Review Screening- 2" Carbon Steel Cover Plate Installation at 241-SX-105 Pump Pit
3) USQ TF-99-0615, Rev. 1, 241-SX-105- Distributor Pit Cover Plate
4) Structural calculations for SX-105 cover plate dated: 5/30/00

Documents for cover plates at S-A, S-C, and SX-A Valve Pits:

1) ECN-659207, Replace East Cover Block on S-A Valve Pit by 3" Steel Plate
2) ECN-659208, Replace West Cover Block on S-C Valve Pit by 3" Steel Plate
3) ECN-659209, Replace West Cover Block on SX-A Valve Pit by 3" Steel Plate
4) RPP- 6161, Rev. 0, Radiological Design Review Screening-241-SX-105 Hose-in-Hose Transfer System for the IS Program (screening of S-A, S-C, and SX-A Valve Pits)
5) USQ TF-00-0370 Rev. 0, Replace Concrete Cover Blocks by Steel Cover Plates on S and SX Farm Pits
6) Structural Calculations and Design of 3" Cover Plate for 241-S-A Valve Pit dated: 6/8/00.
7) Structural Calculations and Design of 3" Cover Plate for 241-S-C Valve Pit dated: 6/7/00.
8) Structural Calculations and Design of 3" Cover Plate for 241-SX-A Valve Pit dated: 6/7/00.

The ECN provided the layout of a 2" steel shielding plate with slot holes, a FGM sensor hole and valve handle holes to match with holes in the existing 1" plate. A layout was also provided of new slot holes and a FGM sensor hole in the existing 1" plate. The ECN provided the details for the Safety Class Shield Plug to cover the 8"X6" hole for the FGM.

The USQ TF-99-0229, Rev. 5 provided the screening for the modification of the existing 1" cover plate and 2" additional shielding plate. This screening has all "No" or "N/A" responses, therefor it did not require a USQ Determination.

The Radiological Design Review Screening provided the Dose Rate of 139 mrem/hr over the existing 1"cover plate during the pumping operation. This high Dose rate will limit the personnel occupancy over the pump pit cover which is required during the life cycle of Saltwell Pumping for 241-U-109 Tank.

By analysis, the addition of a 2" steel carbon plate on top of a 1" existing plate will drop the dose rate to 21 mrem/hr, which will allow operations personnel to spend the required time during the lifecycle of the project, and will not result in exposure to > 1 person-REM.

By analysis, an adequate factor of safety exists for maximum stress and deflection of the 1" plate. Also the 2" plate is supported in the same way on the pit wall as the 1" plate.

All documentation is related to the Interim Stabilization program for Saltwell Pumping of Tank 241-U-109 in 241-U Tank Farm. All objectives of this review has been to establish the design approval for the 1" Safety Class cover plate and additional 2" shielding plate on 241-U-109 pump pit.

As the cover plates for 241-U-105 and 241-U-109 are identical, the factor of safety for bending stress and deflection are very similar. The radiological dose rate for 241-U-105 is 20 mrem/hr, compared to 21 mrem/hr for 241-U-109. From the analysis given here, the cover plates for 241-U-105 provide adequate safety function as per FSAR requirements.

To perform saltwell pumping the concrete cover blocks were replaced with steel cover plates for seven pits in addition to 241-U-109 and 241-U-105, namely: 241-U-103, 241-AX-101, 241-A-101, 241-SX-105, 241-S-A, 241-S-C, and 241-SX-A. The cover plates for six out of seven of these pits have a higher factor of safety for bending stress and deflection than U-109, and all have adequate safety factors. The radiological dose rates for the U-103, AX-101, and A-101 pump pits, are less than or equal to that of U-109, or 21 mrem/hr. The radiological dose rates for the SX-105 pump pit and the S-A, S-C, and SX-A valve pits were between 30 and 35 mrem/hr. Although this is a higher dose rate than U-109, these pits each have a shorter duration of pumping. Thus, their total radiation exposure is close to that of U-109 and within the exposure limit. From the analysis given here, the cover plates for 241-U-103, 241-AX-101, 241-A-101, 241-SX-105, 241-S-A, 241-S-C, and 241-SX-A provide adequate safety function and shielding as per FSAR requirements.

2.0 SUMMARY

The design review meeting was held on November 9, 1999. The meeting minutes are attached in Appendix A. Comments were recorded on Review Comment Records (Appendix B) and in the meeting minutes. All comments were dispositioned in the meeting and no further comments were made. It was concluded that the 1" existing cover plate with the additional 2" steel shielding plate will meet the requirements of the FSAR. The FSAR requirements have been met for spray leak knockdown and shielding for facility workers.

There are no outstanding action items remaining on the design for the existing cover plate or shielding plate for 241-U-109 Saltwell Pump Pit.

By comparing the data from analysis of 241-U-105 cover plates shown below, it is concluded that the 241-U-105 cover plates will meet the requirements of FSAR.

By comparing the data shown in the table below from analysis of 241-U-109 cover plates with 241-U-103, 241-AX-101, 241-A-101, 241-SX-105, 241-S-A, 241-S-C, and 241-SX-A, it is concluded that the additional seven cover plate designs will meet the requirements of FSAR.

Design Review by Comparison

	Steel Plates:	Stress Safety Factor:	Deflection SF:	Radiation Dose Rate: (mrem/hr)
Design Verified Cover Plate: U-109 Pump Pit ECN-648492	**1"+2" thk. 7'-8"x7'-8"**	**10.092**	**1.172**	**21**
U-105 Pump Pit ECN-648484	1"+2" thk. 7'-8"x7'-7 1/2"	11.31	2.9	20
U-103 Pump Pit ECN-648470	1"+2" thk. 7'-8"x7'-8"	11.31	2.63	20
AX-101 Pump Pit ECN-659244	1"+2" thk. 6'-6"x11'-2"	7.963	4.732	21
A-101 Pump Pit ECN-652568	2" thk. 7'-0"x7'-6"	31.826	8.813	13
SX-105 Pump Pit ECN-638579	3" thk. 8'-0"x8'-2"	43.233	14.829	30*
S-A Valve Pit ECN-659207	3" thk. 8'-0"x11'-10"	39.26	19.573	35*
S-C Valve Pit ECN-659208	3" thk. 8'-0"x11'-10"	12.0	8.2	35*
SX-A Valve Pit ECN-659209	3" thk. 8'-0"x11'-10"	12.0	7.88	35*

*The total Radiation dose for these pits is comprable to U-109. Although their radiological dose rate is higher than that of U-109, their duration of pumping is shorter.

Conclusion:

By comparing results given in the table U-105 cover plate has the better safety factors and it will provide adequate safety functions to knock down spray leak and limit the release of waste aerosol to the atmosphere. Duration of pumping for U-105 is 9 months compared to 24 months for U-109 so total Radiation dose will be less for U-105 and it will be within the exposure limit. Hence U-105 plate is acceptable by comparison.

Comparing the data for 241-U-109 with the seven additional pits, namely: 241-U-103, 241-AX-101, 241-A-101, 241-SX-105, 241-S-A, 241-S-C, and 241-SX-A, shows that adequate safety is provided and the total Radiation dose will be within the exposure limit. Thus, the new steel cover plates for these seven pits are acceptable by comparison.

3.0 DOCUMENTATION

Design Review Committee Members:

O. M. Jaka*	Design Agent
M. A. White*	Cognizant Engineer
M. R. Koch*	Cognizant Engineering Manager
W. F. Zuroff*	Design Authority
L. L. Penn*	Environmental
T. J. Volkman*	Quality Assurance
F. A. Zak*	Safety
K. J. Hull*	Cognizant Engineer (SST)
K. R. Ellingson*	Administration

*Meeting Attendees

Documents:

Meeting Minutes, dated 11/9/99

Radiological Design Review Screening, 2" Carbon Steel Cover Plate Installation at 241-U-109 Pump Pit, dated

Unreviewed Safety Question (USQ) Screening/Determination, TF-99-0229, dated 10/28/99.

Design Calculations for Structural Integrity of existing 1" Plate for additional holes, dated

APPENDIX A

MEETING MINUTES
DESIGN REVIEW MEETING ECN 648492
241-U-109 COVER PLATE

MEETING MINUTES

SUBJECT: Design Review for the Modification of the Existing 1" Cover Plate and Adding a 2" Shielding Plate

TO:	**Building:**	**Date:**
Distribution	2704-HV/G-133	11/9/99
FROM:	**Chairman:**	**Number Attending:**
Interim Stabilization Engineering	W. F. Zuroff	9

Design Review Committee Members:

O.M. Jaka*	Design Agent
M.A. White*	Cognizant Engineer
M.R. Koch*	Cognizant Engineering Manager
W.F. Zuroff*	Design Authority, Chairman
L.L. Penn*	Environmental
T.J. Volkman*	Quality Assurance
F.A. Zak*	Safety
KJ. Hull*	Cognizant Engineer (SST)
K.R. Ellingson*	Administration

Attendees*

This Design Review Meeting was called to review the proposed changes noted on ECN 648492, "Modification of the Existing 1" Cover Plate and Adding a 2"Sheilding Plate on Tank 241-U-109, Saltwell Pump Pit"

Comments were received by Review Comment Record's (RCR) and these comments were dispositioned during the meeting to the satisfaction of the reviewers. Additional comments were taken during the meeting and are as follows:

Koch

Question:
Is the shielding plate sitting on all four sides of the pit?
Disposition:
Yes, is supported by 3 walls and adjacent cover block.

Question:
What is the structural strength?
Disposition:
Yes, Analysis treated as a dead load sitting on the plate. The 1" and 2" plate are supporting their own loads. The safety factor is adequate against yield strength and deflection.

Question:
Will the lifting bails be removed from the 1" plate?
Disposition:
No.

Question:
Will the 2" shielding plate have it's own hoisting rings?
Disposition:
Yes

Question:
Is there a painting diagram for the pit?
Disposition:
Yes

Comment:
Page 4 of ECN "CS Shielding Plate per detail "Z" change to detail "P".
Disposition:
Agreed, will correct

Comment:
Add bolt call out.
Disposition:
Agreed, will correct

Question:
Is the shielding plug 2" and the slot cover's 1"?
Disposition:
Yes

Question:
Should page 4 of this ECN be detail "P"?
Disposition:
Yes

Comment:
Specify that the holes will be plugged on the 2" plate after the hoist rings are removed.
Disposition:
Agreed

Comment:
Specify bolt length
Disposition:
Agreed

Question:
How far does the slot overhang the pit walls?
Disposition:
A little more than 6" in length.

Question:
Has the plug been fabricated yet?
Disposition:
Yes

<u>**Zuroff**</u>
Comment:
The Belhaven unit will be replaced by a remotely calibrated sensor.

Question:
Is the sheet metal box a cover for the existing slot?
Disposition:
Yes

Question:
Will the hole be covered by a safety class cover?
Disposition:
Yes, the cover will be modified to accept the sensor signal cable and the calibration gas tubing. This design review will serve as the design review for the modification of the S/C cover.

<u>**Swaney**</u>
Comment:
On Page 6 of ECN 648492, in the "Shielding Application Table" delete "Assembly X" and add "not required'
Disposition:
Agreed

Comment:
On page 4 of ECN 648492 remove the call out from the top left corner, it is repeated.
Disposition:
Agreed

<u>**Hull**</u>
Question:
Will you be using the existing slot?
Disposition:
No

Question:
Are the dimensions shown on pages 3, 4 and 5 of ECN 648492 correct?
Disposition:
Yes,
Page 3 of this ECN shows a dimension of 3'-10' for the center line of the riser.
Page 5 of this ECN shows a dimension of 3'-9' 7/8" for the 4" hole.
Page 4 of this ECN shows the 4" hole is not in the center of the cover plate.

Question:
Are all related ECNs work complete?
Disposition:
Yes

Comment:
Specify the bolt length.
Disposition:
Agree

APPENDIX B

REVIEW COMMENT RECORDS
241-U-109 COVER PLATE

REVIEW COMMENT RECORD (RCR)

1. Date 11/9/99
2. Review No. 1
3. Project No.
4. Page 1 of 1

5. Document Number(s)/Title(s)	6. Program/Project/Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
ECN 648492	Saltwells (ISE)	S.C. Swaney	TD400	2704HV/D104 373-3472

17. Comment Submittal Approval:

Organization Manager (Optional)

10. Agreement with indicated comment disposition(s)

11/9/99 Date — [signature] Reviewer/Point of Contract

[signature] Author/Originator

11. CLOSED

11/11/99 Date — [signature] Reviewer/Point of Contact

[signature] Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	Remove "Drill & Tap For 3/8"-16UNC-2B 4PL, Template Locations to shield plug, See Detail 'K'" from pg. 4 of 7. Redundant on pg. 5.		Removed - Page 4 of 7 updated	
2	Remove "match Drill & Tap 7/8"-16UNC-2B, 12 PL" from page 4 of 7. Move to page 5 of 7.		Removed - Page 5 of 7 updated	
3	Delete "Drill & Tap 3/8"-16UNC-2B, thru, 12PL See Detail 'Y' H-2-73720" from page 5 of 7. Item #2 will replace.		Page 5 of 7 has been revised.	
4	Remove assembly 'X' from page 6 of 7. From ECN 648484 that is not work complete.		Accept - Page 6 of 7 has been updated	

A-6400-090.11 (03/99)

REVIEW COMMENT RECORD (RCR)

1. Date 11-9-99
2. Review No.
3. Project No.
4. Page 1 of 1

5. Document Number(s)/Title(s): ECN ~~68~~ 648492/2" SHIELD PLATE U-109
6. Program/Project/Building Number: 241-U-109
7. Reviewer: M R KOCH
8. Organization/Group: 74D00
9. Location/Phone: 2704HV D117,1,3 2659

17. Comment Submittal Approval:

Organization Manager (Optional)

10. Agreement with indicated comment disposition(s)

11-9-99 Date

[signature] Reviewer/Point of Contract

[signature] Author/Originator

11. CLOSED

11-9-99 Date

[signature] Reviewer/Point of Contact

[signature] Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1.	Page 4, "2" CS SHIELDING PLATE PER DETAIL 'Z'" Change to Detail "P"		Will CORRECT	
2.	Add fill bolt call out		Will CORRECT	

A-6400-090.1 (03/98)

REVIEW COMMENT RECORD (RCR)

1. Date 11/9/99
2. Review No.
3. Project No. I.S.E.
4. Page 1 of 1

5. Document Number(s)/Title(s): ECN ~~I.S.E.~~ 648492
6. Program/Project/Building Number: U-109
7. Reviewer: FA Zak
8. Organization/Group: SAFETY
9. Location/Phone:

17. Comment Submittal Approval:

Organization Manager (Optional)

10. Agreement with indicated comment disposition(s)

Date

Reviewer/Point of Contract

Author/Originator

11. CLOSED

11/9/99
Date

[signature]
Reviewer/Point of Contact

[signature]
Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1.	No COMMENT			

A-6400-090 11 (03/99)

REVIEW COMMENT RECORD (RCR)

1. Date 11/9/99
2. Review No.
3. Project No.
4. Page 1 of 1

5. Document Number(s)/Title(s): ECN-648492
6. Program/Project/Building Number: 241-U-109
7. Reviewer: K.J. Hull
8. Organization/Group: SSTE
9. Location/Phone: MO281/376 4145

17. Comment Submittal Approval:

Organization Manager (Optional)

10. Agreement with indicated comment disposition(s)

11/9/99
Date

Reviewer/Point of Contract

Author/Originator

11. CLOSED

11/9/99
Date

Reviewer/Point of Contact

Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1.	SPECIFY BOLTS TO BE USED FOR SHIELD PLUG AND SLOT COVER, PAGE 4		Page 4 of ECN will be updated to show bolts for shield plug and slot covers	

A-6400-090.1 (03/99)

REVIEW COMMENT RECORD (RCR)

1. Date 11/9/99
2. Review No.
3. Project No.
4. Page 1 of 1

5. Document Number(s)/Title(s)	6. Program/Project/Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
ECN 648492		W.F. Zuroff	RSE	373-1003

17. Comment Submittal Approval:

Organization Manager (Optional)

10. Agreement with indicated comment disposition(s)

W.F. ZUROFF — Reviewer/Point of Contract

11/9/99 — Date

[signature] — Author/Originator

11. CLOSED

[signature] — Reviewer/Point of Contact

11/9/99 — Date

[signature] — Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1.	Pg 3, Pg 5- Existing Slot should be incorporated onto the new shielding cover, with a safety class slot cover to add cover this cover. This precludes using a SC shielding plate		cut slot and provide SC slot cover	O.K.

A-6400-090.1 (03/99)

REVIEW COMMENT RECORD (RCR)

1. Date 1/9/99	2. Review No.
3. Project No.	4. Page 1 of 1

5. Document Number(s)/Title(s)	6. Program/Project/Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
ECN 648492	U-109	TJ VOLKMAN	QA	

17. Comment Submittal Approval:	10. Agreement with indicated comment disposition(s)	11. CLOSED
Organization Manager (Optional)	Date; Reviewer/Point of Contract; Author/Originator	11/9/99 Date; [signature] Reviewer/Point of Contact; [signature] Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1.	NO COMMENT			

A-6400-090.11 (03/99)

REVIEW COMMENT RECORD (RCR)

1. Date 11/9/99
2. Review No.
3. Project No.
4. Page 1 of 1

5. Document Number(s)/Title(s)	6. Program/Project/Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
ECN-648492		M.A. White	ISE	D-104/2704 HV/ 373-5453

17. Comment Submittal Approval:

Organization Manager (Optional)

10. Agreement with indicated comment disposition(s)

Date

Reviewer/Point of Contract

Author/Originator

11. CLOSED

[signature]
Reviewer/Point of Contact

11/9/99
Date

[signature]
Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1.	No Comments - Accept as is			

A-6400-090.11 (03/99)

REVIEW COMMENT RECORD (RCR)

1. Date 11/9/99	2. Review No.	
3. Project No.	4. Page 1 of 1	

5. Document Number(s)/Title(s)	6. Program/Project/Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
ECN 648492		Lucinda L. Penn	Reg. Compliance Environmental Eng.	2704HV B102/372-2234

17. Comment Submittal Approval:

Organization Manager (Optional)

10. Agreement with indicated comment disposition(s)

Date

Reviewer/Point of Contract

Author/Originator

11. CLOSED

11/9/99
Date

Reviewer/Point of Contact [signature]

Author/Originator [signature]

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1.	No comments - Accept as is			

A-6400-090.1 (03/99)

APPENDIX C

STRUCTURAL CALCULATIONS
241-U-109

Determine factors of safety for 241-U-109 pump pit cover plate design (ECN-648492) with respect to maximum allowable deflection and bending stress:

ASSUMPTIONS -
Neglect plate penetrations (largest penetration dia (6")<< plate width)
Plate is simply supported on three edges, one edge free (worst case)
Plate is uniformly loaded over entire plate

$a := 92\ \mathrm{in}$ (Width of plate) $b := 92\ \mathrm{in}$ (Length of plate - free side)

$t_{steel} := 1\ \mathrm{in}$ (Thickness of plate)

$A := a \cdot b$ $A = 8.464 \cdot 10^3\ \mathrm{in}^2$ (Area of plate)

$V_{steel} := a \cdot b \cdot t_{steel}$ $V_{steel} = 8.464 \cdot 10^3\ \mathrm{in}^3$ (Volume of plate)

$\rho_{steel} := 487\ \frac{\mathrm{lb}}{\mathrm{ft}^3}$ (Density of ASTM A36 steel) $E := 29 \cdot 10^6\ \mathrm{lb \cdot in}^{-2}$ (Modulus of elasticity, ASTM A36 steel)

$W_{steel} := \rho_{steel} \cdot V_{steel}$ $W_{steel} = 2.385 \cdot 10^3\ \mathrm{lb}$ (Weight of steel plate)

$q_{steel} := \frac{W_{steel}}{A}$ $q_{steel} = 0.282\ \mathrm{lb \cdot in}^{-2}$ (Distributed dead load due to weight of steel plate)

Use Uniformly distributed live load = 50 lbs/sq ft = 0.3472 lb/sq ft

$q_{udl} := .3472\ \frac{\mathrm{lb}}{\mathrm{in}^2}$ $q_{total} := q_{steel} + q_{udl}$

$q_{total} = 0.629\ \mathrm{lb \cdot in}^{-2}$

$$adivb := \begin{bmatrix} .5 \\ .667 \\ 1.0 \\ 1.5 \\ 2.0 \\ 4.0 \end{bmatrix} \quad \beta := \begin{bmatrix} .36 \\ .45 \\ .67 \\ .77 \\ .79 \\ .80 \end{bmatrix} \quad \alpha := \begin{bmatrix} .080 \\ .106 \\ .140 \\ .160 \\ .165 \\ .167 \end{bmatrix}$$

From Roark, Table 26, Pg.461 Case 2b.

Use curve fitting to determine β:

$fit := cspline(adivb, \beta)$ $\beta := interp\left(fit, adivb, \beta, \frac{a}{b}\right)$ $\beta = 0.67$

Originator m. Omar Jaka (signature) Date 11/9/99 Checked by: (signature) Date 11/9/99
Omar Jaka Mike A. White

Calculate maximum stress and safety factor:

$$\sigma_{max} := \frac{\beta \cdot q_{total} \cdot b^2}{t_{steel}^2} \qquad \sigma_{max} = 3.567 \cdot 10^3\ lb \cdot in^{-2}$$

$\sigma_{yield} := 36000\ lb \cdot in^{-2}$ (ASTM A36)

$\sigma_{allow.} := .6$ Fy (AISC F1-5)

Gives $SF_{min} := 1.666$

$$SF := \frac{\sigma_{yield}}{\sigma_{max}} \qquad SF = 10.092$$

<u>SFmin=1.66, SF>>SFMIN, O.K.</u>

Calculate maximum deflection and safety factor:

Use curve fitting to determine α:

$fit := cspline(adivb, \alpha)$ $\qquad \alpha := interp\left(fit, adivb, \alpha, \frac{a}{b}\right)$ $\qquad \alpha = 0.14$

UBC Section 1608: any structural member deflection shall not exceed L/360 (Table 16-D)

Max Deflection:= L/360 = 92/360 = 0.255 in

$$y_{max} := \frac{-\alpha \cdot q_{total} \cdot b^4}{E \cdot t_{steel}^3} \qquad y_{max} = -0.218 \cdot in$$

<u><<0.255 in, O.K.</u>

Originator: m. Omar Jaka Date: 11/9/99 Checked by: Mike White Date: 11/9/99
Omar Jaka Mike A.White

APPENDIX D

STRUCTURAL CALCULATIONS
241-U-102
241-U-103
241-U-105
241-U-107
241-U-108
241-U-111

Note: Appendix D assumes structural calculations for the worst case U Farm pump

ENGINEERING CHANGE NOTICE CONTINUATION SHEET	Page 18 of 20	ECN: 651971 Date: 3/11/99

H-2-73720 SH 1, REV 2, ADD JET PUMP/JUMPER INSTALLATION AND COVER PLATE MODIFICATION STATUS TABLE AS SHOWN:

TANK NO.	JET PUMP/JUMPER INSTALLATION AND COVER PLATE MODIFICATION STATUS
241-U-102	NOT INSTALLED
241-U-103	NOT INSTALLED
241-U-105	NOT INSTALLED
241-U-106	NOT INSTALLED
241-U-107	NOT INSTALLED
241-U-108	NOT INSTALLED
241-U-109	NOT INSTALLED
241-U-111	NOT INSTALLED

NOTE – THE FOLLOWING CALCULATIONS ARE FOR INFORMATION ONLY, DO NOT INCORPORATE ON DRAWINGS

Determine factors of safety for worst case 241-U pump pit cover plate design with respect to maximum allowable deflection and bending stress, considering stress concentration resulting from valve wrench penetrations:

ASSUMPTIONS -

Plate is simply supported on three edges, one edge free (worst case)
Plate is uniformly loaded over entire plate
'Worst Case' is defined as "COVER PLATE PLAN A & D" due to potential for no support on one side and valve handle penetration near center of plate (location of greatest bendidng stress)

$a := 91.5\,in$ (Width of plate) $b := 92\,in$ (Length of plate - free side)

$t_{steel} := 1\,in$ (Thickness of plate)

$A := a \cdot b$ $A = 8.418 \cdot 10^3 \cdot in^2$ (Area of plate)

$V_{steel} := a \cdot b \cdot t_{steel}$ $V_{steel} = 8.418 \cdot 10^3 \cdot in^3$ (Volume of plate)

$\rho_{steel} := 487 \frac{lb}{ft^3}$ (Density of ASTM A36 steel) $E := 29 \cdot 10^6\, lb \cdot in^{-2}$ (Modulus of elasticity, ASTM A36 steel)

$W_{steel} := \rho_{steel} \cdot V_{steel}$ $W_{steel} = 2.372 \cdot 10^3\, lb$ (Weight of steel plate)

Originator: M. A. White Date: 3/17/99 Checked By: J. S. Boettger Date: 3/18/99

ENGINEERING CHANGE NOTICE CONTINUATION SHEET	Page 19 of 20	ECN: 651971 Date: 3/11/99

$$q_{steel} := \frac{W_{steel}}{A} \qquad q_{steel} = 0.282 \cdot lb \cdot in^{-2}$$ (Distributed dead load due to weight of steel plate)

$$adivb := \begin{bmatrix} .5 \\ .667 \\ 1.0 \\ 1.5 \\ 2.0 \\ 4.0 \end{bmatrix} \qquad \beta := \begin{bmatrix} .36 \\ .45 \\ .67 \\ .77 \\ .79 \\ .80 \end{bmatrix} \qquad \alpha := \begin{bmatrix} .080 \\ .106 \\ .140 \\ .160 \\ .165 \\ .167 \end{bmatrix}$$

From Roark, Table 26, Pg.461 Case 2b.

Use curve fitting to determine β:

$fit := cspline(adivb, \beta)$ $\qquad \beta := interp\left(fit, adivb, \beta, \frac{a}{b}\right)$ $\qquad \beta = 0.667$

Calculate bending stress:

$$\sigma_b := \frac{\beta \cdot q_{steel} \cdot b^2}{t_{steel}^{\,2}} \qquad \sigma_b = 1.592 \cdot 10^3 \cdot lb \cdot in^{-2} \qquad \sigma_{yield} := 36000\, lb \cdot in^{-2}$$ (ASTM A36)

From *Advanced Mechanics of Materials*, 4th Ed., Boresi and Sidebottom, since width of plate is much greater than the diameter of the hole (92">>4"), for case of symmetrical plate, uniformly loaded, Stress concentration factor will be Sc=2 (pg.533, 570).

Calculate stress increased by concentration factor Sc :

$Sc := 2 \qquad \sigma_{Sc} := \sigma_b \cdot Sc \qquad \sigma_{Sc} = 4.584 \cdot 10^5\ lb \cdot ft^{-2}$

$SF := \frac{\sigma_{yield}}{\sigma_{Sc}} \qquad SF = 11.31$ **SF>2, O.K.**

Use curve fitting to determine α:

$fit := cspline(adivb, \alpha)$ $\qquad \alpha := interp\left(fit, adivb, \alpha, \frac{a}{b}\right)$ $\qquad \alpha = 0.14$

Calculate maximum deflection and safety factor:

$$y_{max} := \frac{-\alpha \cdot q_{steel} \cdot b^4}{E \cdot t_{steel}^{\,3}} \qquad y_{max} = -0.097 \cdot in$$

From US Steel Handbook, page P-39, deflection should be held to < 1/100 of span.

$\frac{a}{100} = 0.915 \cdot in$ **.097"<<.915", O.K.**

Originator: M. A. White Date: 3/17/99 Checked By: J. S. Boettger Date: 3/18/99

ENGINEERING CHANGE NOTICE CONTINUATION SHEET	Page 20 of 20	ECN: 651971 Date: 3/11/99

Determine factors of safety with 1" thick lead sheilding distributed evenly over plate surface:

$\rho_{lead} := 710 \frac{lb}{ft^3}$ (Density of lead used for sheilding)

$t_{lead} := 1\ in$ (Thickness of lead required)

$V_{lead} := a \cdot b \cdot t_{lead}$ $V_{lead} = 4.872\ ft^3$ (Volume of lead plate)

$W_{lead} := \rho_{lead} \cdot V_{lead}$ $W_{lead} = 3.459 \cdot 10^3\ lb$ (Weight of lead plate)

$q_{lead} := \frac{W_{lead}}{A}$ $q_{lead} = 0.411 \cdot lb \cdot in^{-2}$ (Loading due to lead plate)

$\rho_{sheet} := 487 \frac{lb}{ft^3}$ (Density of sheet used to cover lead sheilding)

$t_{sheet} := 2 \cdot 0.125 in$ (Thickness of sheet (11 Ga.) x top & bottom)

$V_{sheet} := a \cdot b \cdot t_{sheet}$ $V_{sheet} = 1.218\ ft^3$ (Volume of sheet)

$W_{sheet} := \rho_{sheet} \cdot V_{sheet}$ $W_{sheet} = 593.109 lb$ (Weight of sheet)

$q_{sheet} := \frac{W_{sheet}}{A}$ $q_{sheet} = 0.07 \cdot lb \cdot in^{-2}$ (Loading due to sheet)

$\Sigma q := q_{lead} + q_{steel} + q_{sheet}$ $\Sigma q = 0.763 \cdot lb \cdot in^{-2}$ (Total distributed load on plate)

Assuming no friction between lead and steel plates-

Calculate bending stress w/lead:

$\sigma_{bl} := \frac{\beta \cdot \Sigma q \cdot b^2}{t_{steel}^2}$ $\sigma_{bl} = 4.31 \cdot 10^3 \cdot lb \cdot in^{-2}$ $\sigma_{yield} := 36000 lb \cdot in^{-2}$ (ASTM A36)

Calculate stress increased by concentration factor Sc, w/lead :

$Sc := 2$ $\sigma_{Scl} := \sigma_{bl} \cdot Sc$ $\sigma_{Scl} = 1.241 \cdot 10^6\ lb \cdot ft^{-2}$

$SF := \frac{\sigma_{yield}}{\sigma_{Scl}}$ $SF = 4.177$ **SF>2, O.K.**

calculate maximum deflection and safety factor:

$y_{max} := \frac{-\alpha \cdot \Sigma q \cdot b^4}{E \cdot t_{steel}^3}$ $y_{max} = -0.263 \cdot in$ **.263"<.915", O.K.**

Originator: M. A. White Date: 3/17/99 Checked By: J. S. Boettger Date: 3/18/99

A-7900-013-4 (05/96) GEF094

APPENDIX E

STRUCTURAL CALCULATIONS
241-AX-101

Determine factors of safety for 241-AX-101 Distributor Pit cover plate design (ECN-657823)with respect to maximum allowable bending stress and deflection:

ASSUMPTIONS -
Neglect plate penetrations (largest penetration 3"x13"<< plate width)
Plate is simply supported on three edges, one edge free (worst case)
Plate is uniformly loaded over entire plate

$\mathbf{a} := 78.00\ \mathbf{in}$ (Width of plate) $\mathbf{b} := 134\ \mathbf{in}$ (Length of plate - free side)

$\mathbf{t}_{\mathbf{steel}} := 1\ \mathbf{in}$ (Thickness of plate, The worst case) (2" plate will support itself)

$\mathbf{A} := \mathbf{a} \cdot \mathbf{b}$ $\mathbf{A} = 1.045 \cdot 10^{4} \cdot \mathbf{in}^{2}$ (Area of plate)

$\mathbf{V}_{\mathbf{steel}} := \mathbf{a} \cdot \mathbf{b} \cdot \mathbf{t}_{\mathbf{steel}}$ $\mathbf{V}_{\mathbf{steel}} = 1.045 \cdot 10^{4} \cdot \mathbf{in}^{3}$ (Volume of plate)

$\rho_{\mathbf{steel}} := 487 \dfrac{\mathbf{lb}}{\mathbf{ft}^{3}}$ (Density of ASTM A36 steel) $\mathbf{E} := 29 \cdot 10^{6}\ \mathbf{lb} \cdot \mathbf{in}^{-2}$ (Modulus of elasticity, ASTM A36 steel)

$\mathbf{W}_{\mathbf{steel}} := \rho_{\mathbf{steel}} \cdot \mathbf{V}_{\mathbf{steel}}$ $\mathbf{W}_{\mathbf{steel}} = 2.946 \cdot 10^{3}\ \mathrm{lb}$ (Weight of steel plate)

$\mathbf{q}_{\mathbf{steel}} := \dfrac{\mathbf{W}_{\mathbf{steel}}}{\mathbf{A}}$ $\mathbf{q}_{\mathbf{steel}} = 0.282 \cdot \mathbf{lb} \cdot \mathbf{in}^{-2}$ (Distributed dead load due to weight of steel plate

$\mathbf{q}_{\mathbf{liveload}}\ 50 \dfrac{\mathbf{lb}}{\mathbf{ft}^{2}}$ $\mathbf{q}_{\mathbf{liveload}} := .35 \dfrac{\mathbf{lb}}{\mathbf{in}^{2}}$ $\mathbf{q}_{\mathbf{total}} := \mathbf{q}_{\mathbf{steel}} + \mathbf{q}_{\mathbf{liveload}}$

$\mathbf{q}_{\mathbf{total}} = 90.983\ \mathrm{lb} \cdot \mathrm{ft}^{-2}$

$$\mathbf{adivb} := \begin{bmatrix} .5 \\ .667 \\ 1.0 \\ 1.5 \\ 2.0 \\ 4.0 \end{bmatrix} \quad \beta := \begin{bmatrix} .36 \\ .45 \\ .67 \\ .77 \\ .79 \\ .80 \end{bmatrix} \quad \alpha := \begin{bmatrix} .080 \\ .106 \\ .140 \\ .160 \\ .165 \\ .167 \end{bmatrix}$$

From Roark,Ed. 6, Table 26, Case 2a, Pg.461

Use curve fitting to determine β:

$\mathbf{fit} := \mathbf{cspline}(\mathbf{adivb}, \beta)$ $\beta := \mathbf{interp}\left(\mathbf{fit}, \mathbf{adivb}, \beta, \dfrac{\mathbf{a}}{\mathbf{b}}\right)$ $\beta = 0.398$

Calculate maximum stress and safety factor:

$\sigma_{\mathbf{max}} := \dfrac{\beta \cdot \mathbf{q}_{\mathbf{total}} \cdot \mathbf{b}^{2}}{\mathbf{t}_{\mathbf{steel}}^{2}}$ $\sigma_{\mathbf{max}} = 6.51 \cdot 10^{5}\ \mathrm{lb} \cdot \mathrm{ft}^{-2}$ $\sigma_{\mathbf{yield}} := \mathbf{36000\ lb} \cdot \mathbf{in}^{-2}$ (ASTM A36)

$\mathbf{SF} := \dfrac{\sigma_{\mathbf{yield}}}{\sigma_{\mathbf{max}}}$ $\mathbf{SF} = 7.963$ **SFmin=5, SF>SFMIN, O.K.**

Originator: [signature] Date: 3/4/00 Checked by: [signature] Date: 3/14/00
Omar Jaka J. S. Boettger

Calculate maximum deflection and safety factor using 2" thick plate which is on top:

Use curve fitting to determine α:

$\mathbf{fit} := \mathbf{cspline}(\mathbf{adivb}, \alpha)$ $\alpha := \mathbf{interp}\left(\mathbf{fit}, \mathbf{adivb}, \alpha, \frac{\mathbf{a}}{\mathbf{b}}\right)$ $\alpha = 0.094$

$t_{steel} := 2\ \mathbf{in}$

UBC section 1608, table 16-D deflection not to exceed L/360: (L=Length of span)

$y_{allow} := \frac{L}{360}$ $\frac{140}{360} = 0.389$

$y_{allow} := -.389\ \mathbf{in}$

$y_{max} := \frac{-\alpha \cdot q_{total} \cdot b^4}{E \cdot t_{steel}^3}$ $y_{max} = -0.082 \cdot \mathbf{in}$ <u>**<<0.389 in, O.K.**</u>

$SF := \frac{y_{allow}}{y_{max}}$

$SF = 4.732$ Good

Originator: m. Omar Jaka Date: 3/4/00 Checked by: J S Boettger Date: 3/14/00

Omar Jaka J. S. Boettger

ANALYTICAL CALCULATIONS

Subject 241-AX-101 DISTRIBUTOR PIT COVER PLATES

Originator OMAR JAKA Date 3/3/2000

Checker [signature] Date 3/14/2000

CHECK THE HOIST RINGS & 3/4" Φ CONNECTION BOLTS:

1. WT. OF 1" PLATE = 1/12 x 6.5 x 11.16 x 490 = 2962 #
2. WT. OF 2" PLATE = 2/12 x 6.5 x 11.16 x 490 = 5924 #

(USING UNIT WT. OF STEEL = 490 lbs/FT³) 8886 #

1. CHECK HOIST RINGS:

USING McMASTER-CARR HOIST RINGS 3052T67 (CATALOG 106)

WORK LOAD LIMIT = 10,000 lbs.

4 - HOIST RINGS CAPACITY = 40,000 lbs.

WORST CASE 2 - HOIST RINGS SUPPORTING THE PLATES = 20000 lbs. > 8886 lbs

∴ HENCE 4 - HOIST RINGS 3052T67 ARE ADEQUATE ∴ O.K.

2. CHECK 8 - 3/4" Φ A307 GR. B BOLTS HOLDING 2 PLATES TOGETHER:

(AISC 8TH EDITION PAGES 4-3&4-5)

3/4" Φ A 307 THREADED BOLT SHEAR CAPACITY = 4.4^K / BOLT

" " " " TENSION " = 8.8^K / BOLT

(a) CHECK FOR TENSION IF 1" PLATE DEFLECTS (WORST CASE):

TENSION = WT. OF 1" PLATE = 2962 # = $2.962^K < 8 \times 8.8^K$

∴ O.K.

(b) CHECK FOR SHEAR DURING SEISMIC EVENT:

2" PLATE SLIDING OVER 1" PLATE * AISC 8th ED. PAGE 5-15

SHEARING FORCE = WT. OF PLATE + *IMPACT (50%)

= 5924 + 0.5 x 5924

= 8886 lbs

= $8.89^K < 8$ BOLTS x 4.4^K/BOLT = 35.2^K

∴ O.K.

∴ 8 - 3/4" Φ A-307 BOLTS ARE ADEQUATE

APPENDIX F

STRUCTURAL CALCULATIONS 241-A-101

Determine factors of safety for 241-A-101pump pit cover plate design (ECN-652568) with respect to maximum allowable deflection and bending stress:

ASSUMPTIONS -
Neglect plate penetrations (largest penetration dia (8"x6")<< plate width)
Plate is simply supported on four edges, Plate is uniformly loaded over entire plate

$a := 90.00\ in$ (Width of plate) $b := 84.00\ in$ (All edges simply supported)

$t_{steel} := 2\ in$ (Thickness of plate)

$A := a \cdot b$ $A = 52.5\ ft^2$ (Area of plate)

$V_{steel} := a \cdot b \cdot t_{steel}$ $V_{steel} = 8.75\ ft^3$ (Volume of plate)

$\rho_{steel} := 487 \frac{lb}{ft^3}$ (Density of ASTM A36 steel) $E := 29 \cdot 10^6\ lb \cdot in^{-2}$ (Modulus of elasticity, ASTM A36 steel)

$W_{steel} := \rho_{steel} \cdot V_{steel}$ $W_{steel} = 4.261 \cdot 10^3\ lb$ (Weight of steel plate)

$q_{steel} := \frac{W_{steel}}{A}$ $q_{steel} = 81.167\ lb \cdot ft^{-2}$ (Distributed dead load due to weight of steel plate

$q_{liveload}$ $50 \frac{lb}{ft^2}$ $q_{liveload} := .35 \frac{lb}{in^2}$ $q_{total} := q_{steel} + q_{liveload}$

$q_{total} = 131.567\ lb \cdot ft^{-2}$

From Roark,Ed. 6, Table 26, Case 2a, Pg.461

adivb :=	β :=	α :=	γ :=
1.0	0.2874	0.0444	0.420
1.2	0.3762	0.0616	0.455
1.4	0.4530	0.0770	0.478
1.6	0.5172	0.0906	0.491
1.8	0.5688	0.1017	0.499
2.0	0.6102	0.1110	0.503
3.0	0.7134	0.1335	0.505
4.0	0.7410	0.1400	0.502
5.0	0.7476	0.1417	0.501
1000.0	0.7500	0.1421	.500

Use curve fitting to determine β:

$fit := cspline(adivb, \beta)$ $\beta := interp\left(fit, adivb, \beta, \frac{a}{b}\right)$ $\beta = 0.32$

Originator [signature] Date 1/13/00 Checked by [signature] Date 02/25/00
Omar Jaka D.D. Wiggins

Calculate maximum stress and safety factor:

$\sigma_{max} := \dfrac{\beta \cdot q_{total} \cdot b^2}{t_{steel}^2}$ $\sigma_{max} = 7.437 \cdot 10^4 \, lb \cdot ft^{-2}$ $\sigma_{yield} := 36000 \, lb \cdot in^{-2}$ (ASTM A36)

$SF := \dfrac{\sigma_{yield}}{\sigma_{max}}$ $SF = 69.703$ **SFmin=5, SF>SFMIN, O.K.**

Calculate maximum deflection and safety factor: :

Use curve fitting to determine α:

$fit := cspline(adivb, \alpha)$ $\alpha := interp\left(fit, adivb, \alpha, \dfrac{a}{b}\right)$ $\alpha = 0.051$

$t_{steel} := 2 \, in$

UBC section 1608, table 16-D deflection not to exceed L/360: (L=Length of span)

$y_{allow} := \dfrac{L}{360}$ $\dfrac{140}{360} = 0.389$

$y_{allow} := -.389 \, in$

$y_{max} := \dfrac{-\alpha \cdot q_{total} \cdot b^4}{E \cdot t_{steel}^3}$ $y_{max} = -9.954 \cdot 10^{-3} \, in$ **<<0.389 in, O.K.**

$SF := \dfrac{y_{allow}}{y_{max}}$

$SF = 39.079$ Good

Originator: M. Omar Jaka Date: 1/13/00 Checked by: Dirk Wiggins Date: 12/25/00

Omar Jaka D. D. Wiggins

CONSERVATIVE CALCULATION WITH 3-SIDE SUPPORTED

Determine factors of safety for 241-A101 pump pit cover plate design (ECN-652568) with respect to maximum allowable deflection and bending stress:

ASSUMPTIONS -
Neglect plate penetrations (largest penetration dia (3"x9")<< plate width)
Plate is simply supported on three edges, one edge free (worst case)
Plate is uniformly loaded over entire plate

$a := 90.00\ \mathbf{in}$ (Width of plate) $b := 84.00\ \mathbf{in}$ (Length of plate - free side)

$t_{steel} := 2\ \mathbf{in}$ (Thickness of plate)

$A := a \cdot b$ $A = 52.5\ ft^2$ (Area of plate)

$V_{steel} := a \cdot b \cdot t_{steel}$ $V_{steel} = 8.75\ ft^3$ (Volume of plate)

$\rho_{steel} := 487 \frac{lb}{ft^3}$ (Density of ASTM A36 steel) $E := 29 \cdot 10^6\ lb \cdot in^{-2}$ (Modulus of elasticity, ASTM A36 steel)

$W_{steel} := \rho_{steel} \cdot V_{steel}$ $W_{steel} = 4.261 \cdot 10^3\ lb$ (Weight of steel plate)

$q_{steel} := \frac{W_{steel}}{A}$ $q_{steel} = 81.167\ lb \cdot ft^{-2}$ (Distributed dead load due to weight of steel plate

$q_{liveload}\ 50 \frac{lb}{ft^2}$ $q_{liveload} := .35 \frac{lb}{in^2}$ $q_{total} := q_{steel} + q_{liveload}$

$q_{total} = 131.567\ lb \cdot ft^{-2}$

$$adivb := \begin{bmatrix} .5 \\ .667 \\ 1.0 \\ 1.5 \\ 2.0 \\ 4.0 \end{bmatrix} \quad \beta := \begin{bmatrix} .36 \\ .45 \\ .67 \\ .77 \\ .79 \\ .80 \end{bmatrix} \quad \alpha := \begin{bmatrix} .080 \\ .106 \\ .140 \\ .160 \\ .165 \\ .167 \end{bmatrix}$$

From Roark,Ed. 6, Table 26, Case 2a, Pg.461

Use curve fitting to determine β:

$fit := cspline(adivb, \beta)$ $\beta := interp\left(fit, adivb, \beta, \frac{a}{b}\right)$ $\beta = 0.702$

Calculate maximum stress and safety factor:

$\sigma_{max} := \frac{\beta \cdot q_{total} \cdot b^2}{t_{steel}^2}$ $\sigma_{max} = 1.629 \cdot 10^5\ lb \cdot ft^{-2}$ $\sigma_{yield} := 36000\ lb \cdot in^{-2}$ (ASTM A36)

$SF := \frac{\sigma_{yield}}{\sigma_{max}}$ $SF = 31.826$ <u>SFmin=5, SF>SFMIN, O.K.</u>

Originator: [signature] Date: 1/13/00 Checked by: [signature] Date: 02/25/00
Omar Jaka D. D. Wiggins

Calculate maximum deflection and safety factor:

Use curve fitting to determine α:

$fit := cspline(adivb, \alpha)$ $\qquad \alpha := interp\left(fit, adivb, \alpha, \frac{a}{b}\right)$ $\qquad \alpha = 0.145$

$t_{steel} := 2\ in$

UBC section 1608, table 16-D deflection not to exceed L/360: (L=Length of span)

$y_{allow} := \frac{b}{360}$ $\qquad \frac{90}{360} = 0.25$

$y_{allow} := -.25\ in$

$y_{max} := \frac{-\alpha \cdot q_{total} \cdot b^4}{E \cdot t_{steel}^{3}}$ $\qquad y_{max} = -0.028 \circ in$ $\qquad$ **<u><<0.25 in, O.K.</u>**

$SF := \frac{y_{allow}}{y_{max}}$

$SF = 8.813$ Good

Originator: m. Omar Jaka Date: 1/13/00 Checked by: Duke Wiggins Date: 02/25/00
Omar Jaka D. D. Wiggins

APPENDIX G

STRUCTURAL CALCULATIONS
241-SX-105

CONSERVATIVE CALCULATION WITH 3-SIDE SUPPORTED

Determine factors of safety for 241-SX-105 Distributor pit cover plate design (ECN-638579) with respect to maximum allowable deflection and bending stress:

ASSUMPTIONS -
Neglect plate penetrations (largest penetration dia (8"x6")<< plate width)
Plate is simply supported on three edges, one edge free (worst case)
Plate is uniformly loaded over entire plate

$\mathbf{a} := 98.00\mathbf{in}$ (Width of plate) $\quad \mathbf{b} := 96.00\mathbf{in}$ (Length of plate - free side)

$\mathbf{t}_{steel} := 3\mathbf{in}$ (Thickness of plate)

$\mathbf{A} := \mathbf{a}\cdot\mathbf{b} \qquad \mathbf{A} = 65.333\,\mathrm{ft}^2$ (Area of plate)

$\mathbf{V}_{steel} := \mathbf{a}\cdot\mathbf{b}\cdot\mathbf{t}_{steel} \qquad \mathbf{V}_{steel} = 16.333\,\mathrm{ft}^3$ (Volume of plate)

$\rho_{steel} := 487\dfrac{\mathbf{lb}}{\mathbf{ft}^3}$ (Density of ASTM A36 steel) $\quad \mathbf{E} := 29\cdot 10^6\mathbf{lb}\cdot\mathbf{in}^{-2}$ (Modulus of elasticity, ASTM A36 steel)

$\mathbf{W}_{steel} := \rho_{steel}\cdot\mathbf{V}_{steel} \qquad \mathbf{W}_{steel} = 7.954\times 10^3\,\mathrm{lb}$ (Weight of steel plate)

$q_{steel} := \dfrac{\mathbf{W}_{steel}}{\mathbf{A}} \qquad q_{steel} = 121.75\,\mathrm{lb\,ft}^{-2}$ (Distributed dead load due to weight of steel plate)

$q_{liveload} \quad 50\dfrac{\mathbf{lb}}{\mathbf{ft}^2} \qquad q_{liveload} := .35\dfrac{\mathbf{lb}}{\mathbf{in}^2} \qquad q_{total} := q_{steel} + q_{liveload}$

$q_{total} = 172.15\,\mathrm{lb\,ft}^{-2}$

$$\mathbf{adivb} := \begin{pmatrix} .5 \\ .667 \\ 1.0 \\ 1.5 \\ 2.0 \\ 4.0 \end{pmatrix} \qquad \beta := \begin{pmatrix} .36 \\ .45 \\ .67 \\ .77 \\ .79 \\ .80 \end{pmatrix} \qquad \alpha := \begin{pmatrix} .080 \\ .106 \\ .140 \\ .160 \\ .165 \\ .167 \end{pmatrix}$$

From Roark,Ed. 6, Table 26, Case 2a, Pg.461

Use curve fitting to determine β:

$\mathbf{fit} := \mathbf{cspline}(\mathbf{adivb}, \beta) \qquad \beta := \mathbf{interp}\left(\mathbf{fit}, \mathbf{adivb}, \beta, \dfrac{\mathbf{a}}{\mathbf{b}}\right) \qquad \beta = 0.68$

Calculate maximum stress and safety factor:

$\sigma_{max} := \dfrac{\beta\cdot q_{total}\cdot\mathbf{b}^2}{{t_{steel}}^2} \qquad \sigma_{max} = 1.199\times 10^5\,\mathrm{lb\,ft}^{-2} \qquad \sigma_{yield} := 36000\mathbf{lb}\cdot\mathbf{in}^{-2}$ (ASTM A36)

$\mathbf{SF} := \dfrac{\sigma_{yield}}{\sigma_{max}} \qquad \mathbf{SF} = 43.233$ <u>SFmin=5, SF>SFMIN, O.K</u>.

Originator: *[signature]* Date: 5/23/00 Checked by: *[signature]* Date: 5/30/00
Omar Jaka D. K. DeFord

Calculate maximum deflection and safety factor:

Use curve fitting to determine α:

$\mathbf{fit} := \mathbf{cspline}(\mathbf{adivb}, \alpha)$ $\alpha := \mathbf{interp}\left(\mathbf{fit}, \mathbf{adivb}, \alpha, \frac{\mathbf{a}}{\mathbf{b}}\right)$ $\alpha = 0.141$

$\mathbf{t_{steel}} := 3\mathbf{in}$

UBC section 1608, table 16-D deflection not to exceed L/360: (L=Length of span)

$\mathbf{y_{allow}} := \frac{\mathbf{b}}{360}$ $\frac{98}{360} = 0.272$

$\mathbf{y_{allow}} := \mathbf{.272in}$

$\mathbf{y_{max}} := \frac{-\alpha \cdot \mathbf{q_{total}} \cdot \mathbf{b}^4}{\mathbf{E} \cdot \mathbf{t_{steel}}^3}$ $\mathbf{y_{max}} = -0.018\,\mathbf{in}$ **<u><<0.272in, O.K.</u>**

$\mathbf{SF} := \frac{\mathbf{y_{allow}}}{\mathbf{y_{max}}}$

$\mathbf{SF} = -14.829$ Good

Originator: m. Omar Jaka Date: 5/23/00 Checked by: D. DeFord Date: 5/30/00

Omar Jaka D. K. DeFord

ANALYTICAL CALCULATIONS

Subject: CALCS FOR SX-105 COVER PLATE

Originator: OMAR JAKA Date: 5/30/00

Checker: D. Def... Date: 5/30/00

CHECK 3/8"Φ HOIST RING FOR OGT COVER

WT. OF TEMPORARY COVER FOR OGT = 12×17.5×3 +

(12×17.5×3) + (12×18×3) =

630 + 648 = 1278 CU. IN

= 0.739 CU. FT.

(REF. TO McMASTER-CARR CATALOG FOR 3/8"Φ HOIST RING 3052T56 CAPACITY 1000 #)

WT. = 0.739 × 490 = 363# < 1000# CAPACITY ∴ O.K.

CHECK FOR 1"Φ HOIST RINGS FOR PLATE (4 USED)

McMaster-CARR 3052T67 CAPACITY 10,000# EACH

TOTAL WT. OF PLATES = 8 × 8.16 × 3/12 × 490 + 1.25×(5+2.2)×3/12×490

= 9099# << 4×10,000#

<< 40,000 ∴ O.K.

DOME LOAD CHECK:

WT. OF CONC. BLOCK REMOVED = (6'-5 1/2" × 7'-1 3/4" × 1'-3") 150

= 6.458 × 7.146 × 1.25 × 150

= 8653#

WT. OF CONC. BLOCK REMOVED = 8653# > WT. OF STEEL PLATE

HENCE THERE IS NO ADDITIONAL LOAD ON THE DOME

∴ O.K.

APPENDIX H

STRUCTURAL CALCULATIONS
241-S-A

Determine factors of safety for 241-S-A valve pit cover plate design (ECN-659207) with respect to maximum allowable deflection and bending stress:

ASSUMPTIONS -
Neglect plate penetrations (largest penetration 20"x22")<< plate width)
Plate is simply supported on three edges, one edge free (worst case). Plate is uniformly loaded over entire plate with 50 lbs/sft.

$\mathbf{a} := 142.00\mathbf{in}$ (Width of plate) $\mathbf{b} := 96.00\mathbf{in}$ (Length of plate - free side)

$\mathbf{t_{steel}} := 3\mathbf{in}$ (Thickness of plate, The worst case)

$\mathbf{A} := \mathbf{a}\cdot\mathbf{b}$ $\mathbf{A} = 1.363 \times 10^4 \mathbf{in}^2$ (Area of plate)

$\mathbf{V_{steel}} := \mathbf{a}\cdot\mathbf{b}\cdot\mathbf{t_{steel}}$ $\mathbf{V_{steel}} = 4.09 \times 10^4 \mathbf{in}^3$ (Volume of plate)

$\rho_{steel} := 487 \frac{\mathbf{lb}}{\mathbf{ft}^3}$ (Density of ASTM A36 steel) $\mathbf{E} := 29\cdot 10^6 \mathbf{lb}\cdot\mathbf{in}^{-2}$ (Modulus of elasticity, ASTM A36 steel)

$\mathbf{W_{steel}} := \rho_{steel}\cdot\mathbf{V_{steel}}$ $\mathbf{W_{steel}} = 1.153 \times 10^4 \text{ lb}$ (Weight of steel plate)

$q_{steel} := \frac{\mathbf{W_{steel}}}{\mathbf{A}}$ $q_{steel} = 0.845 \mathbf{lb}\cdot\mathbf{in}^{-2}$ (Distributed dead load due to weight of steel plate)

$q_{liveload}$ $50 \frac{\mathbf{lb}}{\mathbf{ft}^2}$ $q_{liveload} := .35 \frac{\mathbf{lb}}{\mathbf{in}^2}$ $q_{total} := q_{steel} + q_{liveload}$

$q_{total} = 172.15 \text{ lb ft}^{-2}$

$$\mathbf{adivb} := \begin{pmatrix} .5 \\ .667 \\ 1.0 \\ 1.5 \\ 2.0 \\ 4.0 \end{pmatrix} \quad \beta := \begin{pmatrix} .36 \\ .45 \\ .67 \\ .77 \\ .79 \\ .80 \end{pmatrix} \quad \alpha := \begin{pmatrix} .080 \\ .106 \\ .140 \\ .160 \\ .165 \\ .167 \end{pmatrix}$$

From Roark,Ed. 6, Table 26, Case 2a, Pg.461

Use curve fitting to determine β:

$\mathbf{fit} := \mathbf{cspline}(\mathbf{adivb}, \beta)$ $\beta := \mathbf{interp}\left(\mathbf{fit}, \mathbf{adivb}, \beta, \frac{\mathbf{a}}{\mathbf{b}}\right)$ $\beta = 0.769$

Calculate maximum stress and safety factor:

$\sigma_{max} := \frac{\beta\cdot q_{total}\cdot \mathbf{b}^2}{\mathbf{t_{steel}}^2}$ $\sigma_{max} = 1.356 \times 10^5 \text{ lb ft}^{-2}$ $\sigma_{yield} := 36000\mathbf{lb}\cdot\mathbf{in}^{-2}$ (ASTM A36)

$\mathbf{SF} := \frac{\sigma_{yield}}{\sigma_{max}}$ $\mathbf{SF} = 38.237$ <u>SFmin=5, SF>SFMIN, O.K</u>.

Originator: M. Omar Jaka Date: 5/21/00 Checked by: D. DeFord Date: 6/8/00
Omar Jaka Doug DeFord

Calculate maximum deflection and safety factor using 3" thick plate.

Use curve fitting to determine α:

$\mathbf{fit} := \mathbf{cspline}(\mathbf{adivb}, \alpha)$ $\alpha := \mathbf{interp}\left(\mathbf{fit}, \mathbf{adivb}, \alpha, \frac{\mathbf{a}}{\mathbf{b}}\right)$ $\alpha = 0.16$

$t_{steel} := 3\,\mathbf{in}$

UBC section 1608, table 16-D deflection not to exceed L/360: (L=Length of span)

$y_{allow} := \frac{L}{360}$ $\frac{142}{360} = 0.394$

$y_{allow} := -.394\,\mathbf{in}$

$y_{max} := \frac{-\alpha \cdot q_{total} \cdot b^4}{E \cdot t_{steel}^3}$ $y_{max} = -0.021\,\mathbf{in}$ **<u><<0.394 in, O.K.</u>**

$SF := \frac{y_{allow}}{y_{max}}$

$SF = 19.038$ **<u>O.K.</u>**

Originator:______________ Date:______ Checked by: D. DeFord Date: 6/8/00

Omar Jaka Doug DeFord

ANALYTICAL CALCULATIONS

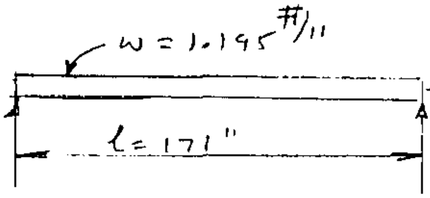
Subject: DESIGN OF 3" COVER PLATE FOR 241-S-A VALVE PIT

Originator: OMAR JAKA Date: 6/12/00

Checker: [signature] Date: 6/8/00

ALTERNATE CALCULATIONS:

PLATE IS 3" X 11'-10" X 8'-0"



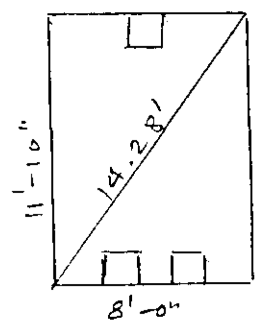
ASSUMPTIONS:

① DUE TO SEVERAL CUTOUT FROM PLATE USE DIAGONAL STRIP FOR ANALYSIS.

② USE LIVE LOAD OF 50 #/□'

MAX. MOMENT — REF. AISC MANUAL 8th EDITION P. 2-114

$$M_{MAX} = \frac{w l^2}{8} = \frac{1.195 \times 171^2}{8} = 4368 \text{ LB-IN}$$



$l = \sqrt{11.83^2 + 8^2} = \sqrt{203.95} = 14.28' = 171''$

BENDING STRESS @ CENTER

$$f_b = \frac{Mc}{I} = \frac{4368 \times 1.5}{6.75} = 971 \text{ PSI}$$

$F_y = 36000$ PSI

BENDING STRESS SAFETY FACTOR:

$$SF = \frac{36000}{971} \boxed{= 37.1} > 5.0 \therefore O.K$$

ω = WT. OF STEEL + LIVE LOAD

$$= 1'' \times 1'' \times 3'' \times \frac{490 \#/FT^3}{12^3} + \frac{50}{12^2} \#/□'$$

$$= 3 \times \frac{490}{12^3} + \frac{50}{12^2}$$

$$= 0.851 + 0.344 = 1.195 \#/"$$

TO CALCULATE I & C

1" × 3" = d

$$c = \frac{d}{2} = \frac{3}{2} = 1.5''$$

$$I = \frac{d^4}{12} = \frac{3^4}{12} = 6.75 \text{ IN}^4$$

DEFLECTION SAFETY FACTOR (S.F):

MAX. DEFLEC @ CENTER — REF. AISC MANUAL 8TH. EDITION P. 2-114

$$\Delta_{MAX} = \frac{5 w l^4}{384 E I} = \frac{5 \times 1.195 \times 171^4}{384 \times 29000 \times 10^3 \times 6.75} = 0.068''$$

E = MODULUS OF ELASTICITY = 29000 KSI FOR STEEL

I = MOMENT OF INERTIA (IN^4)

$$\Delta_{ALLOW} = \frac{l}{360} = \frac{171}{360} = 0.475$$

(FROM UBC, SEC. 1608 TABLE 16-D)

l = SPAN LENGTH

$$S.F. = \frac{\Delta_{ALLOW}}{\Delta_{ACTUAL}} = \frac{0.475}{0.068} \boxed{= 7.0} > 1.0 \therefore O.K.$$

APPENDIX I

STRUCTURAL CALCULATIONS
241-S-C

ANALYTICAL CALCULATIONS

Page 1 of 4

Subject DESIGN OF 3" COVER PLATE FOR 241-S-C VALVE PIT

Originator OMAR JAKA Date 6/6/00

Checker Doug Deford Date 6/7/00

REF. DWG. H-2-46153

REPLACING WEST CORR. COVER BLOCK BY 3" COVER PLATE AS SHOWN IN ECN 659208

3" COVER PLATE (11'-10" x 8'-0") WITH PENETRATIONS AS SHOWN ON PAGE 4 OF 8 OF ECN 659208.

PLATE HAS BEEN ANALYZED BY COSMOS'GEOSTAR 2.5 AND ON 6/5/00 AND RESULTS FOR STRESS AND DEFLECTIONS ARE SHOWN ON PAGE 3 & 4

CHECK FACTORS OF SAFETY FOR STRESS AND DEFLECTION

STRESS SAFETY FACTOR: REFER TO SHEET # 3 OF 4
PLATE IS $F_y = 36$ KSI $= \sigma_{YIELD}$

ACTUAL MAX STRESS $\sigma_{MAX} = 3000$ PSI

$$S.F. = \frac{\sigma_{YIELD}}{\sigma_{MAX}} = \frac{36000}{3000} = \boxed{12} > 5 \quad \therefore \text{O.K.}$$

DEFLECTION SAFETY FACTOR: REFER TO SHEET # 4 OF 4

ALLOW. DEFLECTION $= \frac{\ell}{360}$ (UBC, Section 1608 TABLE 16-D)
ℓ = span length

$$\Delta_{ALLOW} = \frac{\ell}{360} = \frac{142}{360} = 0.394''$$

$$\Delta_{ACTUAL} = 0.048''$$

$$S.F. = \frac{\Delta_{ALLOW}}{\Delta_{ACTUAL}} = \frac{0.394}{0.048} = 8.2 > 1.0 \quad \therefore \text{O.K.}$$

ANALYTICAL CALCULATIONS

Page 2 of 4

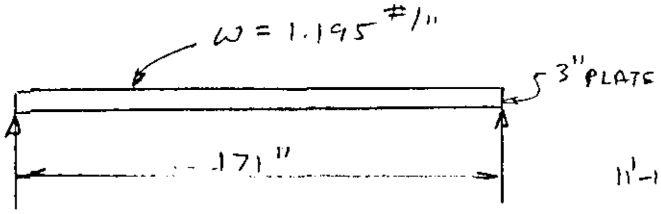
Subject: DESIGN OF 3" COVER PLATE FOR 241-S-C VALVE PIT

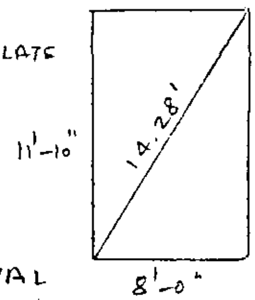
Originator: OMAR JAKA Date: 6/6/00

Checker: Doug [signature] Date: 6/7/00

ALTERATE CALCULATIONS:

PLATE IS 11'-0" x 8'-0"





ASSUMPTION:
DUE TO SEVERAL CUTOUT IN THE PLATE, USE DIAGONAL STRIP FOR SPANING

$L = \sqrt{11.83^2 + 8^2}$
$= \sqrt{203.95'}$
$= 14.28' = 171"$

MAXIMUM MOMENT

REF. AISC MANUAL 8TH. EDITION P. 2-114

$M_{max} = \frac{w \ell^2}{8}$

$= \frac{1.195 \times 171^2}{8}$

$= 4368$ lb-in

$w =$ WT. OF STEEL + LIVE LOAD

$= 1" \times 1" \times 3" \times 490 \#/FT^3 + 50 \#/\square'$

$= \frac{3 \times 490}{12^3} + \frac{50}{12^2}$

$= 0.851 + 0.344$

$= 1.195 \#/"$

BENDING MOMENT @ CENTER

$f_b = \frac{Mc}{I} = \frac{4368 \times 1.5}{6.75}$

$= 971$ PSI

$F_y = 36000$ PSI

TO CALCULATE I (1" x 3" = d)

$c = \frac{d}{2} = \frac{3}{2} = 1.5"$

$I = \frac{d^4}{12} = \frac{3^4}{12} = 6.75 \, IN^4$

STRESS $SF = \frac{36000}{971}$ **= 37.1** > 5 ∴ O.K (TOO HIGH COMPARED TO COMPUTER RESULT)

DEFLECTION SAFETY FACTOR (SF):

MAX DEFLECTION AT CENTER $\Delta_{MAX} = \frac{5 w \ell^4}{384 EI} = \frac{5 \times 1.195 \times 171^4}{384 \times 29000 \times 10^3 \times 6.75}$

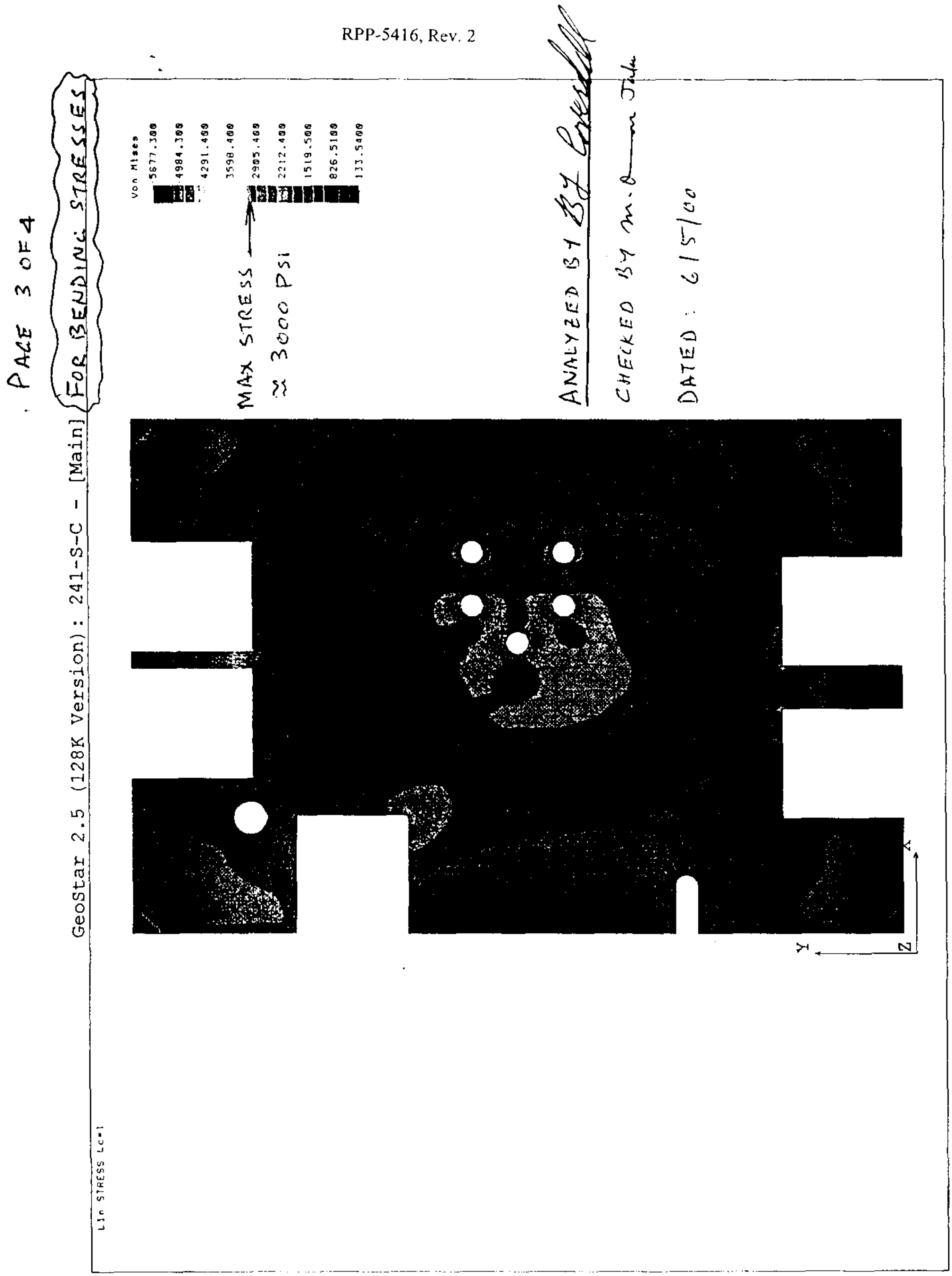
$E = 29000$ KSI

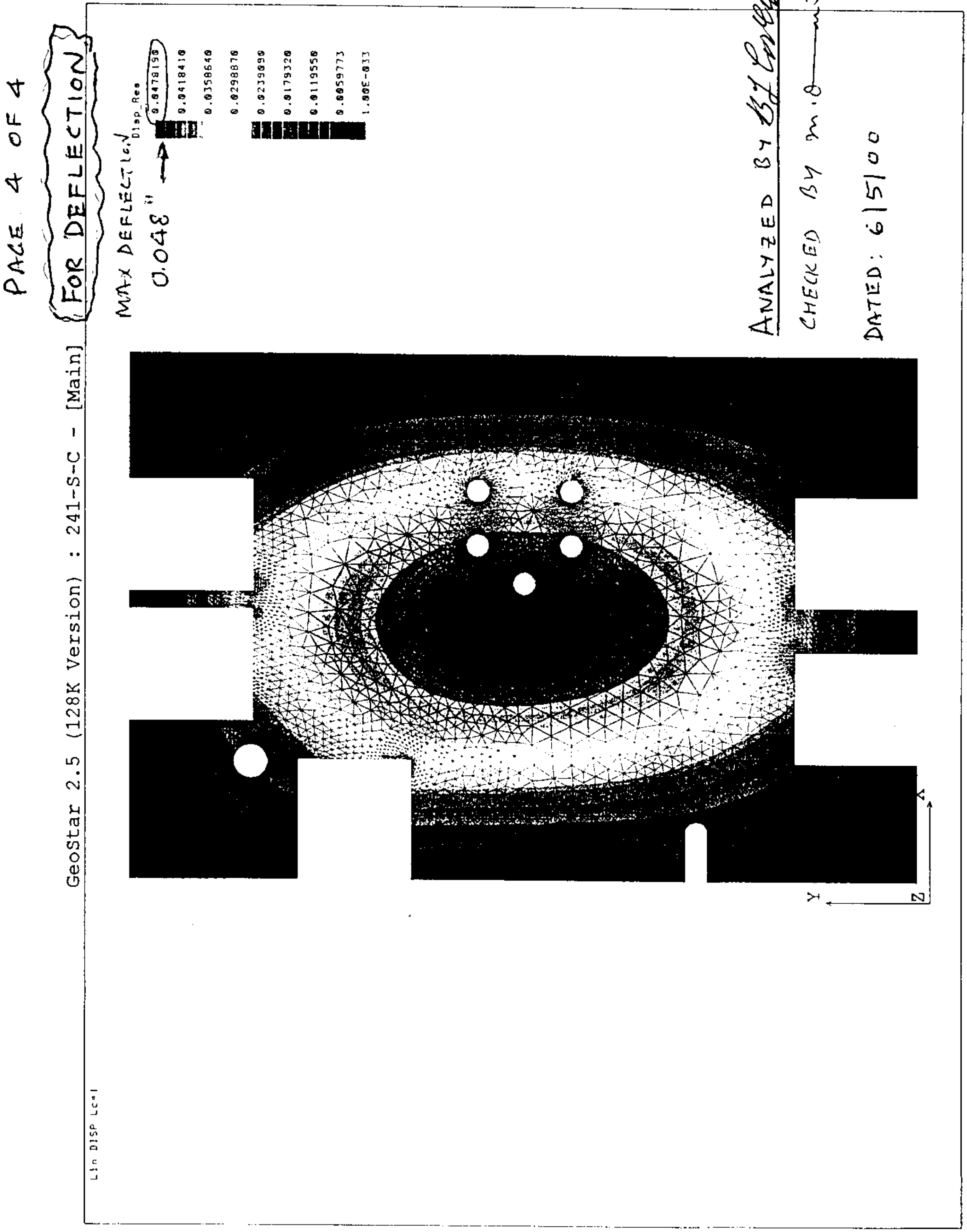
$= 0.068"$

$\Delta_{ALLOW} = \frac{\ell}{360} = \frac{171}{360} = 0.475"$

$SF = \frac{0.475}{0.068} = 7.0 > 1.0$ ∴ O.K. (CLOSE TO COMPUTER RESULT)

USE SAFETY FACTOR ANALYZED BY COMPUTER PROGRAM


PAGE 3 OF 4
FOR BENDING STRESSES
GeoStar 2.5 (128K Version): 241-S-C - [Main]
Von Mises
5677.300
4984.300
4291.400
3598.400
2905.400
2212.400
1519.500
826.5100
133.5400
MAX STRESS
≈ 3000 PSI
ANALYZED BY
CHECKED BY
DATED: 6/5/00
Lin STRESS Lc=1
X
Y
Z


PAGE 4 OF 4
FOR DEFLECTION
MAX DEFLECTION
0.048"
GeoStar 2.5 (128K Version) : 241-S-C - [Main]
Disp_Res
0.0478190
0.0418410
0.0358640
0.0298870
0.0239090
0.0179320
0.0119550
0.0059773
1.00E-033
Lin DISP Lc=1
ANALYZED BY
CHECKED BY
DATED: 6/5/00

APPENDIX J

STRUCTURAL CALCULATIONS
241-SX-A

ANALYTICAL CALCULATIONS

Subject: DESIGN OF 3" COVER PLATE FOR 241-SX-A VALVE PIT

Originator: OMAR JAKA Date: 6/6/00

Checker: Doug Deford Date: 6/7/00

REPLACING WEST CONCRETE COVER BLOCK BY 3" THK. STEEL COVER PLATE AS SHOWN IN ECN 659209

3" COVER PLATE (11'-10" x 8'-0") WITH PENETRATION AS SHOWN ON PAGE 4 OF 8 OF ECN 659209

PLATE HAS BEEN ANALYZED COSMOS "GEOSTAR 2.5" COMPUTER PROGRAM ON 6/5/00, RESULTS FOR STRESSES AND DEFLECTION ARE ATTACHED AS PAGE 3 & 4.

CHECK FACTORS OF SAFETY FOR STRESS AND DEFLECTION

STRESS SAFETY FACTOR:

REFER TO PAGE 3 OF 4

PLATE IS $F_y = 36$ KSI $= \sigma_{YIELD}$

ACTUAL MAX STRESS $= \sigma_{MAX} = 3000$ PSI

$$S.F. = \frac{\sigma_{YIELD}}{\sigma_{MAX}} = \frac{36000}{3000} = 12 > 5 \therefore O.K.$$

DEFLECTION SAFETY FACTOR:

REFER TO PAGE 4 OF 4

ALLOW DEFLECTION $= \frac{\ell}{360}$ (UBC, SECTION 1608 TABLE 16-D)

ℓ = SPAN LENGTH

$$Y_{ALLOW} = \frac{\ell}{360} = \frac{142}{360} = 0.394"$$

$$Y_{ACTUAL} = 0.05"$$

$$S.F. = \frac{Y_{ALLOW}}{Y_{ACTUAL}} = \frac{0.394}{0.05}$$

$$= 7.88 > 1.0 \therefore O.K$$

$1-8\frac{3}{8} \times 1-10\frac{1}{4}$

1.698×1.854

CUTOUT

WT. OF PLATE $= 11.83 \times 8 \times 3/12 \times 490 = 11593^{\#} - 5 \times 1.698 \times 1.854 \times 3/12 \times 490$

$11593 - 1928$

EACH CUTOUT $= 1928/5 = 386^{\#} < 1000 \therefore O.K.$ $= 9669^{\#} < 4 \times 10000$ O.K

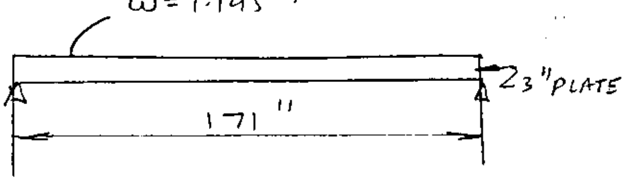
ANALYTICAL CALCULATIONS

Page 2 of 4

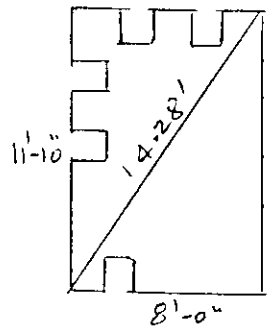
Subject: DESIGN OF 3" COVER PLATE FOR 241-SX-A VALVE PIT
Originator: OMAR JAKA Date: 6/6/00
Checker: Doug Deffd Date: 6/7/00

ALTERNATE CALCULATIONS:

PLATE IS 11'-10" x 8'-0"



ASSUMPTION: ① DUE TO SEVERAL CUTOUT IN THE PLATE, USE DIAGONAL STRIP FOR SPAN
② USE LIVE LOAD OF 50 #/□'



$\ell = \sqrt{11.83^2 + 8^2}$

$= \sqrt{203.95}$

$= 14.28' \simeq 171"$

MAX. MOMENT AISC MANUAL 8 th. EDITION P. 2-114

$M_{AX} = \frac{w\ell^2}{8}$

$= \frac{1.195 \times 171^2}{8}$

$= 4368$ lb-IN

w = WT. OF STEEL + LIVE LOADS

$= 1" \times 1" \times 3" \times \frac{490 \text{ #/ft}^3}{12^3} + \frac{50 \text{ #/□'}}{12^2}$

$= 3 \times \frac{490}{12^3} + \frac{50}{12^2}$

$= 0.851 + 0.344 = 1.195$ #/IN

BENDING MOMENT @ CENTER:

$f_b = \frac{Mc}{I} = \frac{4368 \times 1.5}{6.75}$

$= 971$ PSI

$F_y = 36000$ PSI

TO CALCULATE I & C

1" □ d = 3" $c = \frac{d}{2} = \frac{3}{2} = 1.5"$

$I = \frac{d^4}{12} = \frac{3^4}{12} = 6.75 \text{ IN}^4$

BENDIN STRESS SAFETY FACTOR:

$SF = \frac{36000}{971}$ **= 37.1** > 5 ∴ O.K

(TOO HIGH COMPARED TO COMPUTER VALUE)

DEFLECTION SAFETY FACTOR:

E = 29000 KSI = 29000x10³ PSI

MAX. DEFLECTION @ CENTER $\Delta_{MAX} = \frac{5w\ell^4}{384EI}$ AISC MANUAL P. 2-114

$= \frac{5 \times 1.195 \times 171^4}{384 \times 29000 \times 1000 \times 6.75}$

$= 0.068"$

$\Delta_{ALLOW} = \frac{\ell}{360} = \frac{171}{360} = 0.475"$

$S.F. = \frac{0.475}{0.068}$ **= 7.0** > 1.0 ∴ O.K (COMPARABLE TO COMPUTER VALUE)

∴ USE SAFETY FACTOR ANALYZED BY COMPUTER PROGRAM

BD-6400-060.1 (07/93)

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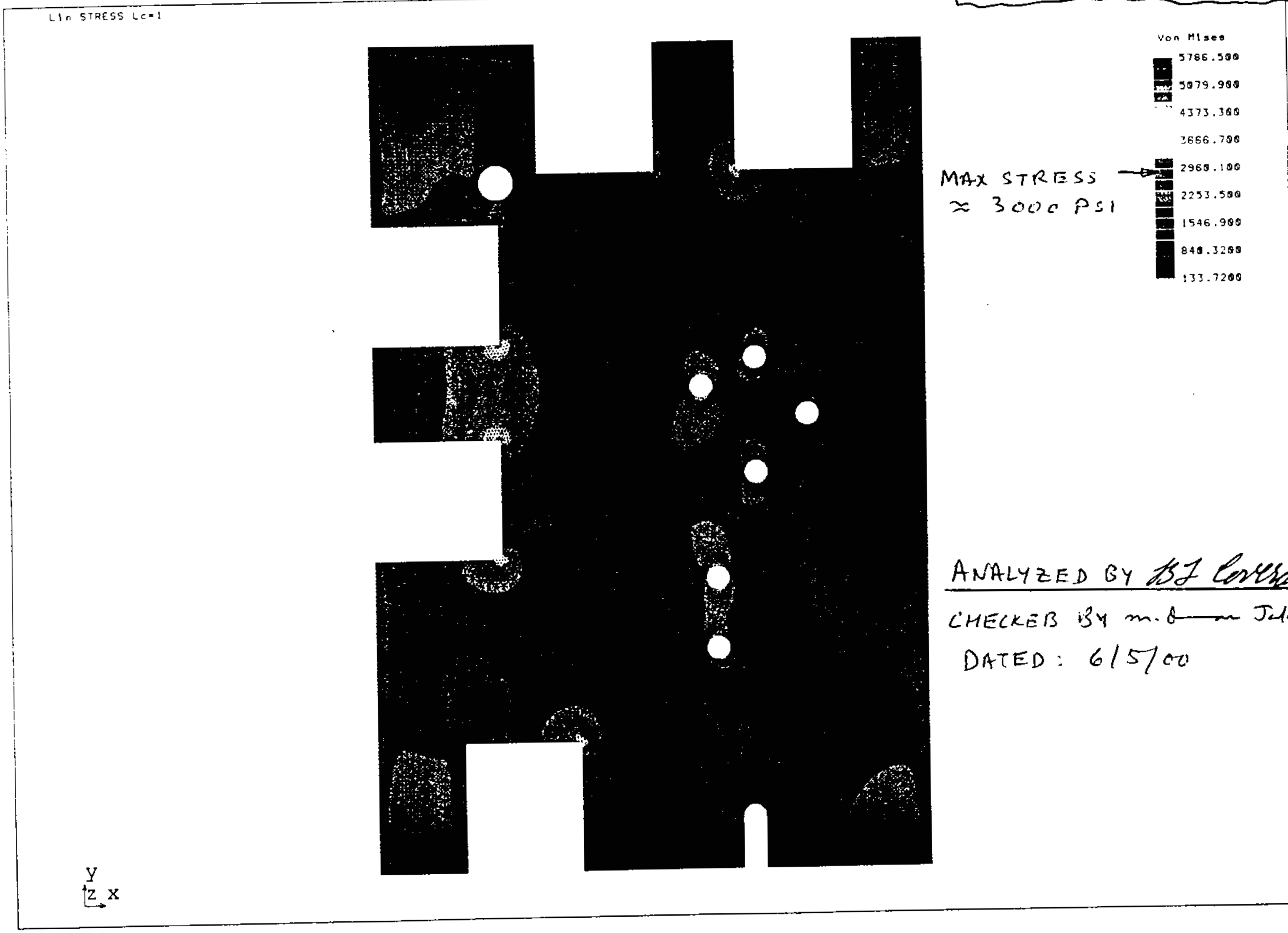
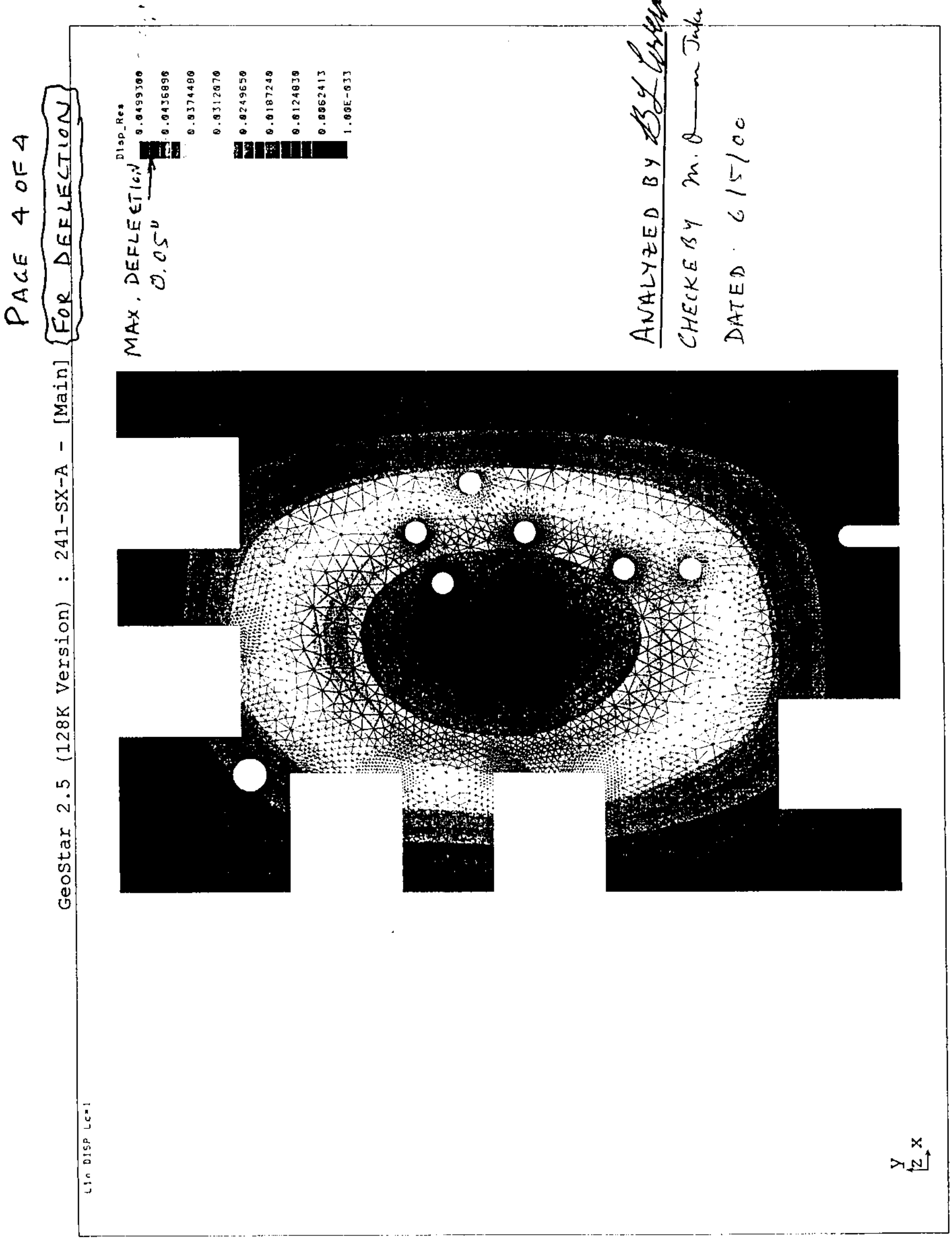
GeoStar 2.5 (128K Version): 241-SX-A - [Main]

FOR BENDING STRESSES

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FOR DEFLECTION
GeoStar 2.5 (128K Version) : 241-SX-A - [Main]
MAX. DEFLECTION
0.05"
Disp_Res
0.0499300
0.0436890
0.0374400
0.0312070
0.0249650
0.0187240
0.0124830
0.0062413
1.00E-033
ANALYZED BY
CHECKED BY
DATED 6/15/00
Lin DISP Lc=1
Y
Z
X