

SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

October 1980
NSRP 0007

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

Proceedings of the REAPS Technical Symposium

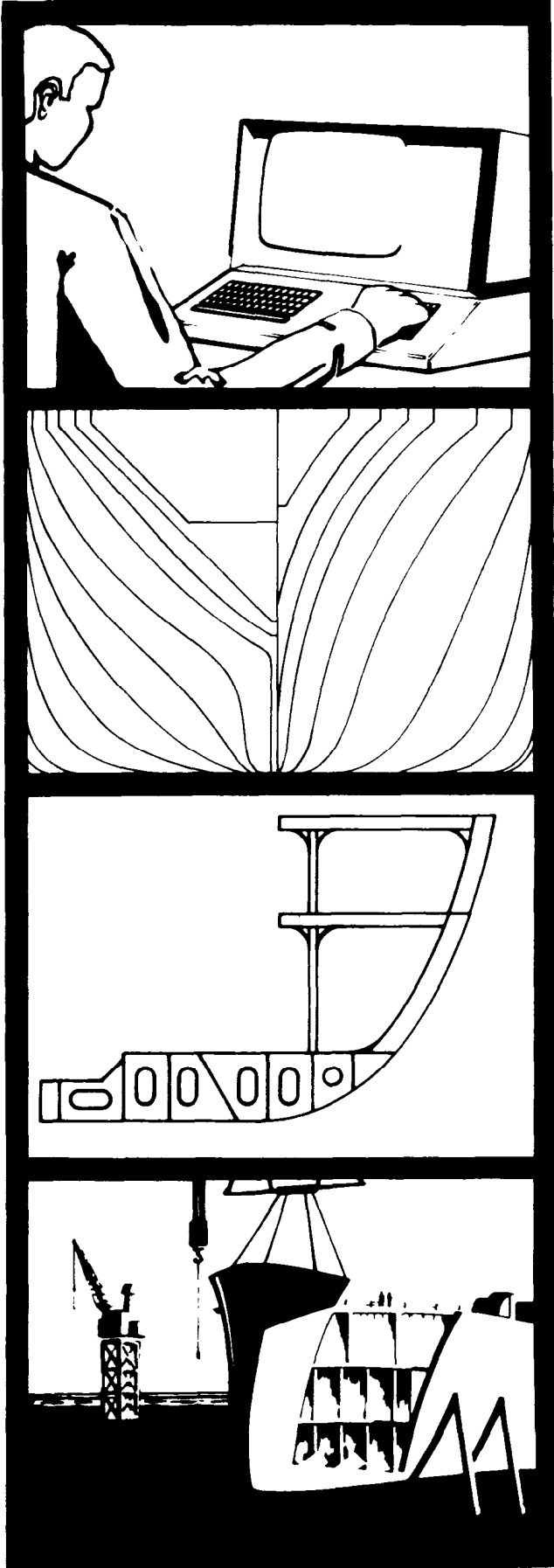
Paper No. 15: A New Approach to Fabrication Drawings

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE OCT 1980		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE The National Shipbuilding Research Program Proceedings of the REAPS Technical Symposium Paper No. 15: A New Approach to Fabrication Drawings				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Surface Warfare Center CD Code 2230 - Design Integration Tools Building 192 Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5700				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 25	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

DISCLAIMER

These reports were prepared as an account of government-sponsored work. Neither the United States, nor the United States Navy, nor any person acting on behalf of the United States Navy (A) makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this report/manual, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or (B) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in the report. As used in the above, "Persons acting on behalf of the United States Navy" includes any employee, contractor, or subcontractor to the contractor of the United States Navy to the extent that such employee, contractor, or subcontractor to the contractor prepares, handles, or distributes, or provides access to any information pursuant to his employment or contract or subcontract to the contractor with the United States Navy. ANY POSSIBLE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR PURPOSE ARE SPECIFICALLY DISCLAIMED.



R ESEARCH
E AND
E NGINEERING
A FOR
A UTOMATION
P AND
P RODUCTIVITY
S IN
SHIPBUILDING

**Proceedings of the
REAPS Technical Symposium
October 14-16, 1980
Philadelphia, Pennsylvania**

A NEW APPROACH TO FABRICATION DRAWINGS

D. P. Ross
Vice President, Marketing and N/C Services
Cali & Associates Inc
New Orleans, Louisiana

Mr. Ross has been with Cali & Associates Inc for 6 years. The prior 17 years he has served in various capacities at Ingalls Shipbuilding including the production and engineering departments. He has been involved in N/C lofting/design for 11 years.

ABSTRACT

In this paper a problem is discussed that has existed in the shipbuilding industry for many years; that is how to present to production workers fabrication drawings that are more accurate, less cumbersome and easily understood. An approach to solving this problem through use of N/C lofting software is presented and discussed.

INTRODUCTION

For many years the shipbuilding industry has recognized the fact that skilled craft workers are becoming more difficult to find.

The skilled Shipfitter of years past is practically non-existent today. This person worked with large, cumbersome detail drawings that were prepared for regulatory body approval, along with full size templates furnished by the Mold Loft, where applicable.

In order to fabricate one unit of a vessel it was usually necessary to work with several large drawings for structures such as Shell Plating, Decks, Transverse Floors, Transverse Bulkheads, Longitudinal Bulkheads and Longitudinal Girders. Since these drawings were prepared for one third to one half of the vessel, a great deal of redundant information had to be sorted out by the Shipfitter.

In order to reduce the skill level requirement of the Shipfitter several new processes have been developed such as N/C Lofting and Plate cutting. While these processes reduced the fitting and welding man hours they did not eliminate the problem of cumbersome, difficult to understand drawings which were still necessary to fabricate the structure.

In recent years several new approaches have been made to provide fabrication drawings that are easily understood by the average craft person within the industry. These drawings are generally prepared by hand and are subject to the usual error of this process.

This paper will discuss a new approach to preparation of fabrication drawings utilizing previously generated N/C Lofting information.

THE CONCEPT

The concept of developing the fabrication drawings from previously developed N/C Lofting data came about recently as a result of the needs of a new shipyard, Upper Peninsula Shipbuilding Company. This totally new facility was to employ a local work force with no prior shipbuilding experience, therefore it was imperative that the fabrication drawings be simplified as much as possible.

Working with Breit & Garcia, the design Agent for UPSCO, Cali & Associates is developing the fabrication drawings for the first vessels being constructed in the new facility at Ontonogan, Michigan. To date, approximately one third of the structural units for the Tug of a Tug/Barge combination have been constructed utilizing the N/C Lofting data and Fabrication Drawings.

DEVELOPMENT

As can be seen from the Functional Diagram, Figure 1, the development of Fabrication Drawings does not require anything exceptional or out of the ordinary within the normal operational cycle. Some additional work is required by the N/C Loft and the Design Department which will be covered in more detail further on.

The general evolution from Design to Production, as depicted in Figure 1, is as follows:

Utilizing Contract Scantling Drawings or Detail Design Drawings the Production Department decides on the Unit breakdown, erection sequence, and welding details for

the vessel. This information is relayed to the Design Department for inclusion on drawings as necessary.

(Figure 2)

The Design Department adds erection information to the drawings such as butts, seams and welding details as required by the Production Department, for subsequent issue to the N/C Loft.

(Figure 3)

The N/C Loft, utilizing Scantling or Detail Drawings issued by the Design Department along with written planning information from the Production Department, produces all the individual parts, templates, nest tapes, stiffener data and Bills of Material required for each defined structural unit.

(Figures 4 & 5)

Upon completion and validation of all parts within a Unit, the N/C Loft prepares the background fabrication drawings utilizing the previously defined parts and a feature within the "SPADES" software that allows these parts to be drawn in their proper relationship to each other, since they have been defined within the ship's coordinate system. These drawings, by virtue of the parts having been programmed to include labeling, have all the required piece mark identification as well as reference lines and orientation.

(Figure 6)

A recently added. feature of the "SPADES" software allows the direct generation of a panel drawing for flat rectangular parts with all identification labeling, locating dimensions for attaching structure and check dimensions for alignment checks. Dimensions are all provided by the system, from the Data Base, and not from input by the part programmer. This assures accuracy and control of the data provided to the Production Department.

(Figure 7)

The Design Department completes the Fabrication Drawing generated in the N/C Loft by adding welding, standard detail call-outs and any notes that might be required. This drawing is then issued to the Production Department for subsequent use of the Shipfitters in assembly of the Units.

(Figure 8)

FUNCTIONAL DIAGRAM

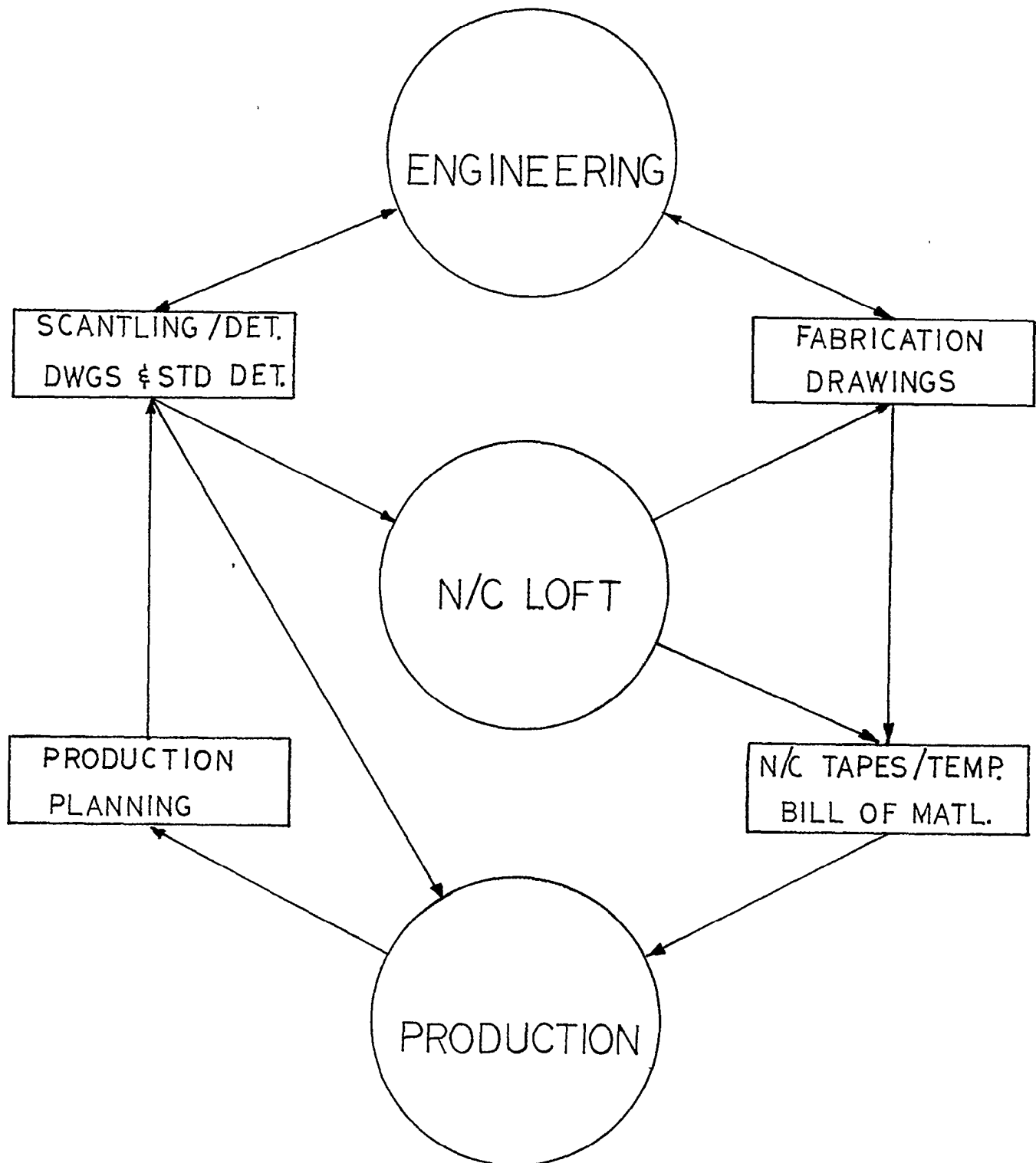


FIGURE 1

PRODUCTION PLANNING

UNIT DESCRIPTION

UNIT NO: 10

TITLE: WING TANK FR. 29-42 STBD.

DESCRIPTION:

THIS UNIT TO BE ASSEMBLED USING WING TANK BULKHEAD AS A BASE. PANEL WELD BULKHEAD AND ERECT FRAMES ON SAME. PANEL WELD MAIN DECK, FIT AND WELD TO PREVIOUSLY ERECTED FRAMES. FIT AND WELD SHELL PLATES, TACK WELDING ONLY TO FRAMES. ROLL UNIT ONTO SIDE SHELL AND COMPLETE WELDING DOWNHAND. LEAVE 1" STOCK ON FORWARD END OF UNIT.

FIGURE 2


```

*****
*
*          U P P E R   P E N I N S U L A   S H I P B L D G .
*          -----
*
*          U F S C O   T U G
*****
* NO. PLATES LIKEWISE = 1 NO. PLATES MIRROR IMAGE = 0 TOTAL NO. PLATES = 1
*
* PLATE SIZE = 3600X 9800X 51 STOCK NO. = MTL. = STEEL
*
*****
*
*          P A R T S   I N C L U D E D   I N   T H I S   T A P E
*
*          PART NO.      QTY.      PART NO.      QTY.      PART NO.      QTY.
*          -----      -----      -----      -----      -----
*          14 60F        2/      1      14 60F        1/      1      14 CLR        1/      10
*          14 CLR        2/      10      14 CLR        4/      2      14 50F        51/      2
*          14 50F        4/ S   1      14 50F        4/ P   1      14 51F        4/ S   1
*          14 51F        4/ P   1      14 55F        4/ S   1      14 55F        4/ P   1
*
*
*
*
*
*
*
*
*
*
*****
*
*          R E V I S I O N S
*****
* REV *          DESCRIPTION          * BY * DATE *
*****
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*
*****
*
*          PREPARED BY
*
*
*          C A L I * A S S O C I A T E S ,   I N C .
*          -----
*
* CHECKED BY:          VALIDATED BY:
*****
* JOB NO. 9026UP01          TEST TAPE NO. 4610144- 3 /
*****

```

FIGURE 4

IDENTIFICATION & PLOT LOCATION OF PARTS
FOR TAPE NO. 4610144- 3

PLOT REF.	DRWG. & LOC.	N/C ID & MODE	LINE PLATE MODULE & FCNK.	MIRR. PLATE MODULE & FCNK.
*	*	*	*	*
*	*	*	*	*
1	* 14	* 0421-302- 1 L	* 14 60F 2/	* *
*	*	*	*	*
2	* 14	* 0421-301- 1 L	* 14 60F 1/	* *
*	*	*	*	*
3	* 14	* 0431- 3- 4 L	* 14 CLR 1/	* *
*	*	*	*	*
4	* 14	* 0431- 4- 4 L	* 14 CLR 2/	* *
*	*	*	*	*
5	* 14	* 0431- 2- 4 L	* 14 CLR 4/	* *
*	*	*	*	*
6	* 14	* 0432- 1- 2 L	* 14 50F 51/	* *
*	*	*	*	*
7	* 14	* 0404- 1- 3 L	* 14 50F 4/ S	* *
*	*	*	*	*
8	*	*	* 14 50F 4/ F	* *
*	*	*	*	*
9	* 14	* 0404- 2- 3 L	* 14 51F 4/ S	* *
*	*	*	*	*
10	*	*	* 14 51F 4/ F	* *
*	*	*	*	*
11	* 14	* 0404- 6- 3 L	* 14 55F 4/ S	* *
*	*	*	*	*
12	*	*	* 14 55F 4/ F	* *

FIGURE 4 a

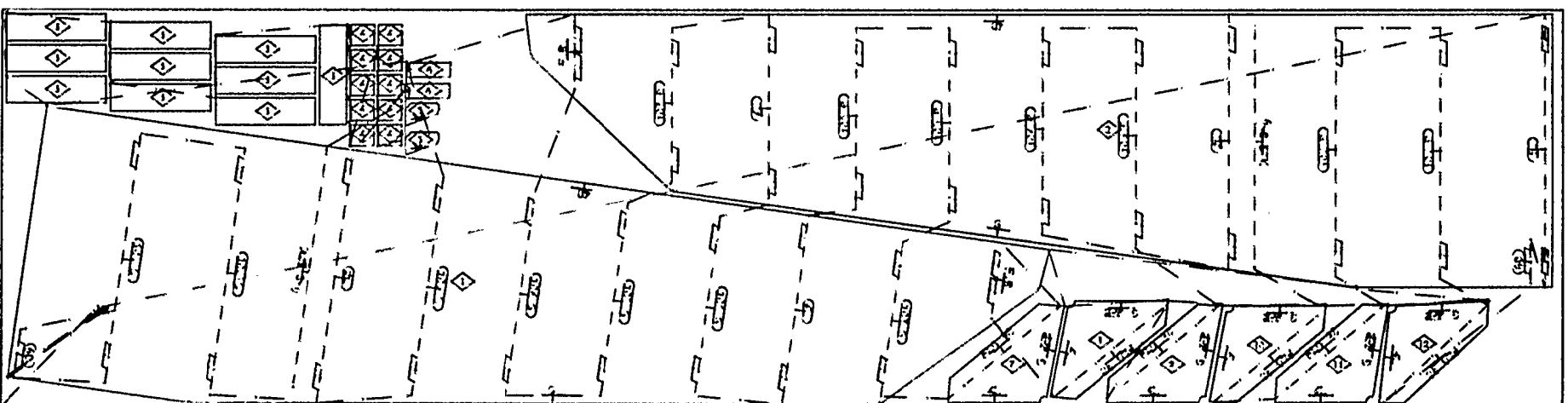


FIGURE 4 b

+ UFGI - 4610144 - 3

S P A D E S S Y S T E M

DATE 10/03/80

SUMMARY REPORT OF BURNING TAPE NO.

4610144 - 3

PIERCING TIME	0.0	(PIERCING ALLOWANCE 0.0/ 0.0 MIN.)
RAPID TRAVERSE TIME	10.2	(ASSUMED SPEED 250.0 IN./MIN.)
CENTER PUNCHING TIME	5.7	(ASSUMED SPEED 250.0 IN./MIN.)
BURNING TIME	30.0	(ASSUMED SPEED 90.0 IN./MIN.)
TOTAL PROCESSING TIME	46.0	MINUTES

POST PROCESSOR OPTIONS USED FOR TAPE :

FORMAT : EIAS

CUTTING PROCESS : PLSM

PAPER TAPE PARITY : EVEN

PLATE OUTLINED BY : D.M.

KERF COMPENSATED BY AUX. FUNCTION

LABEL MARKING OPT IONS: . 11

NO OF STOPS PROGRAMMED IN THE TAPE : 4

MATERIAL UTILIZATIONS DATA

PLATE UTILIZATION = 83.9 PERCENT

SCRAP WEIGHT = 540.2 POUNDS

TYPE OF MATERIAL STEEL

FIGURE 4 c

REPORT DATE : 9/11/80
 D.B.NAME : UP01 9026UP01
 VESSEL : UPSCO TUG

S P A D E S S Y S T E M
 SHIP PRODUCTION AND CONTROL MODULE

PAGE NO. 0. 1
 MODULE/UNIT: 10
 REPORT REV. 1

TOTAL WEIGHT FOR SHAPES: 6831.7 LBS.
 TOTAL WEIGHT FOR PLATES: 74252.2 LBS.
 TOTAL WEIGHT FOR MODULE: 81083.9 LBS.

FIGURE 5

REPORT DATE : 9/11/80
 D.B.NAME : UP01 9026UP01
 VESSEL : UPSCO TUG

S P A D E S S Y S T E M
 SHIP PRODUCTION AND CONTROL MODULE

PAGE NO. 3. 1
 MODULE/UNIT: 10
 REPORT REV. 1

PIECES PRODUCED FROM SHAPES

303

LINE-REV	PIECE MARK/ DRAWING NO.	QTY/ LOC.	WGT.	MAT'L	LENGTH	STK	*A*	*B*	*C*	N/C ID	WEB 1 FLANGE 1	WEB 2 FLANGE 2	OTHER N/C DESCRIPTION	AIDS		
1-	1 29F	101	2	141 DS 668	11-05-08		11-05-08			0	B	C-04	T	C-04	0	0
2-	1 31F	101	1	97 DS 668	7-10-13					0		C104		C-02	0	0
3-	1 31F	102	1	72 DS 668	5-10-06					0		C-04		C102	0	0
4-	1 31F	103	1	55 DS 670	3-05-00		3-05-00			0	B	C-04	T	C102	0	0
5-	1 31F	104	1	63 DS 670	3-11-00		3-11-00			0	B	C-04	T	C101	0	0
6-	1 31F	105	1	107 DS 670	6-07-00		6-07-00			0	B	C-04	T	C102	0	0
7-	1 32F	101	1	95 DS 668	7-08-07					0		C104		C-02	0	0
8-	1 32F	102	1	69 DS 668	5-07-10					0		C-04		C102	0	0
9-	1 32F	103	1	55 DS 670	3-05-00		3-05-00			0	B	C104	T	C-02	0	0
10-	1 32F	104	1	86 DS 670	5-04-00		5-04-00			0	B	C104	T	C-02	0	0
11-	1 32F	105	1	107 DS 670	6-07-00		6-07-00			0	B	C104	T	C-02	0	0

FIGURE 5 a

REPORT DATE : 9/11/80
D.B.NAME : UP01 9026UP01
VESSEL : UPSCO TUG

S P A D E S S Y S T E M
SHIP PRODUCTION AND CONTROL MODULE

PAGE- NO. 6. 1
MODULE/UNIT: 10
REPORT REV. 1

PLATE MATERIAL LIST

LINE	STOCK NO.	GRADE	SIZE	QTY.	N/C-TAPE	ND.	PRC.TIME	LOC.	NOTES:
1		STEEL	38600X 9800X 25	2	4610073-14		47.8		
2		STEEL	38603X 9800X 25	1	461CC78-	4	47.7		
3		STEEL	38600X 9800X 25	1	4610079-	3	44.1		
4		STEEL	38600X 9800X 38	2	4610081-	3	55.4		
5		STEEL	38600X 9800X 38	2	4610084-	3	42.1		
6		STEEL	38600X 9800X 50	2	4610089-	5	167.9		
7		EH36 STL	48000x 7400x 75	2	4610090-	6	49.3		
8		STEEL	38600X 9800X 62	1	4610091-	6	94.1		
9		STEEL	38600X 9800X 50	1	4610099-	5	156.5		
10	BEVELS	EH36 STL	48000X10200X 62	2	4610102-	4	147.1		
11		STEEL	38600X 9800X 25	1	4610103-	3	41.7		
12		STEEL	38600X 9800X 38	2	4610014-	6	146.4		
13		STEEL	38600X 9800X 38	1	4610105-	4	72.8		
14	BEVELS	EH36 STL	48000X10200X 75	1	4613106-	3	114.4		
15	BEVELS	STEEL	38600X 9800X 50	1	4610108-	4	169.0		
16		STEEL	38600X 9800X 75	1	4610110-	3	79.1		
17	BEVELS	STEEL	38600X 9800X 62	1	4610111-	6	172.7		

FIGURE 5 b

REPORT DATE : 9/11/80
D.B.NAME : UP01 9026UP01
VESSEL : UPSCO TUG

S P A D E S S Y S T E M
SHIP PRODUCTION AND CONTROL MODULE

PAGE NO. 7. 1
MODULE/UNIT: 10
REPORT REV. 1

PIECES PRODUCED THROUGH N/C CUTTING

LINE-REV	PIECE	MARK	DRAWING NO.	LOC.	QTY.	WGT.	HAT.	THK.	STK	N/C	ID.	NEST	TAPES	TEMPLATES	PROCESS 1ST 2ND	DESCRIPTION
	1-	1	10D			1	531	0	.62	0335-	1- 2		10115-	3		
	2-	1	1D		9-10	1	715	0	.50	0335-	2- 2		10113-	7		
	3-	1	1D		9-10	1	952	0	.38	0335-	3- 2		10112-	2		
	4-	1	27D		9-10	3	364	0	1.50	0330-	1- 4		10108-	4		
	5-	1	29F			1	635	0	.38	0299-	1- 2		10081-	3		
w	6-	1	29F			1	1034	0	.38	0311-	1- 4		10122-	6		
85	7-	1	29F			1	30	0	.38	0299-	2- 2		10081-	3		
	8-	1	29f			1	24	0	.38	0299-	3- 2		10081-	3		
	9-	1	29F			4	11	a	.38	0311-	2- 4		10122-	6		
	10-	1	29F			2	13	0	.38	0311-	3- 4		10122-	6		
	11-	1	30F			1	630	0	.38	0299-	5- 2		10081-	3		
	12-	1	30F			1	262	0	.38	0312-	1- 2		10122-	6		
	13-	1	31F			1	30	0	.38	0299-	6- 2		10081-	3		
	14-	1	30F			1	24	0	.38	0299-	7- 1		10081-	3		
	15-	1	30F			2	11	0	.38	0312-	2- 2		10122-	6		
	16-	1	31F			1	618	0	.38	0220-	1- 5		10081-	3		
	17-	1	31F			1	1925	3	.75	0313-	1- 3		10119-	2		

FIGURE 5 c

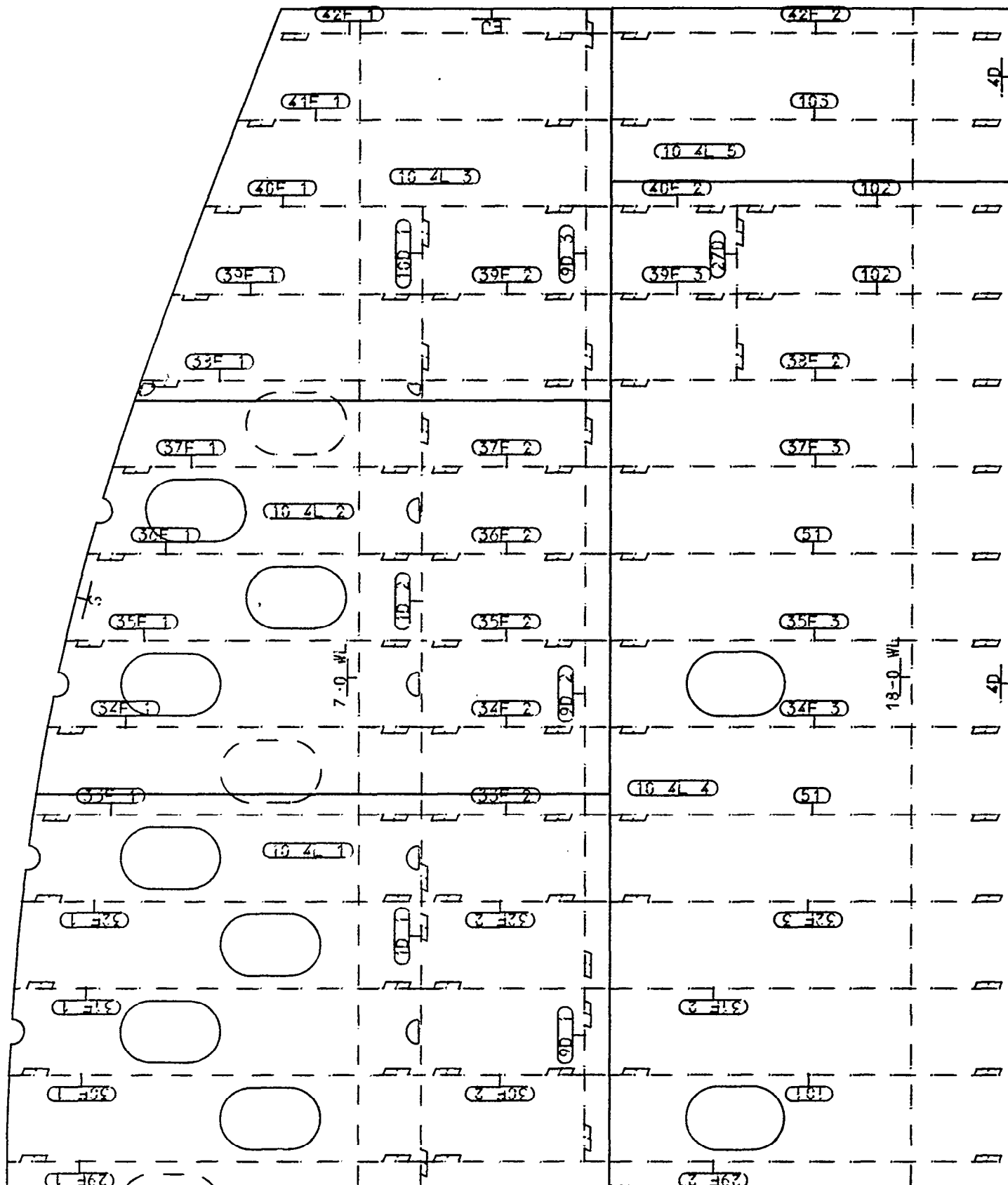


FIGURE 6

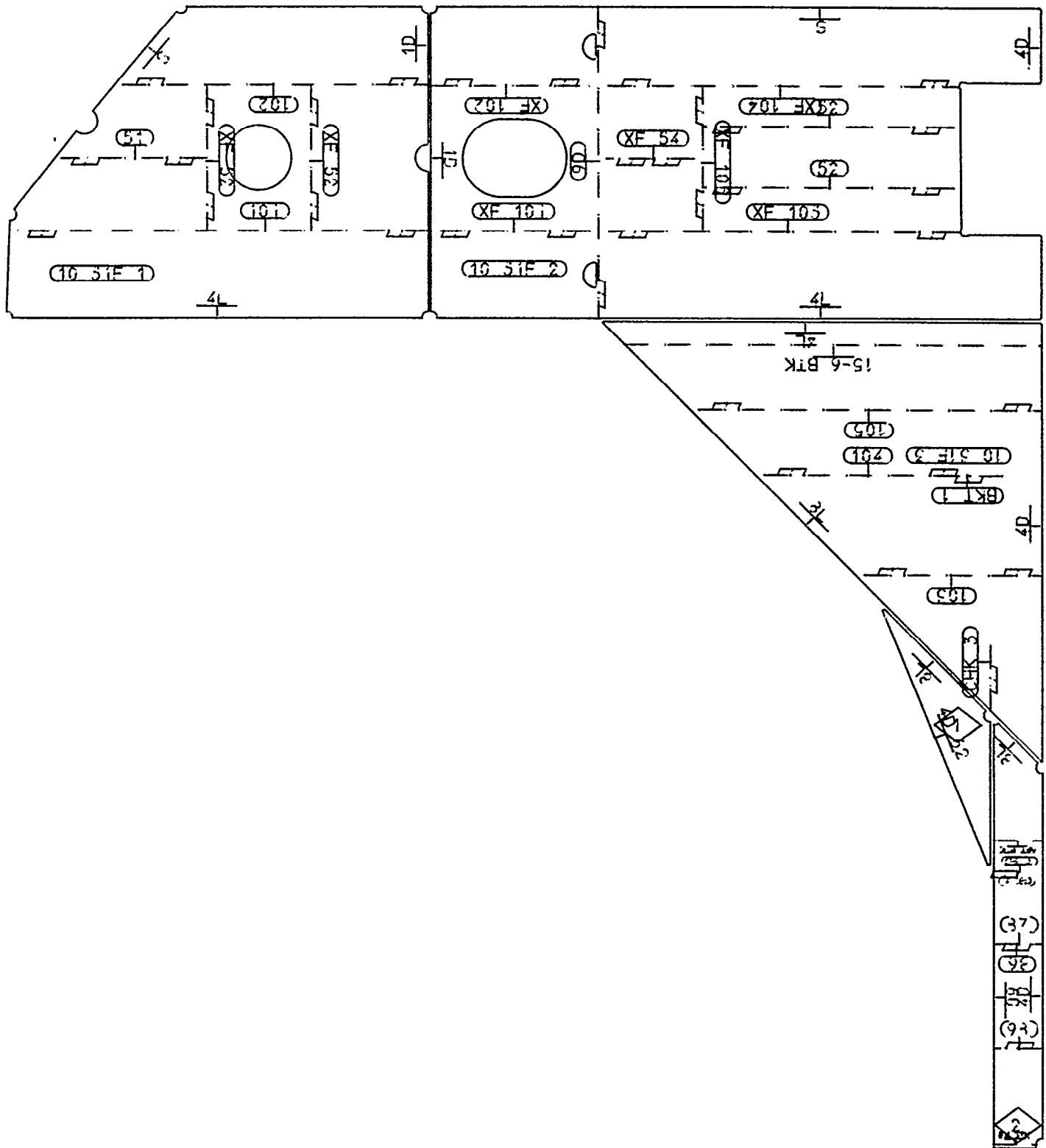


FIGURE 6 a

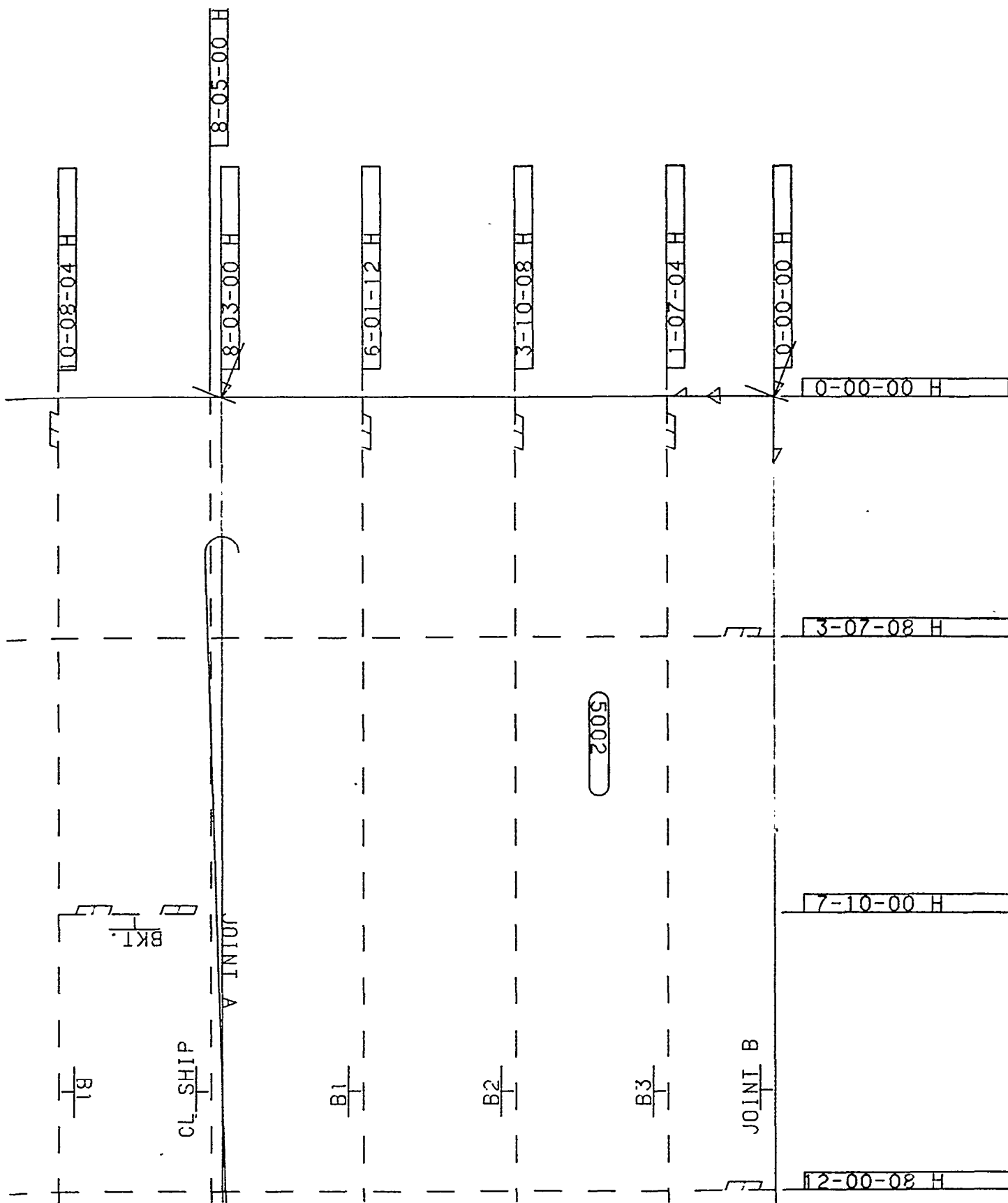


FIGURE 7

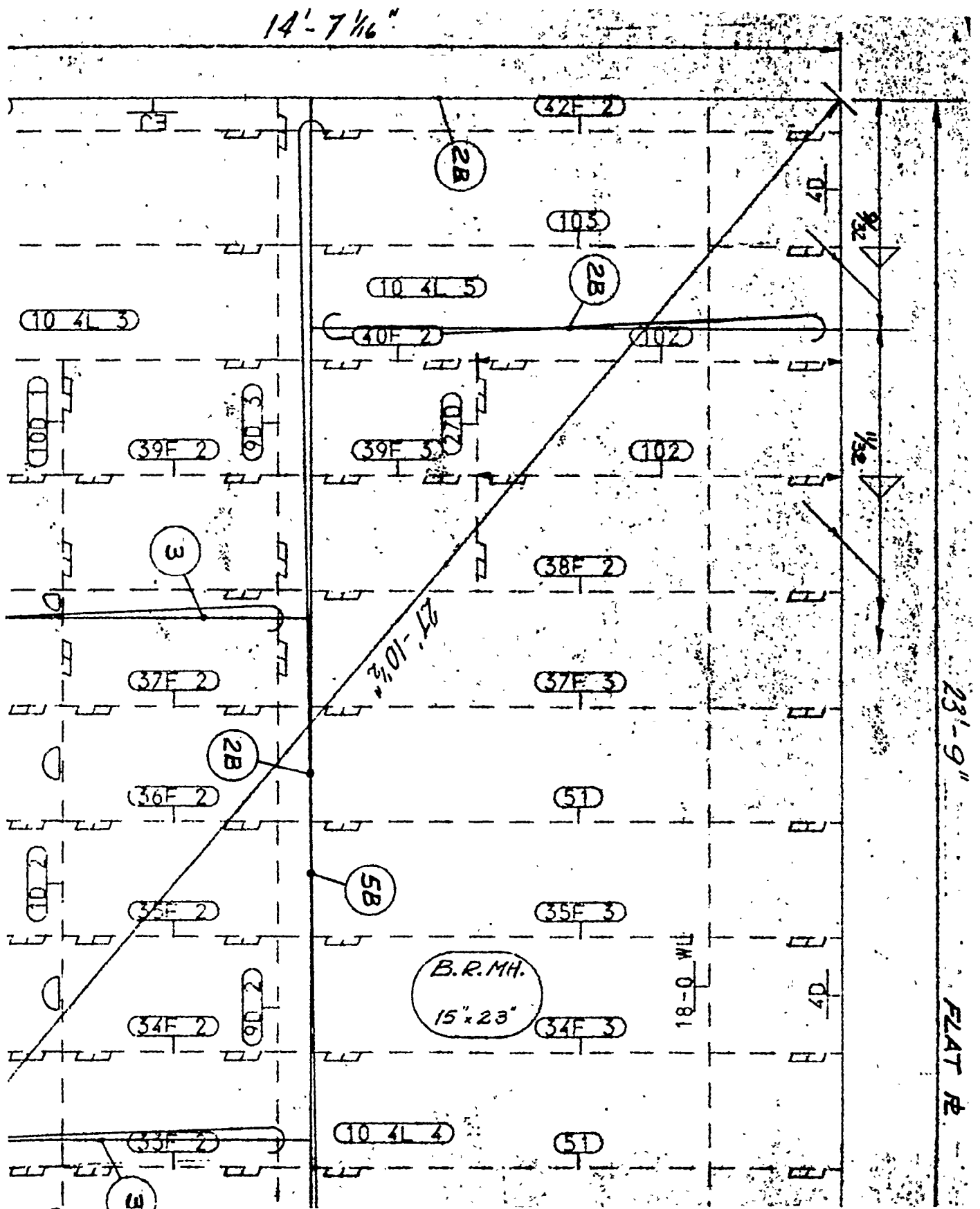


FIGURE 8

CONCLUSION

Reports from Upper Peninsula Shipbuilding indicate the Fabrication Drawings being used are a total success in that people without prior shipfitting experience are doing an excellent job in fabrication of the Tug Boat.

As experience is gained, and particularly through use of Interactive Graphics, the time to produce the Fabrication Drawings is being reduced considerably. A conservative estimate would place the cost to produce the drawings in this manner at about twenty five percent (25%) of the cost to prepare them entirely by hand.

Since the lofting effort is mandatory to the construction of a vessel, it seems that the development of Fabrication Drawings should be handled as described in this paper in order to take full advantage of the inherent accuracy and reduced man hours.

Additional copies of this report can be obtained from the
National Shipbuilding Research and Documentation Center:

<http://www.nsnet.com/docctr/>

Documentation Center
The University of Michigan
Transportation Research Institute
Marine Systems Division
2901 Baxter Road
Ann Arbor, MI 48109-2150

Phone: 734-763-2465
Fax: 734-763-4862
E-mail: Doc.Center@umich.edu