HNF-FMP-07-32540-R0

FMP (FACILITY MODIFICATION PACKAGE) FORM

Design Package Identification

1. Mod Title:
Pallets, 48 x 48 and 56 x 56

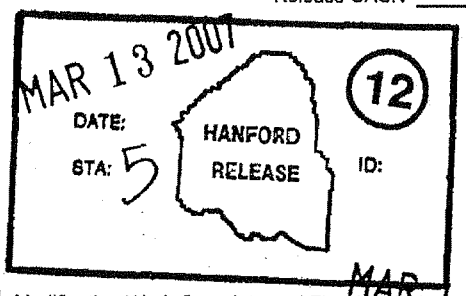
Key Words:
N/A

2. Project No./Work Package No.:
N/A

3. Review Designators:
N/A ☒ D ☐ P ☐ E ☐ N ☐ R ☐ I ☐ F ☐ Q ☐
Additional Reviewers:
☐ ☐ ☐ ☐ ☐ ☐

4. Area	5. Building	6. System No.	7. FMP Author
200G	N/A	N/A	K D HEIN

8. Release: Release CACN 118798



☒ Modification Work Complete and Field Verified MAR 13 2007
☐ Not Approved/Archive KD Hein
for D STEEN / 2/22/07
Design Authority Print/Signature/Date

9. USQ Required? ☐ USQ ☐ CX ☒ NA No.: _____

10. Environmental-Activity Screening Form Completed? ☐ YES ☒ NO
If Yes, is the Environmental-Activity Form Attached? ☐ YES ☐ NO

11. Distribution - Name	MSIN	Distribution - Name	MSIN
N/A		N/A	

12. Change Description (description and reason for requested change):
H-2-832930 PROVIDED FOR INITAL RELEASE OF DRAWING SET.

Approvals

13. FMP Author	Design Authority	Engineering Management
K D HEIN 02/21/07	R STEEN 2/22/07	F HAMADA 2/27/07
Print/Signature/Date	Print/Signature/Date	Print/Signature/Date
Title N/A	Title N/A	Title N/A
Print/Signature/Date	Print/Signature/Date	Print/Signature/Date

14. Document Index

Action	Document Number	Sh/Pg	Rev	E/S	FMP Section Title	FMP Page	Release To Work?
NWC	H-2-832930	1,2	0	S	N/A		☐

15. Related FMPs/Changes:	16. Incorporated FMPs/EDCs/ECNs/DCNs:
N/A	N/A
17. Lead Engineering Discipline:	**18. Affected Engineering Disciplines:**
N/A	N/A

Modification Bases

19. Engineering Request or Proposal:
N/A
CACN _____

20. Change Status of Engineering Documents to be Modified:

Document Number	Sh/Pg	Rev	E/S	Outstanding ECN(s), DCN(s), FMP(s)	Work Complete?
N/A			E		

Submit List to Document Control for Project Status? ☐ YES ☒ NO

FMP (FACILITY MODIFICATION PACKAGE) FORM (continued)

21. Potentially Affected Documents Not Changed By This FMP:

Document Type	Document Number/Revision	Document Owner (Organization)	Technical Authority Notified	Date Notified
N/A	N/A	N/A	N/A	N/A

22. Conceptual Evaluations:

N/A

23. Functions, Requirements, and Design Criteria:

Functions:

USED FOR STORAGE AND TRANSPORT OF DRUMS

Requirements:

MUST HAVE LOAD CAPACITY OF 12,000 LBS. MUST MEET CERTAIN SECTIONS OF ASME MH1 (2005) - SEE DWG NOTES ON SHT 1

Design Criteria:

SEE DWG NOTES ON SHT 1

24. Post-Installation Acceptance Test Criteria:

25. Design Verification:

Verification by: ☒ ***Peer Review*** ☐ ***Formal Design Review*** ☐ ***Alternate Calculations*** ☐ ***Qualification Testing***

Design Verification Record Form (A-6003-845) required per HNF-PRO-8336? ☐ YES ☒ NO

Additional Design Verification Documentation Prepared? ☐ YES ☒ NO

Design Verification Checklist Questions

a. Are the assumptions, functions, requirements, and design criteria appropriately selected? ☒ YES ☐ NO

b. Does the design meet the stated assumptions, functions, requirements, and design criteria? ☒ YES ☐ NO

c. Were the design inputs correctly incorporated into the design? ☒ YES ☐ NO

d. Is the design output reasonable compared to the design inputs? ☒ YES ☐ NO

e. Have suitable materials, parts, processes, and inspections and testing criteria been specified? ☒ YES ☐ NO

f. Have manufacture, maintenance, and operability been adequately addressed in the design? ☒ YES ☐ NO

g. Are all affected active design documents identified and appropriately changed? ☒ YES ☐ NO

A review of the design has been performed. The selected functions, requirements, and design criteria meet the stated engineering request. The verification completed by the method(s) noted that this FMP is accurate, and the design defined by this FMP and related documents meets the stated functions, requirements, and design criteria.

Design Verifier Michael Gerst Michael Gerst 2/21/07

Print/Signature/Date

These calculations demonstrate the adequacy of the pallet currently ordered and used for SWOC. Throughout the calculations, it is assumed that the wood used is Western White Pine. Western White Pine has the least desirable mechanical properties of wood allowed by ASME MH1, *Pallets, Slip Sheets, and Other Bases for Unit Loads,* (2005). This assumption builds conservatism, while bounding other wood selections allowed by MH1. Some other data was gleaned from *Machinery's Handbook,* 26th Addition (2000).

Credit is taken for Administrative controls in place for limiting a single pallet to 4000 lbs, and that they can be stacked a maximum of 3 high.

The fasteners used are 3 mm (D) x 2.75 in (L), helically threaded and hardened.

1) Force required for shearing fasteners.

Assume the fastener material is low carbon steel (1025), with an ultimate tensile strength (UTS) of 70 ksi. Further assume that Shear is .75 of UTS. A pure shearing load for pallet fasteners is highly unlikely.

$$\text{Shear} = \frac{Pi \times D^2 \times .75UTS}{4} = \frac{3.14(.118)^2 \times .75(70\ ksi)}{4} = 575\ lbs.$$

Minimum 3 fasteners are used per connection point, so Shear = 3X, or 1725 lbs.

2) Wood Failure between Fasteners – Shear Loading

Wood Tear (WT) = (p – D) x t x S(t), where S(t) = Tensile Strength of Pine Perp to Grain, p = distance between fasteners (3 ea) on a 2 x 6 pallet.

S(t) = 330 psi So, WT = (1.375 - .118) x 1.5 x 330 = 622 lbs.

3) Force Withdrawal Resistance (FWI) See MH1 for values and definitions

$$FWI = 221 \times (WD) \times [1 + 27.15 \times (TD - WD) \times (H / TL)]$$

$$= 221 \times (.118) \times [1 + 27.15 \times (.142 - .118) \times (9 / 1.75)]$$

$$= 113$$

4) Fastener Withdrawal Resistance Value (FWRF), Single fastener. See MH1 for values and definitions

$$FWRF = 222.2 \times FWI \times (GS^{2.25}) \times P / (MC-3)$$

$$FWRF = 222.2 \times 113 \times (40/62.4)^{2.25} \times 1.5 / (20 - 3)$$

FWRF = 818 lbf

5) Fastener Head Pull-Through Resistance Value (HPRF) Single fastener. See MH1 for values and definitions

$$HPRF = 1.25 \times 10^6 \times T \times (GD^{2.25}) \times (HD^2 - WD^2) / (MC - 3)$$

$$HPRF = 1.25 \times 10^6 \times .75 \times (40/62.4)^{2.25} \times (.28^2 - .118^2) / (20 - 3)$$

HPRF = 1307 lbf

6) Crushing Pallet Material Perp to the Grain – Machinery's Handbook offers a range of 190 psi to 470 psi.

Pallet Stringers are 48 in long 2 x 4 members. Actual dimensions of a finished 2 x 4 is 1 1/2 x 3 1/2.

Single stringer contact area with a single deck board = 5 1/2 in x 1 1/2 in = 8.25 in^2

The 48 x 48 pallet has 4 total stringers and 4 bottom deck boards, making 16 areas of contact, so
Total Area = 16 x 8.25 = 132 in^2

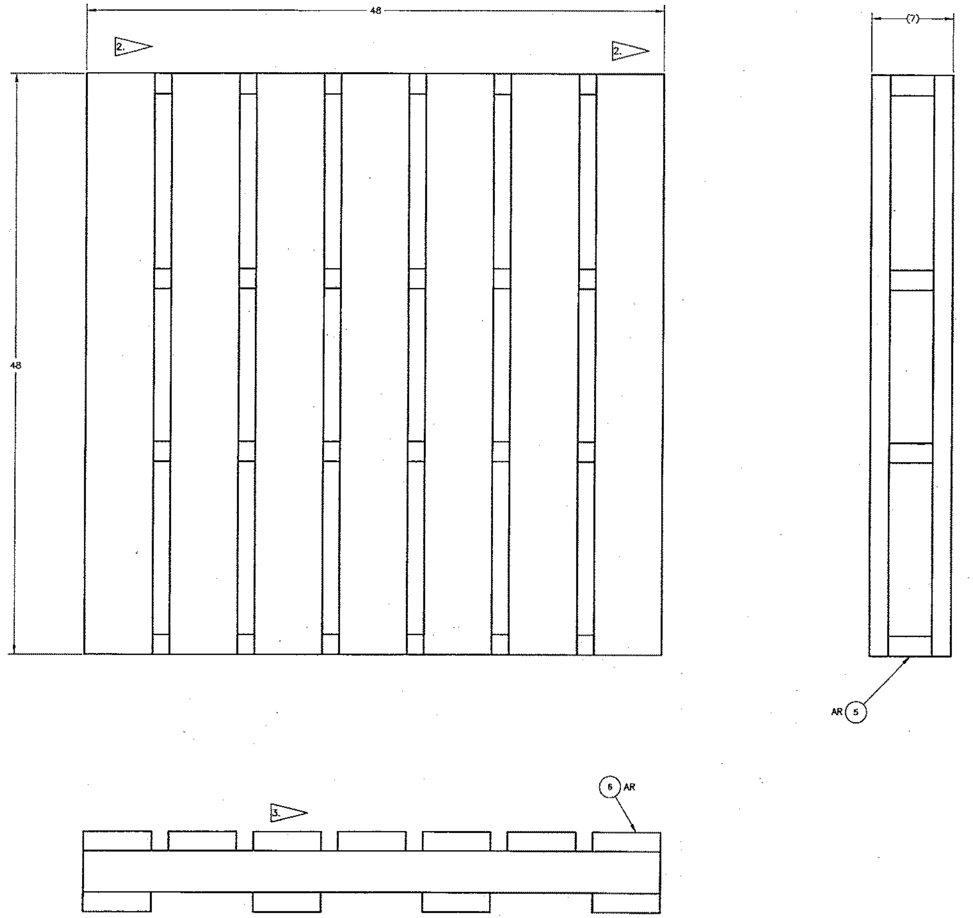
The Admin Control for pallets is 4000 lbs max per pallet, and a maximum of 3 stacks high, for a total of 12,000 lbs.

The maximum pressure exerted on the bottom pallet is 12,000 lbs / 132 in^2 = 91 psi << 190 psi. This offers a safety factor in excess of 2 even if the lowest crushing strength value is used.

Calculations 1 and 2 demonstrate an intuitively obvious dynamic, that in a shear load condition, the material between fasteners would fail before the fastener would. Again, shear loading for pallets is highly unlikely, and is an off-normal condition for pallet use.

Calculations 3, 4 and, 5 offer performance criteria for the pallet in use at SWOC. They provide the forces needed for fastener pullout and fastener head pull-through for a single fastener. The drawing requires a minimum 3 fasteners at each attachment location between stringer and deck board, and this attribute increases each of the criteria by the total number of fasteners.

Calculation 6 demonstrates that, under maximum static loading, the pallet material will not crush due to overloading.



① PALLET, 48 X 48
SCALE: NONE

PARTS/MATERIAL LIST

QTY REQD -030	QTY REQD -020	QTY REQD -010	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO.
		X	-010	PALLET, 48 X 48		1	1
	X		-020	PALLET, 56 X 56		2	2
							3
							4
	AR	AR	-001	STRINGER BOARD, 2 X 4	SEE NOTE 5	1,2	5
	AR	AR	-002	DECK BOARD, 2 X 6 (TOP AND BOTTOM)	SEE NOTE 5	1,2	6
							7
							8
							9
							10
							11
							12
							13
							14
							15

Row -010 is flagged with note 3; row -020 is flagged with note 4.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

1. DIMENSIONS ARE IN INCHES. TOLERANCES AND FASTENING METHODS ARE PER ASME MH1 (2005) PART I-6.
2. EACH ATTACHMENT POINT OF A DECK BOARD TO A STRINGER SHALL HAVE A MINIMUM OF 3 FASTENERS. CHOSEN FASTENER(S) SHALL BE ANY COMMERCIALLY AVAILABLE ITEM USED IN STANDARD INDUSTRY PRACTICES, AND IS COMPLIANT WITH ASME MH1 (2005), PART 5. HELICALLY THREADED NAILS ARE PREFERRED.
3. EACH 48 X 48 PALLET SHALL HAVE A TOP DECK BOARD SPACING OF 1 1/2 IN. THE BOTTOM DECK BOARDS SHALL BE EQUALLY SPACED ALONG THE LENGTH. THE STRINGERS SHALL BE ON 16 IN CENTERS, EQUALLY SPACED ALONG THE WIDTH.
4. EACH 56 X 56 PALLET SHALL HAVE A TOP DECK BOARD SPACING OF 2 IN. THE BOTTOM DECK BOARDS SHALL BE EQUALLY SPACED ALONG THE LENGTH. THE STRINGERS SHALL BE ON 18-19 IN CENTERS, SPACED ALONG THE WIDTH.
5. MINIMUM LOAD CAPACITY FOR ITEMS 1 AND 2 IS 12,000 LBS. ITEMS 1 AND 2 TO BE COMPATIBLE WITH A FORKLIFT AND PALLET JACK. WOOD SPECIES MAY BE ANY COMMERCIALLY AVAILABLE PRODUCT THAT MEETS OR EXCEEDS THE LOAD CAPACITY FOR A FINISHED PALLET, AND IS COMPLIANT WITH ASME MH1 (2005), APP A3-I. WOOD SPECIES QUALITY SHALL MEET ASME MH1 (2005), SECTION I-5.
6. TYPICAL USE FOR PALLETS IS DRUM STORAGE AND TRANSPORT.

MAR 13 2007
HANFORD RELEASE
DATE:
STA: 5
ID: 12

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	END ITEM

	REV	DESCRIPTION
S	0	-32540-RO RELEASED PER HNF-FMP-07

REVISIONS

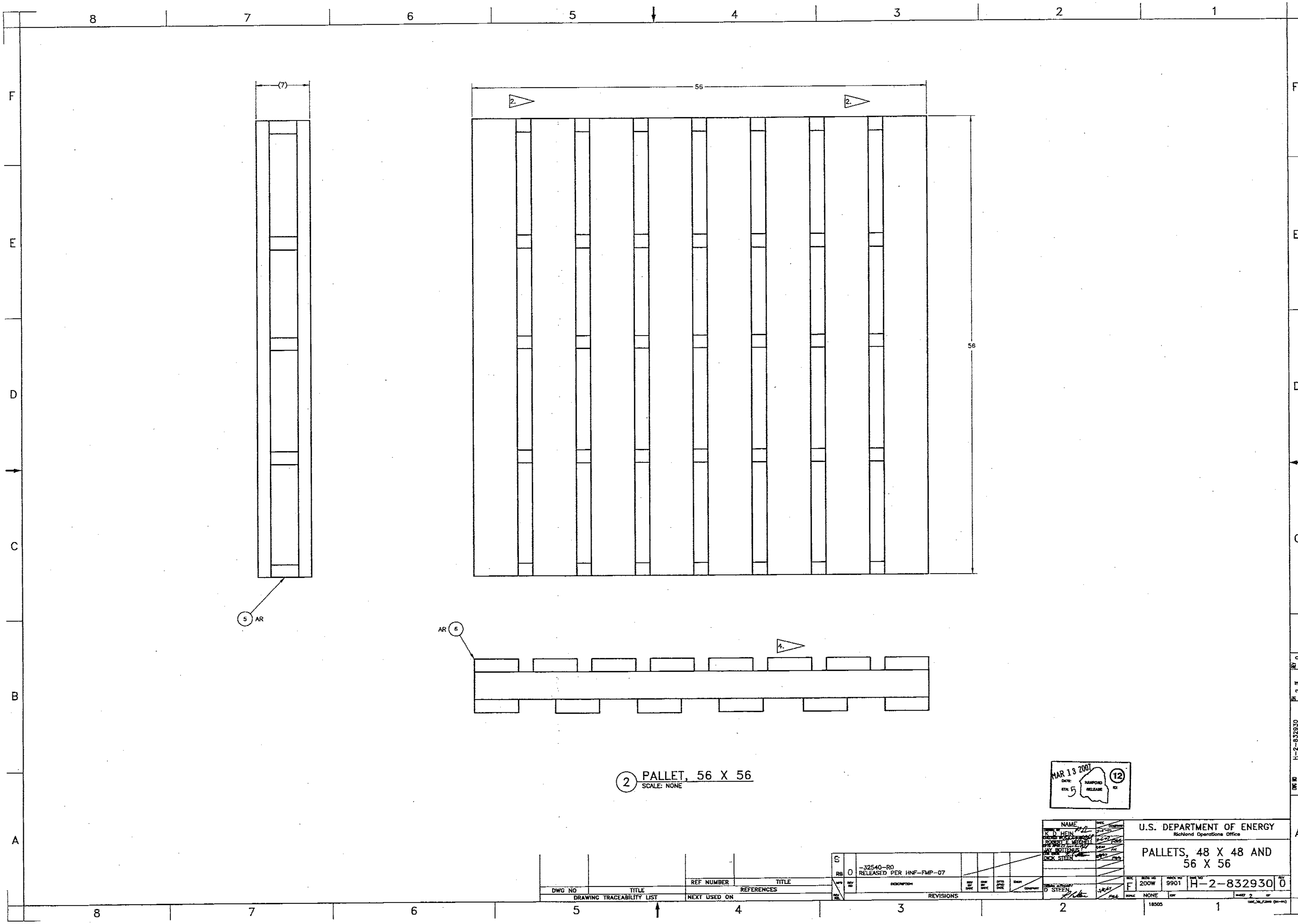
NAME
K D HEIN
D STEEN

U.S. DEPARTMENT OF ENERGY
Richland Operations Office

PALLETS, 48 X 48 AND 56 X 56

F | 200W | 9901 | H-2-832930 | 0

SCALE: NONE | 15970 | SHEET 1 OF 2



(7)
56
56
2.
4.
5 AR
AR 6
2 PALLET, 56 X 56
SCALE: NONE
MAR 13 2007
HANFORD RELEASE
12
U.S. DEPARTMENT OF ENERGY
Richland Operations Office
PALLETS, 48 X 48 AND 56 X 56
H-2-832930
0
NAME
K D HEIN
ROBERT E MITCHELL
JAY BOTTENUS
DICK STEEN
D STEEN
F
200W
9901
NONE
18505
-32540-R0
RELEASED PER HNF-FMP-07
REVISIONS
DESCRIPTION
DWG NO
TITLE
DRAWING TRACEABILITY LIST
REF NUMBER
TITLE
REFERENCES
NEXT USED ON