

**10 MWe Solar Thermal  
Central Receiver Pilot Plant  
Solar Facilities Design Integration**

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**PSS FINAL DESIGN CALCULATIONS  
BOOK 2 OF 26--WAREHOUSE  
CONSTRUCTION PACKAGE 3 (RADL ITEM 7-8)**

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**September 1980**

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**PREPARED FOR THE  
U.S. DEPARTMENT OF ENERGY  
SOLAR ENERGY  
UNDER CONTRACT DE-AC-03-79SF10499**

## PREFACE

This document is provided by McDonnell Douglas Astronautics Company (MDAC) in accordance with Department of Energy Contract Number DE-AC03-79SF10499, Reports and Deliverables List (RADL Item 7-8). The report was prepared by Stearns-Roger Engineering Corporation under MDAC Subcontract Number 78012035.

The Plant Support Subsystem Final Design Calculations (RADL Item 7-8) are arranged in a twenty-six book volume as shown on the master Table of Contents.

Book 2 of this document is provided in support of the Warehouse, Construction Package No. 3. These calculations include the interrupting rating (short circuit study), lighting, and foundation design for the pre-fabricated metal building.

Questions concerning this report should be directed to R.J. Perkins at (714) 896-3073.

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DESIGN CALCULATIONS (RADL ITEM 7-8)

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BOOK 4 - RECEIVER TOWER  
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Note: This document includes design calculation for the receiver tower steel (Construction Package 5A) which was previously submitted by MDAC letter A3-228-EP-RJP-46, dated 16 January 1980, and therefore, is not included in this submittal. Please transfer your copy to your RADL ITEM 7-8 file, marking it as BOOK 4 of 25.

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| Line CO-3 | TSS Heater Drain (4"-CO-3-KBA)  | --   |
| Line CO-4 | TSS Heater Drain (4"-CO-4-KBA)  | --   |
| Line CO-5 | TSS Flash Tank Drain EPGS<br>(4"-CO-5-BBA)  | --   |
| Line CO-6 | R.S. Panel Condensate Drain<br>(3" & 1-1/2"-CO-6-BBA)                                   | --   |

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|            | BOOK 13 - RECEIVER FEEDWATER<br>PIPING, CONSTRUCTION<br>PACKAGE 9  |
| Line FW-1  | Receiver Feedwater to Internal<br>Anchor (4"-FW-2-MBA) <span style="float: right;">--</span>                               |
| Line FW-2  | Receiver Feedwater to Heater and<br>Interface 2I (4"-FW-2-MBA & 2-1/2"-<br>FW-9-MBA) <span style="float: right;">--</span> |
|            | BOOK 14 - MAIN STEAM PIPING,<br>CONSTRUCTION PACKAGE 9   |
| Line MS-1  | Main Steam - Receiver to Internal<br>Anchors (6"-MS-2, 3-QEB) <span style="float: right;">--</span>                        |
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|            | BOOK 15 - MAIN STEAM PIPING,<br>CONSTRUCTION PACKAGE 9   |
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| Line MS-4  | Main Steam - Internal Anchor to<br>Condenser (10"-MS-7-FEA) <span style="float: right;">--</span>                          |
| Line MS-5  | Main Steam - TSS Exchanger Branch<br>(8"-MS-4-KBA) <span style="float: right;">--</span>                                   |
|            | BOOK 16 - STEAM PIPING,<br>CONSTRUCTION PACKAGE 9  |
| Line ST-5  | Admission Steam (ST-5, 6 & 8-FBA) <span style="float: right;">--</span>  |
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| Line TO-4  | TSS Oil Charging System Feed<br>(8"-TO-4-BBA)                              | --   |
| Line TO-5  | TSS Oil Charging System Feed<br>(8"-TO-5-BBA)                              | --   |
| Line TO-12 | TSS Oil - Extraction System Feed<br>(8"-TO-12-BBA)                         | --   |
|            | BOOK 18 - THERMAL OIL PIPING,<br>CONSTRUCTION PACKAGE 9                    |      |
| Line TO-13 | TSS Oil - Extraction System Feed<br>(8"-TO-13-BBA)                         | --   |
| Line TO-22 | TSS Oil Charging System<br>(TO-22, 23 & 24)                                | --   |
|            | BOOK 19 - THERMAL OIL PIPING,<br>CONSTRUCTION PACKAGE 9                    |      |
| Line TO-10 | TSU Oil Extraction and Charging<br>(TO-3,9,10,11,21-BBA)                   | --   |
|            | BOOK 20 - THERMAL OIL PIPING,<br>CONSTRUCTION PACKAGE 9                    |      |
| --         | TSU Oil Extraction and Charging  | --   |
|            | BOOK 21 - VENT LINE PIPING,<br>CONSTRUCTION PACKAGE 9                      |      |
| Line VT-1  | Receiver Flash Tank Vent Line<br>(4", 2-1/2", 10"-VT-1, 12,11-KEB,<br>FEA) | --   |

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|           | BOOK 22 - PSS CALORIA MAKEUP<br>TANK, CONSTRUCTION PACKAGE 10     |          |
| 1         | Sizing of Vent  | 1 thru 4 |
| SHT P25-4 | Caloria Makeup Tank Drawing                                       | --       |
|           | BOOK 23 - PSS FIELD ERECTED<br>TANKS, CONSTRUCTION<br>PACKAGE 10A |          |
| SHT P25-1 | Demineralized Water Tank<br>Drawing                               | --       |
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ITEM

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BOOK 25 - COLLECTOR FIELD  
ELECTRICAL, CONSTRUCTION  
PACKAGE 11A

Note: This document was previously submitted by MDAC Letter A3-228-EP-RJP-262, dated 7 March 1980 and therefore is not included in this submittal. Please transfer your copy to your RADL ITEM 7-8 file, marking it as BOOK 25 of 25.

BOOK-26-MDAC GENERAL ANALYSIS AND  
BACKGROUND DATA

- 1 Plant Process and Preliminary Component Requirements
- 2 Receiver Subsystem Calculations
- 3 Thermal Storage Subsystems Calculations
- 4 Analysis of Plant Cost Reduction Options
- 5 Collector Field Design and Plant Power Calculations
- 6 Miscellaneous Plant Calculations

# Stearns-Roger

REV 1.114  
REV 1.1

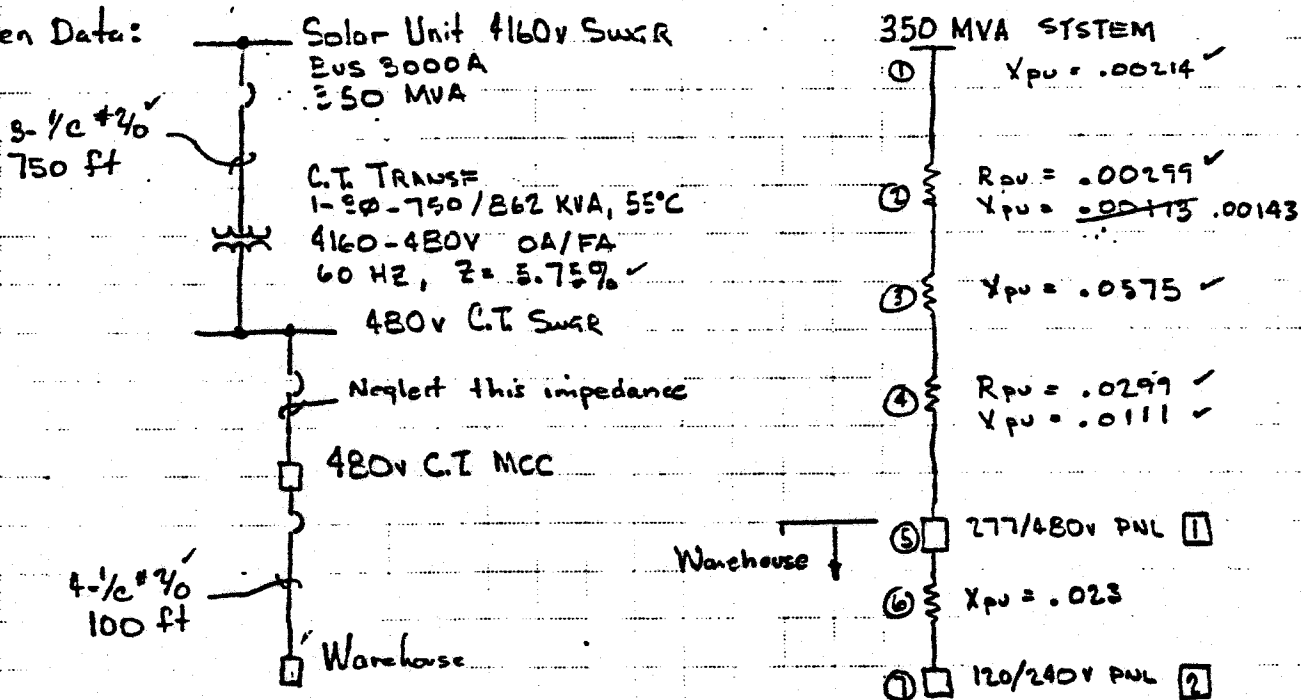
PAGE 1

JOB NO. C21700 - DATE June 29, 1979 - BY P. Negala - CHK. JRD 7/7/79  
 CUSTOMER MDAC - PROJECT BARSTOW - SOLAR 10MW PILOT  
 SUBJECT WAREHOUSE INTERRUPTING RATING (SHORT-CIRCUIT STUDY)

Objective: Find Interrupting Rating of W.H. Panelboards

Result: Fault at Warehouse  $\square$  277/480V PNL: <sup>11,390</sup> 11,418.6 AMP  
 $\square$  120/240V PNL: 1,493 AMP

Given Data:



Calculations: (Used 750 kva for Base kva - Transformer)

① 350 MVA System (This is the interrupting rating of the 4160 v SWGR)

$$Z_{pu} = \frac{\text{BASE KVA}}{\text{Rated KVA}} = \frac{750 \text{ KVA}}{350,000 \text{ KVA}} = .00214$$

② 4160 v Cable (40 AWG, 5kv, 750' LENGTH, installed in non-magnetic duct)

$$R = \left( \frac{.092 \Omega}{1000'} \right) (750') = .069 \Omega$$

$$X = \left( \frac{.0228 \Omega}{1000'} \right) (750') = .0171 \Omega$$

$$R_{pu} = \frac{(.069) (750 \text{ KVA})}{(4.16)^2 (1000)} = .00299$$

$$X_{pu} = \frac{(.0171) (750 \text{ KVA})}{(4.16)^2 (1000)} = .00143$$

① Source: S-2 Standard  
 JF 12.45.07 pg. 6

② Source: S-2 Standard  
 JF 12.45.07 pg. 7

JOB NO. C21700 DATE June 29, 1979 BY P. Negale CHK. JRD 7/2/79  
 CUSTOMER MDAC PROJECT Barstow - Solar 10mw Pilot  
 SUBJECT WAREHOUSE INTERRUPTING RATINGS (SHORT-CIRCUIT STUDY)

Calculation (cont'd)

③ 4160-480V TRANSF (Z = 5.75%) ✓

$Z_{pu} = .0575$

④ 480V CABLE (70 AWG, 600V, 100' LENGTH, installed in non-magnetic conduit)

①  $R_c = \left( \frac{.092 \Omega}{1000} \right) (100') = .0092 \Omega$  ✓

① Source: SR Standard  
JF 12.45.07 page 6

②  $X_c = \left( \frac{.034 \Omega}{1000} \right) (100') = .0034 \Omega$  ✓

$R_{pu} = \frac{(.0092 \Omega) (750)}{(480)^2 (1000')} = .0299$  ✓

$X_{pu} = \frac{(.0034 \Omega) (750)}{(480)^2 (1000')} = .0111$  ✓

⑤ 277/480V PANEL FAULT II  
 Total  $R_{pu} = .03289$  Total  $X_{pu} = .07187$  .0722

$Z_{pu} = \sqrt{X_{pu}^2 + R_{pu}^2} = \sqrt{.07187^2 + .03289^2}$   
 $Z_{pu} = \frac{.07903829}{.0793}$

$\frac{750 \text{ KVA (BASE)}}{.0793} = \frac{9458}{9481.67} \text{ KVA}$

$\frac{9458}{9482} \text{ KVA} = 11,390$   
 $(.73) .480 \text{ KV} = 11,418.6 \text{ AMP}$

JOB NO. C21700 DATE June 29, 1979 BY P. Negale CHK JRD 7/2/79  
 CUSTOMER MDAC PROJECT Barstow - Solar 10 MW Pilot  
 SUBJECT WAREHOUSE INTERRUPTING RATING (SHORT-CIRCUIT STUDY)

## Calculations (cont'd)

⑥ 480-120/240V TRANSF(R, X, Z. From Industrial Pwr Sys Handbook, Beeman)

$$R = 1.5\% = .015 \text{ pu (15 KVA base)}$$

$$X = 1.7\% = .017 \text{ pu "}$$

$$Z = 2.3\% = .023 \text{ pu "}$$

$$R_{pu} = (.015 R_{pu}) \left( \frac{750 \text{ KVA}}{15 \text{ KVA}} \right) = .75 \checkmark$$

$$X_{pu} = (.017 X_{pu}) \left( \frac{750 \text{ KVA}}{15 \text{ KVA}} \right) = .85 \checkmark$$

⑦ 120/240V PANEL Fault [2]

$$\text{Total } X_{pu} = .0787 + .85 = .9287$$

$$\text{Total } R_{pu} = .03289 + .75 = .78289 \checkmark$$

$$Z_{pu} = 1.20945 \checkmark$$

$$\frac{750 \text{ KVA}}{1.20945} = 620 \text{ KVA} \checkmark$$

$$\frac{620 \text{ KVA}}{(1.73)(.240 \text{ KV})} = 1493 \text{ AMP} \checkmark$$

LIGHTING CALCULATION SHEET  
LUMEN METHOD

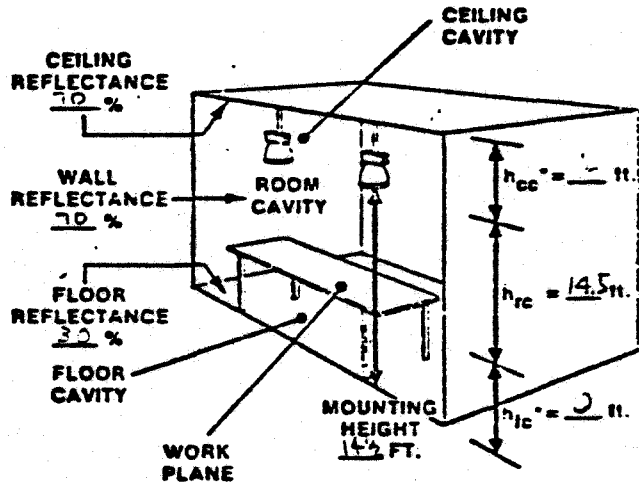
Project BAKETOWN

Job No. C-21700

Date 2-2-79 BY P. NEGALE CHKD J. MADDEN SHEET NO. 1 OF 1

1. ROOM DESIGNATION OFFICE DWG. NO. E19-12
2. ROOM SIZE 12' H 60' W 99' L
3. MOUNTING HEIGHT 14'-6"
4. HEIGHT OF ROOM CAVITY Hrc 14'-6"
5. DESIGN FOOTCANDLE LEVEL 25 fc. C.E. 193 #28

6. EFFECTIVE REFLECTANCES  
JF 12.38.04  
CEILING 70 %  
WALL 70 %  
FLOOR 20 %



7. ROOM CAVITY RATIO  
$$\frac{5 \times h_{rc} (L+W)}{L \times W} = 1.94$$

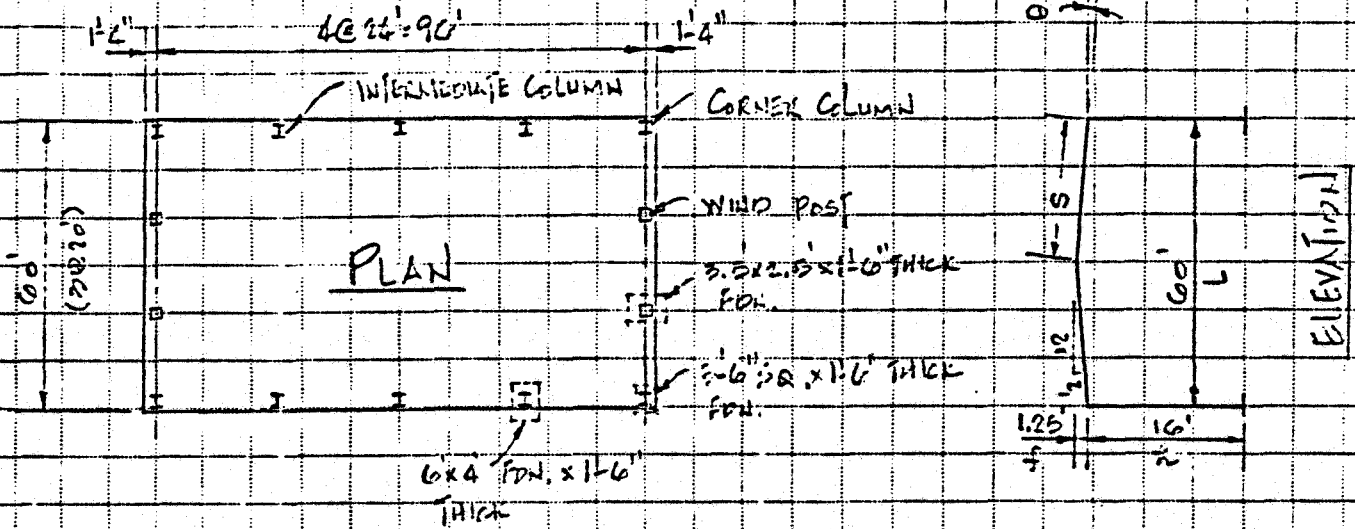
8. FIXTURE TYPE EA (E1-2)  
MFR. 3M CAT. NO. M2402/277  
LAMPS/FIXTURE 2/40 T-12 S/MH 1.4:1  
LUMENS/LAMP 3150 TOTAL LUMENS/FIXTURE 12600

9. LIGHT LOSS FACTOR = (LLF) .70 per JF 12.38.04
10. COEFFICIENT OF UTILIZATION (C.U.) .713
11. NO. OF FIXTURES = DES. fc 25 x area 5940 = 24  
LUMENS/FIXT. 12600 x C.U. .713 x LLF .70

12. ACTUAL fc = LUMENS/FIXT. 12600 x no. of fixt 30 x C.U. .713 x LLF .70  
31.7 area 5940

JOB NO. C-21700 DATE 5-29-79 BY AS. Chang CHK. HJ/M  
 CUSTOMER MIDAC PROJECT SOLAR ONE  
 SUBJECT WAREHOUSE FOUNDATION

SIZE OF BLDG. APPROX. 60' X 100'



LOADING CONDITIONS

ROOF D.L. = 10<sup>#</sup>/10' (ASSUME)  
 ROOF L.L. = 30<sup>#</sup>/10'  
 WIND LOAD = 20<sup>#</sup>/10' (WIND EDGE 25)  
 SEISMIC LOAD (WILL NOT GOVERN)

1. USE S-R STANDARD EJ 14.5.01, 02 & 03 FOR REFERENCE
2. USE "STEEL DESIGN MANUAL" BY BRITISH STEEL PRODUCERS' CONFERENCE PAGE 227

A. INTERMEDIATE COLUMN FOOTING

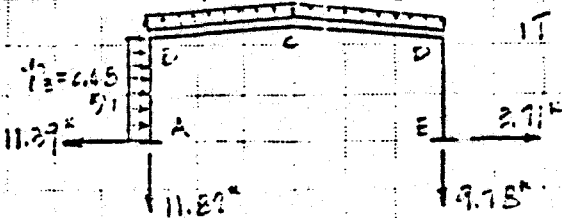
1. WIND LOAD ONLY

STEEL ROOF  
 GLOBE BRIDGE  
 IT IS SMALL

EJ 14.5.03  $\theta = 2.39^\circ$

WINDWARD FACTOR = 0.6 (OUTWARD)

LEEWARD FACTOR = 0.45 (INWARD)



$$P_1 = 0.6 \times 60 \times 1.25 \text{ (EJ 14.5.02)} \times 24 = 2250 \text{ lb}$$

$$P_2 = 0.45 \times 20 \times 1.25 \times 24 = 2700 \text{ lb}$$

(PER DESIGN PURPOSE USE  $P_1 = P_2 = 4800 \text{ lb}$ )

$$P_3 = 20 \times 24 = 480 \text{ lb}$$



JOB NO. C-21700 DATE 5-29-79 BY AS (Hany) CHK HJM  
 CUSTOMER MDAC PROJECT SOLAR ONE  
 SUBJECT WAREHOUSE FOUNDATION

1. WIND LOAD ONLY (CONT.)

ASSUME  $I = \text{CONSTANT}$ ,  $S \approx \frac{1}{2} L = 30'$

$$R = \frac{R}{S} = \frac{16}{30} = 0.533, \quad d = \frac{f}{2} = \frac{1.25}{16} = 0.08$$

$$m = 1 + d = 1.08, \quad P = 2(R + 1) + m = 4.14, \quad C = 1 + 2m = 3.16, \quad N = P + mC = 7.55$$

FOR  $f_1$  &  $f_2$ :

$$M_B = \frac{f_1^2 (3 + 5\pi)}{16N} = \frac{0.30 \times 60^2 (3 + 5 \times 1.08)}{16 \times 7.55} = 90.12 \text{ K}$$

$$V_A = V_E = \frac{0.30 \times 60}{2} = 10.5 \text{ K}$$

$$H_A = H_E = \frac{M_B}{d} = \frac{90.12}{16} = 5.63 \text{ K}$$

FOR  $f_3$ :

$$M_D = \frac{f_3^2 P^2}{8} \cdot \frac{2(B+C) + R}{N} = \frac{0.48 \times 16^2}{8} \times \frac{2(4.14 + 3.16) + 0.533}{7.55} = 30.78 \text{ K}$$

$$H_E = \frac{M_D}{d} = \frac{30.78}{16} = 1.92 \text{ K}$$

$$H_A = 0.48 \times 16 - 1.92 = 5.76 \text{ K}$$

$$V_A \uparrow = V_E \uparrow = \frac{f_3^2 P^2}{16N} \cdot \frac{1}{2} = \frac{0.48 \times 16^2}{2 \times 60} = 1.02 \text{ K}$$

$$\therefore \Sigma V_A = 10.5 + 1.02 = 11.52 \text{ K} \downarrow$$

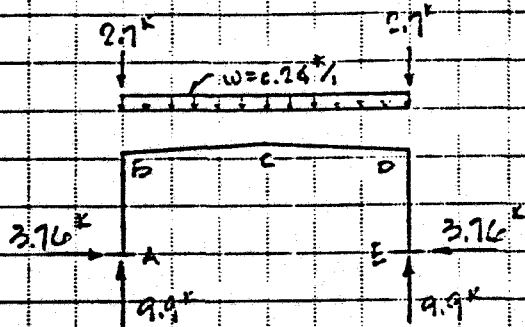
$$H_A = 5.63 + 5.76 = 11.39 \text{ K} \leftarrow$$

$$V_E = 10.5 - 1.02 = 9.48 \text{ K} \downarrow$$

$$H_E = 5.63 - 1.92 = 3.71 \text{ K} \leftarrow$$

JOB NO. C-21700 DATE 5-29-79 BY W. S. ... CHK. HJM  
 CUSTOMER MIDAC PROJECT COCK ONE  
 SUBJECT WAREHOUSE FOUNDATION

2. D.L. ONLY



$W = 10 \times 24 = 240 \text{ k}$

ASSUME SIDING WT =  $7 \text{ lb/ft}^2$

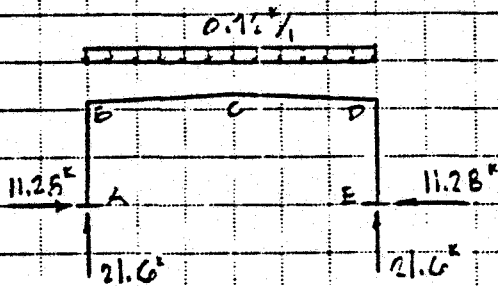
$P = 7 \times 10 \times 24 = 2688 \text{ lb}$

$M_B = M_D = \frac{WL^2(3+5\alpha)}{16N} = \frac{0.24 \times 60^2(3+5 \times 1.65)}{16 \times 7.55} = 60.08 \text{ k}$

$H_A = H_E = \frac{M_B}{L} = 60.08 / 16 = 3.76 \text{ k}$

$V_A = V_E = 0.24 \times 30 + 2.7 = 9.9 \text{ k}$

3. L.L. ONLY



$W = 30 \times 24 = 720 \text{ k}$

SUMMARY:

1. DL + WL

$H = (11.25 - 3.76) \times 0.75 = 5.72 \text{ k}$

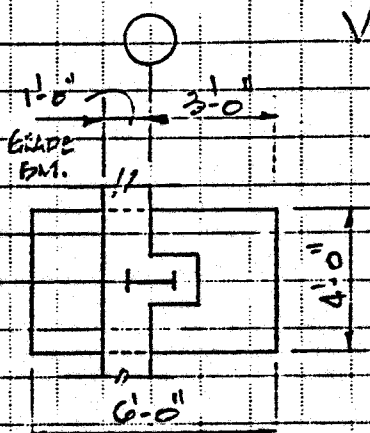
$V = 11.25 - 9.9 = 1.35 \text{ k (UPLIFT, NO REDUCTION)}$

JOB NO. C-21700 DATE 5-29-79 BY [Signature] CHK HJM  
CUSTOMER NDAC PROJECT SOLAR ONE  
SUBJECT WAREHOUSE FOUNDATION

SUMMARY (cont.)

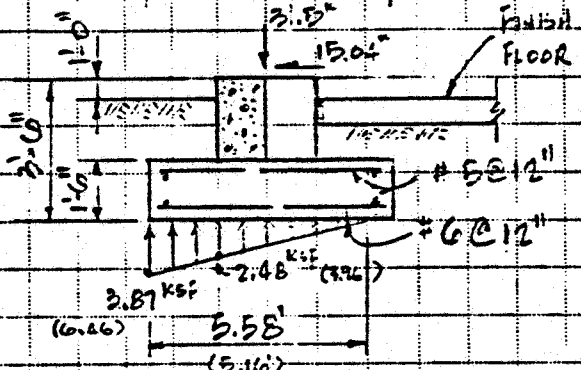
2. DL+LL  $H = 3.76 + 11.28 = 15.04^k$  — GOVERNS!  
 $V = 9.9 + 21.6 = 31.5^k$

3. DL+LL+WL  $H = (11.28 + 3.76 - 3.71) \times 0.75 = 8.5^k$   
 $V = (21.6 + 9.9 - 9.75) \times 0.75 = 16.29^k$



TRY 6"x4"x1'-6" FOOTING & 1'-0" GRADE BEAM

WT. OF FOOTING  $6 \times 4 \times 1.5 \times 0.15 = 5.4^k$   
WT. OF GRADE BM  $1 \times 1.75 \times 24 \times 0.15 = 6.3^k$   
 $V = 9.9 + 21.6 = 31.5^k$   
 $\Sigma = 43.2^k$



$M_c = 15.04 \times 3.5 = 52.6^{ik}$   
 $M_R = 43.2 \times 3 = 129.6^{ik}$   
 $F.S. = 129.6 / 52.6 = 2.46 > 1.5$  O.K.

$e = M_c / P = 52.6 / 43.2 = 1.14 > \frac{1}{6} \times 6 = 1.0'$  OUTSIDE OF MID. 1/3

$\therefore p_{max} = \frac{43.2}{4 \times 6} \left( \frac{4 \times 6}{3 \times 6 - 6 \times 1.14} \right) = 3.87$  ksf,  $p_{net} = 3.87 - 2.5 \times 0.11 = 3.60 < 5.0$  ksf

$(p_{allow} = 1.3 \times 4.5 + 0.3 \times 6 = 1.3 \times 4.5 + 0.3 \times 6 = 5.025 > 5.0 \therefore p_{allow} = 5.0$  ksf)

USE 6"x4"x1'-6" FOOTING FOR INTERMEDIATE COLUMN ←

JOB NO. C-21700 DATE 5-29-79 BY CSG/Hand CHK HJ/17  
 CUSTOMER MIDCO PROJECT COLIF. ONE  
 SUBJECT WATERHOUSE FOUNDATION

B. CORNER COLUMN FOOTING

$$V = 10 \times (12+2) \times (0.01+0.03) + (12+2+10) \times 16 \times 0.007 = 8.3^k$$

$$H_1 (\text{WIND}) = (30 \times 10) \times 0.02 / 2 = 3^k \text{ (TO LONGITUDINAL GRADE BEAM)}$$

$$H_2 (D+L) = 15.04 \times 14 / 4 = 8.77^k \text{ (TO TRANSVERSE GRADE BEAM)}$$

$$\text{WT. OF GRADE BEAM TO FOOTING} = (10+14) \times 1.0 \times 1.75 \times 0.15 = 6.3^k$$

$$\therefore P = 8.3 + 6.3 = 14.6^k$$

USE 3'-6" SQ X 1'-6" FOOTING  $q = 14.6 / 3.5^2 = 1.2 \text{ KSF} < 5.0 \text{ KSF O.K.}$

C. WIND POST FOOTING

$$V = 14 \times 20 \times (0.01+0.03) + 20 \times 16 \times 0.007 = 13.44^k \quad V_{DL} = 3.36^k$$

$$H (\text{WIND}) = 20 \times 16 \times 0.02 / 2 = 3.2^k$$

USE 3.5' x 2.5' x 1'-3" FOOTING (FINAL USE 1'-6" THICK FOR GRADE BEAM CONT. PURPOSE)

|                   |   |                  |
|-------------------|---|------------------|
| WT. OF FOOTING    | $3.5 \times 2.5 \times 1.25 \times 0.15 = 1.64^k$ | 1.64             |
| WT. OF GRADE BEAM | $20 \times 1.0 \times 1.75 \times 0.15 = 5.25^k$  | 5.25             |
| V                 | $DL+LL = 13.44^k$                                 | $DL+LL = 3.36^k$ |
|                   | $\Sigma = 20.33^k$                                | $10.25^k$        |

$$M_o = 3.2 \times 2.5 = 11.2^k, \quad M_R = 10.25 \times 1.75 = 17.9^k \text{ (DL ONLY)}$$

$$F.S. = 17.9 / 11.2 = 1.6 > 1.5 \text{ O.K.}$$

$$e = M_o / P = 11.2 / 20.33 = 0.55' < \frac{1}{6} \times 3.5 = 0.58' \text{ INSIDE MID. } \frac{1}{3}$$

$$p = \frac{20.33}{3.5 \times 3.5} = \frac{6 \times 11.2}{7.5 \times 3.5} = 2.32 \pm 2.19 = \frac{\text{MAX. } 4.5 \text{ KSF}}{\text{MIN. } 0.13 \text{ KSF}} < 5.0 \text{ KSF O.K.}$$

JOB NO. C-21700 DATE 12-29-79 BY [Signature] PAGE 6 OF 8  
 CUSTOMER MRA C PROJECT Solar PHE CHK HJM  
 SUBJECT WATERHOLE FOUNDATION

REBAR DESIGN: A. INTERMEDIATE COL. FOOTING

$$H_u = 3.76 \times 1.4 + 11.28 \times 1.7 = 24.44^k$$

$$V_u = (9.9 + 6.3 + 5.4) \times 1.4 + 21.6 \times 1.7 = 66.7^k$$

$$M_u = 24.44 \times 3.5 = 85.54, \quad e = 85.54 / 66.7 = 1.28'$$

$$p_{max} = \frac{66.7}{4 \times 6} \left( \frac{4 \times 6}{3 \times 6 - 6 \times 1.28} \right) = 6.46 \text{ KSF}$$

$$p_{net} = 6.46 - 1.5 \times 0.15 \times 1.4 = 6.15 \text{ KSF}$$

$$p_{net @ \text{FACE OF G.B.}} = 3.65 - 1.5 \times 0.15 \times 1.4 = 3.65 \text{ KSF}$$

$$M = 3.65 \times 2 \times 1 + (6.15 - 3.65) \times 2 / 2 \times 1.33 = 10.63 \text{ K}$$

$$b = 12, \quad d = 14, \quad f = 0.196, \quad K_u = 10.63 / 0.196 = 54, \quad \therefore R_u = 4.45$$

$$A_s = \frac{10.63}{4.45 \times 14} = 0.17 \text{ in}^2, \quad 0.17 \times 1.33 = 0.23 \text{ in}^2$$

- USE # 6 @ 12" BOT. MAIN DIRECTION
- # 5 @ 12" BOT. TEMP. REINF.
- # 5 @ 12" TOP. EN. TEMP. REINF.

B. CORNER COL. FOOTING & WIND POST FOOTING

USE # 6 @ 12" BOT. BOTH WAYS.

CHECK SHEAR:

$$V_u = 6.15 \times 2 = 12.3^k$$

$$V_u = \frac{12300}{0.85 \times 12 \times 14} = 86.7 < 110 \text{ psi}$$

O.K.!

JOB NO. C-21700 DATE 5-29-79 BY C. C. [unclear] CHK. HJM

CUSTOMER WIZAC PROJECT SOLAR ONE

SUBJECT WAREHOUSE FOUNDATION

GRADE BEAM

$$W = (1'-0" \times 2'-0") \times 0.15 = 0.30 \text{ K/ft}$$

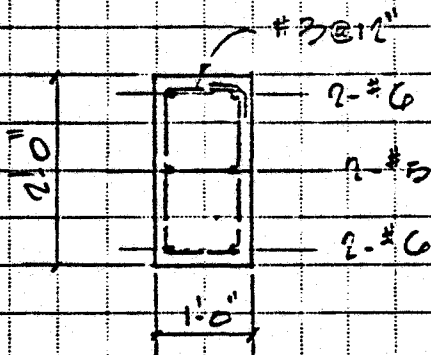
$$M_u = 0.30 \times 1.4 \times 24^2 / 8 = 30.24 \text{ K}$$

$$b = 12, d = 20 \therefore F = 0.4, K_u = 30.24 / 0.4 = 75.6, \lambda_u = 4.42$$

$$A_s = 30.24 / (4.42 \times 20) = 0.34 \text{ in}^2, 0.34 \times 1.33 = 0.45 \text{ in}^2$$

$$A_s = 0.0033 \times 12 \times 20 = 0.79 \text{ in}^2$$

USE 2-#6 T. & B. & 2-#5 CR. (1-E.F.) & #3 TIES @ 12"



# Stearns-Doger

JOB NO. 21700 DATE 8-31-79 BY HJM CH'K. CSO  
 CUSTOMER MDAC PROJECT SILAR ONE  
 SUBJECT WAREHOUSE FDN.

GRADE BEAM, ... E & W @ DOORS

REF.: DWG. C19-1, Sect. J

LOADS: H-20 TRUCK: 16<sup>k</sup> / Wheel

GR. BM: allow. Soil p = 5 Ksf

$$\text{req } A = \frac{16^k}{5 \text{ Ksf}} = 3.2 \text{ ft}^2 \rightarrow 3.2' \times 1.0'$$

Wheel spacing = 6.0'

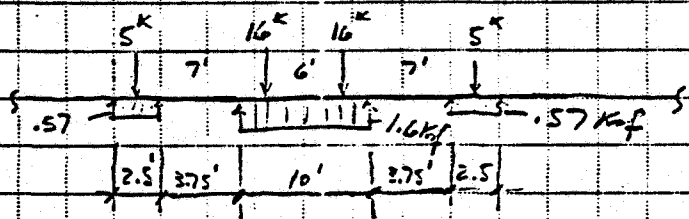
$$p = \frac{16^k}{10 \times 1} = 1.6 \text{ Ksf} < 5.0 \text{ allow. } \textcircled{OK}$$

WIND PIST FTG.: Pg. 5: V<sub>DL</sub> = 3.36<sup>k</sup> (STL. COL.)

1.64<sup>k</sup> (FTG.)

$$\text{min } V_{DL} = 5.00^k$$

$$\text{min } p_{DL} = \frac{5.00^k}{3.5 \times 2.5} = .57 \text{ Ksf}$$



TOP REINF.: -M =  $\frac{1.6 (6.0)^2}{8} = 7.2 \text{ k}$

$$\text{req } d = \sqrt{\frac{7.2 \times 1.7}{1.43}} = 5.3" < 14" \quad \left. \begin{matrix} f'_c = 3 \\ 17 A_s \end{matrix} \right\} \textcircled{OK}$$

$$A_s = \frac{7.2 \times 1.7}{1.43 \times 14} = .20 \text{ in}^2 \text{ (small) } \checkmark$$

BOT. REINF.: +M ~ 16<sup>k</sup> x 3.75' = 60<sup>k</sup>

$$\text{req } d = \sqrt{\frac{60 \times 1.7}{1.43}} = 15.4" \sim 14" \quad \left. \begin{matrix} f'_c = 3 \\ 17 A_s \end{matrix} \right\} \textcircled{OK}$$

$$A_s = \frac{60 \times 1.7}{1.43 \times 14} = 1.82 \text{ in}^2$$

USE 4 #6 BOT. (1.76 in<sup>2</sup>)



STMPO 177

Department of Energy  
San Francisco Operations Office  
1333 Broadway  
Oakland, California 94612

Reply To: DOE Solar One Project Office  
P.O. Box 366  
Daggett, CA 92327

SEP 28 1984

Mr. Robert L. Gervais  
Solar One Project Office  
McDonnell Douglas Astronautics Corp.  
P.O. Box 366  
Daggett, CA 92327

Subject: Contractor Clearance of Contract DE-AC03-79SF10499  
Solar One Reports for DOE/TIC Inclusion.

Dear Bob:

Enclosed are copies of covers and title pages of eight reports prepared by McDonnell Douglas Astronautics Corporation for the Solar One Project under the above referenced contract. In preparation for delivery of these documents to DOE/TIC, I have prepared a SAN form 70 "Request for Patent Clearance" and a DOE form RA-426 "Recommendations for Announcement and Distribution of Documents" for each document.

Please have the appropriate MDAC personnel complete and sign these forms. As agreed, SAN form 70 should be forwarded to SAN/OPC by your office with copies of the completed SAN form 70 and the transmittal letter being sent to me. The completed DOE form RA-426 should be sent directly back to me.

The documents covered by this letter are:

| <u>Primary Document No.</u> | <u>Secondary No.</u> | <u>Brief Title</u>                     |
|-----------------------------|----------------------|--|
| DOE/SF/10499-T91            | STMPO 176            | PSS Design Calculations (Book 1 of 26) |
| DOE/SF/10499-T92            | STMPO 177            | PSS Design Calculations (Book 2 of 26) |
| DOE/SF/10499-T93            | STMPO 178            | PSS Design Calculations (Book 3 of 26) |
| DOE/SF/10499-T95            | STMPO 180            | PSS Design Calculations (Book 5 of 26) |
| DOE/SF/10499-T96            | STMPO 181            | PSS Design Calculations (Book 6 of 26) |
| DOE/SF/10499-T97            | STMPO 182            | PSS Design Calculations (Book 7 of 26) |
| DOE/SF/10499-T98            | STMPO 183            | PSS Design Calculations (Book 8 of 26) |
| DOE/SF/10499-T99            | STMPO 184            | PSS Design Calculations (Book 9 of 26) |



If you should have any questions or concerns please do not hesitate to contact me by telephone at, (619) 254-2672.

Sincerely,



S.D. Elliott, Jr., Director  
DOE Solar One Project Office

SDE/aks  
Project File: CCC008.RNO(SA3:)

Encl: Eight Document Covers W/forms 70 and RA-426

cc: Roger Gaither, SAN/OPC  
W.D. Matheny, DOE/TIC  
Mike Lopez, DOE/SAN (FGS)  
Mary Soderstrum, B&McD



**DEPARTMENT OF ENERGY  
SAN FRANCISCO OPERATIONS OFFICE**

**CONTRACTOR REQUEST FOR PATENT CLEARANCE  
FOR RELEASE OF UNCLASSIFIED DOCUMENT**

|  |
|--|
| Prime Contract No.<br>DE-AC03-79SF10499  |
| Subcontract No.<br>(N/A)   |
| Report No. (STMP0 177)<br>DOE/SF/10499-T92   |
| Date of Report<br>September 1980   |
| Name & Phone No. of DOE<br>Technical Representative<br>S.D. Elliott, Jr.<br>(619) 254-2672 |

**TO:** Roger S. Gaither, Asst. Chief for Prosecution  
Office of Patent Counsel/Livermore Office  
P.O. Box 808, L-376  
Livermore, California 94550

**FROM:** McDonnell Douglas Corporation  
3855 Lakewood Blvd.  
Long Beach, CA 90846

- Document Title: Plant Support Subsystems Design Calculations (Book 2 of 26)
- Type of Document:  Technical Report,  Conference Paper,  Journal Article,  Abstract or Summary,  
 Copy of Oral Presentation,  Other (please specify): \_\_\_\_\_  
(Routine)
- In order to meet a publication schedule or submission deadline, patent clearance by \_\_\_\_\_ would be desired.

**SENDER IS TO CHECK BOX #4 OR #5 BELOW.**

4. I have reviewed (or have had reviewed by technically knowledgeable personnel) this document for possible inventive subject matter (Subject Inventions) and that no inventions or discoveries (Subject Inventions) are deemed to be disclosed in this document except as stated below:
- Attention should be directed to pages \_\_\_\_\_ of this document.
  - This document describes matter relating to an invention:
    - Contractor Invention Docket No. \_\_\_\_\_
    - A disclosure of the invention was submitted to DOE on \_\_\_\_\_ (date)
    - A disclosure of the invention will be submitted shortly \_\_\_\_\_ (approximate date)
    - A waiver of DOE's patent rights to the contractor:
 

has been granted,  has been applied for; or  will be applied for \_\_\_\_\_ (date)

5. This document is being submitted, but no review has been made of this document for possible inventive subject matter.  
Provide copy of clearance to: Solar One Project Office  
P.O. Box 366, Daggett, CA 92327

6. Remarks: \_\_\_\_\_

Reviewing/Submitting Official: Name (Print/Type) \_\_\_\_\_  
Title \_\_\_\_\_  
Signature \_\_\_\_\_ Date \_\_\_\_\_

**TO:** INITIATOR OF REQUEST

**FROM:** ASSISTANT CHIEF FOR PROSECUTION  
Office of Patent Counsel/Livermore Office

- No patent objection to above-identified release.
- Please defer release until advised by this office.

Signed \_\_\_\_\_ Date Mailed \_\_\_\_\_

DOE AND MAJOR CONTRACTOR RECOMMENDATIONS FOR  
ANNOUNCEMENT AND DISTRIBUTION OF DOCUMENTS

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|---|---|---|

4. Title  
Plant Support Subsystems Design Calculations (Book 2 of 26)

5. Type of Document ("x" one)  
 a. Scientific and technical report  
 b. Conference paper: Title of conference \_\_\_\_\_  
\_\_\_\_\_ Date of conference \_\_\_\_\_

Exact location of conference \_\_\_\_\_ Sponsoring organization \_\_\_\_\_  
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14. Submitted by (Name and Position) (Please print or type)  
S.D. Elliott, Jr., Director, DOE Solar One Project Office  
Organization

P.O. Box 366, Daggett, CA 92327 (619) 254-2672  
Signature

\_\_\_\_\_  
Date

10 MWe Solar Thermal  
Central Receiver Pilot Plant

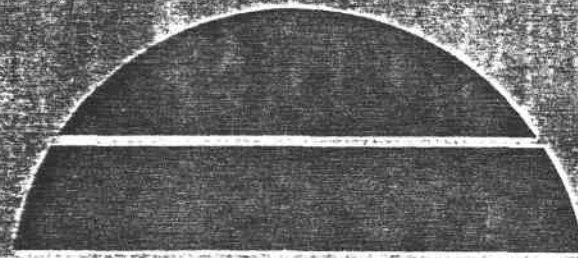
SOLAR FACILITIES DESIGN INTEGRATION

PSS FINAL DESIGN CALCULATIONS  
BOOK 2 OF 26—WAREHOUSE  
CONSTRUCTION PACKAGE 3 (RADL ITEM 7-8)

September 1980

WORK PERFORMED UNDER CONTRACT  
DE-AC03-79SF10499

STEARNS-ROGER ENGINEERING CORP  
4500 CHERRY CREEK DRIVE  
P.O. BOX 5888  
DENVER, CO 80217



U.S. Department of Energy



Solar Energy

**10 MWe Solar Thermal  
Central Receiver Pilot Plant  
Solar Facilities Design Integration**

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**PSS FINAL DESIGN CALCULATIONS  
BOOK 2 OF 26--WAREHOUSE  
CONSTRUCTION PACKAGE 3 (RADL ITEM 7-8)**

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**September 1980**

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**STEARNS-ROGER ENGINEERING CORP  
4500 CHERRY DRIVE  
P.O. BOX 5888  
DENVER, CO 80217**

**PREPARED FOR THE  
U.S. DEPARTMENT OF ENERGY  
SOLAR ENERGY  
UNDER CONTRACT DE-AC-03-79SF10499**

U.S. DEPARTMENT OF ENERGY

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| 4. Title<br><u>Plant Support Subsystems Design Calculations (Book 2 of 26)</u>   |   |   |
| 5. Type of Document ("x" one)<br><input checked="" type="checkbox"/> a. Scientific and technical report<br><input type="checkbox"/> b. Conference paper: Title of conference _____<br><br>Date of conference _____<br><br>Exact location of conference _____ Sponsoring organization _____<br><input type="checkbox"/> c. Other (specify planning, educational, impact, market, social, economic, thesis, translations, journal article manuscript, etc.) _____  |   |   |
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DEPARTMENT OF ENERGY  
SAN FRANCISCO OPERATIONS OFFICE

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| Subcontract No.<br>(N/A)   |
| Report No. (STMPC 177)<br>DOE/SF/10499-T92   |
| Date of Report<br>September 1980   |
| Name & Phone No. of DOE<br>Technical Representative<br>S.D. Elliott, Jr.<br>(619) 254-2672 |

TO: Roger S. Gaither, Asst. Chief for Prosecution  
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P.O. Box 808, L-376  
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FROM: McDonnell Douglas Corporation  
3855 Lakewood Blvd.  
Long Beach, CA 90846

- Document Title: Plant Support Subsystems Design Calculations (Book 2 of 26)
- Type of Document:  Technical Report,  Conference Paper,  Journal Article,  Abstract or Summary,  
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(Routine)
- In order to meet a publication schedule or submission deadline, patent clearance by \_\_\_\_\_  
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- I have reviewed (or have had reviewed by technically knowledgeable personnel) this document for possible inventive subject matter (Subject Inventions) and that no inventions or discoveries (Subject Inventions) are deemed to be disclosed in this document except as stated below:
  - Attention should be directed to pages \_\_\_\_\_ of this document.
  - This document describes matter relating to an invention:
    - Contractor Invention Docket No. \_\_\_\_\_
    - A disclosure of the invention was submitted to DOE on \_\_\_\_\_ (date)
    - A disclosure of the invention will be submitted shortly \_\_\_\_\_ (approximate date)
    - A waiver of DOE's patent rights to the contractor:
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Provide copy of clearance to: Solar One Project Office  
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6. Remarks: \_\_\_\_\_  
Reviewing/Submitting Official: Name (Print/Type) John P. Schell  
Title Asst. Chief Patent Counsel, MDC (MS 122-23)  
Signature [Signature] Date 8 Nov 84

TO: INITIATOR OF REQUEST  
FROM: ASSISTANT CHIEF FOR PROSECUTION  
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- No patent objection to above-identified release.
- Please defer release until advised by this office.