CELL CONTROLLER OPERATIONS MANUAL

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I. INTRODUCTION

This manual is one in a series of operations manuals written to instruct a novice in the operation of one of the systems in the Automated Manufacturing Research Facility (AMRF) at the National Bureau of Standards. The manual assumes that the operator has some training in the use of the computer but little knowledge of the AMRF and only wants to operate the specific system in a standard configuration, not learn how or why it operates as it does. A reader interested in further information about the system should consult this document's bibliography for a list of other publications on the subject.

The AMRF, the major national laboratory for research in automated manufacturing, consists of six workstations and the control rooms and computer equipment necessary to operate them. The facility is a test bed where scientists and engineers from industry, academia, and the government work together on projects of mutual interest. Their research concentrates on the interfaces and measurement techniques needed for successful computer integrated manufacturing.

This particular manual addresses the operation of the AMRF's cell controller. The cell controller is currently the highest level controller in the AMRF. The cell controller directs the actions of five subordinate workstations: Vertical Workstation (VWS), Horizontal Workstation (HWS), Inspection Workstation (IWS), Material Handling Workstation (MHS), and Cleaning and Deburring Workstation (CDWS). There are four major sections to this manual, basic operation of the cell screen management system, startup of the cell, operation of the cell, and shutdown of the cell.

The cell controller is located in Control Room 2 on the desk facing the window. The cell controller is running on a COMPAQ deskpro 386 computer, and requires software to be running concurrently on the Sun Network computer. The Sun computer is located on the table to left of the COMPAQ 386, as you face the COMPAQ.

II. OPERATION OF THE SCREENS

The cell's screens are broken down into three major areas: menu area, data area, and the status bar. Figure 1 shows the location of the three areas on the screen.

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Figure 1. Cell Screen Area

Most user interaction with the system is directed through the menu area. The menu area occupies the topmost three lines on the monitor screen. The first line displays the name of the menu that the user has currently selected. The second line provides selection operations or data that may be chosen by Left and right cursor control keys move the the user. highlighting bar over the possible selections. The cursor control, or "arrow", keys are located on the number key pad on the right side of the keyboard. Pressing the ENTER key makes a selection which will cause an associated menu function to be called and/or another level of descent in the menu structure to occur. Pressing the ESCAPE key causes the user to back up a level in the menu structure. Function keys provide the user with direct access to many functions and screens, which are listed below. The third line displays the next level of options with the selection that is currently highlighted on line 2.

Function keys:

F1: Not used F2: Move from menu to data area F3: Communication state data display F4: Mailbox display F5: Cell control command display F6: Cell control status display F7: Summary display F8: Work elements display F9: Communication display F10: Subordinate controller

Most of the information about the cell is presented in the second area on the screen, the data page. The data page covers from line 4 to line 24 on the screen. Many different page formats are defined which provide control and communications information to the user in real-time.

The last area on the screen, the status bar, provides summary or diagnostic information. The highlighted status bar displays the current clock cycle, the current screen identifier, communications status, and the current time. It provides constant feedback to the user that the cell is operating correctly. The current clock cycle should be updating about ten times a second. If the clock cycles have stopped updating for more than a few seconds, the system might have abnormally stopped. When the system has abnormally stopped, the computer must be turned off and then turned on. The computer is then rebooted, and the startup procedure is repeated.

III. STARTUP

1. CELL CONTROLLER STARTUP

1) The Sun MHS and CELL communications processes are started by either the Network operator or the AMRF operator.

2) Check that the power strip is connected to the COMPAQ 386 and there is no diskette in the disk drive. Check that the computer's power switch is on. When the COMPAQ 386 is ready to operate, the prompt

C>

will be the last item written on the screen.

3) To start the cell controller on the COMPAQ 386 enter commands

c: cd cell cell See Figure 2 in the Appendix. The figures of the cell screens are to help users determine if their keyboard actions are producing the desired effects. The cell takes a few seconds to startup; therefore wait until clock cycles start updating before proceeding.

4) Using the arrow keys, highlight the menu option SET_COMM. Press the Enter key. See Figure 3.

5) Using the arrow keys, highlight the menu option COMM SWITCH. Press the Enter key. See Figure 4.

6) Using the arrow keys, highlight the menu option ON. Press the Enter key. See Figure 5. (Observe on the status bar the COMM: status should be switching from IDLE to RCV about every ten seconds.) This activates communication between the cell computer and the Sun that provides a connection to the AMRF Network.

7) Enter the Esc key to return to the SET COMM menu.

8) Enter the Esc key again to return to the main menu, CELL.

2. UNIVERSITY OF VIRGINIA (UVA) PROTOCOL TO WORKSTATIONS

9) Enter the F7 function key to bring up the Summary display. See Figure 6.

10) Using the arrow keys, highlight the menu option SET_CMDS. Press the Enter key. See Figure 7.

11) For each subordinate workstation that is being used, perform the next 6 steps on each workstation. An example of initializing the Cleaning and Deburring Workstation is shown.

12) Using the arrow keys, highlight the menu option for the workstation desired (for this example use CDWS). Press the Enter key. See Figure 8.

13) Using the arrow keys, highlight the menu option SYNC. Press the Enter key. See Figure 9.

14) Wait for the workstation to return a SHUTDOWN status. See Figure 10.

15) Using the arrow keys, highlight the menu option WARM. Press the Enter key. See Figure 11.

16) Wait for the workstation to return a READY status. See Figure 12.

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17) Enter the Esc key to return to the SET CMDS menu.

18) If there are more subordinate workstations to be initialized, repeat steps 12 through 19 for each workstation.

19) Enter the Esc key, and this will return to the main menu.

20) The cell controller is now fully operational.

IV. OPERATION OF THE CELL

There are two main operations the cell can perform, entering orders and monitoring.

1. ORDER ENTRY

To enter an order do the following.

1) While in the main menu CELL, use the arrow keys to highlight the menu option ORDERS and press the Enter key. See Figure 13.

2) Using the arrow keys, highlight the menu option ENTRY. Press the Enter key. See Figure 14. (The list of orders in the figure is an example of a possible screen.)

3) To select an order use the up and down arrows to highlight the desired order. Once the correct order has been highlighted, press the Enter key. The cell will acknowledge by displaying the message ORDER ACCEPTED, see Figure 15.

4) To enter another order repeat step 3.

5) If there are no more orders to select, press the Esc key. The menu area for the ORDERS screen will return, see Figure 16.

6) Press the Esc key and the main menu CELL will return.

7) To enter more orders in the future return to the ORDER ENTRY screen and repeat steps 2 through 4.

2. MONITORING

The second operation of the cell is to monitor the status messages of the subordinate workstations. This monitoring is displayed on the summary screen. To bring up the summary screen enter the function key F7. An example of the summary screen is shown in Figure 17. The summary screen shows the commands being sent to the subordinate workstations and the status of the workstation. In this example, the Inspection Workstation was given a work order to receive a tray with a lot type of MIXED and quantity of four items in the lot. The Material Handling Workstation is in a READY state.

V. SHUTDOWN

1) Return to the main menu CELL by entering the Esc key until the main menu CELL is on the screen.

2) Using the arrow keys, highlight the menu option SET_CMDS. Press the Enter key.

3) Press the function key F7 to bring up the summary screen. (This will blank out the menu area. The menu area will return when an arrow key is entered.)

4) For each subordinate workstation that is being used, perform the next 4 steps. (An example of shutting down the Cleaning and Deburring Workstation is shown.)

5) Using the arrow keys, highlight the menu option for the workstation desired (for this example use CDWS). Press the Enter key.

6) Using the arrow keys, highlight the menu option SHUTDOWN. Press the Enter key. See Figure 18.

7) Wait for the workstation to return a SHUTDOWN status. The COMPAQ's screen should look roughly like Figure 19 when the SHUTDOWN status has been returned.

8) Enter the Esc key to return to the SET CMDS menu.

9) If there are more subordinate workstations to be shutdown, repeat steps 5 through 8 for each workstation.

10) Using the arrow keys, highlight the menu option EXIT. Press the Enter key. See Figure 20 for the menu portion of the EXIT screen.

11) Using the arrow keys, highlight the menu option YES. Press the Enter key.

12) The COMPAQ computer's prompt should return on the screen.

13) Turn off the power on the COMPAQ computer.

14) The cell controller is now shutdown.

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FIGURES OF CELL SCREENS APPENDIX

CELL

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CYCLE: 2 SCRN:STARTUP SYS:CDWS COMM:OFF TIME:16:08.49

CELL Menu Figure 2

CYCLE:

5 SCRN: STARTUP

SYS:CDWS COMM:OFF

COMM SWITCH Menu Figure 4

TIME:13:39.20

COMM_SWITCH ON OFF EXIT

SET_COMM Menu Figure 3

CYCLE:

4 SCRN:STARTUP

SYS:CDWS COMM:OFF

TIME:13:39.18

SET_COMM COMM_SWITCH COMM_UNIT EXIT ON OFF EXIT

0
2

CELL Menu Figure 6

SET_C	COMM SWITC	SET		SET	STATS	ORDER	S TYPE	SCREEN	STUFF		EXIT		
IIIII Ctlr Name CDWS	 Msg Nr 0	 Tra # - 0 0	IIII nsitio Keywo	on ord)rder - Key	 word	 Ele: &	 ment Plan Ic	111111 1	 Lo	 ot Type & Qty	11111
HWS	0 0	0 0				· · ·							
IWS	0 0	0 0											
MHS	0 0	0 0											
TWS	0 0	0 0											
VWS	0 0	0 0											-
CYCI	E:		2	SCRN	:SUMMAF	RY SY	S:CDWS	COMM: ID	LE TI	IME:13	:31.22	2	

COMM_SWITCH menu Figure 5

CYCLE: 5 SCRN:STARTUP SYS:CDWS COMM:IDLE TIME:13:39.20

COMM_SWITCH ON OFF EXIT

CDWS Menu Figure 8

CYCI	JE:		4	SCRN:S	UMMARY	SYS:CDW	S COM	M:IDLE	TIM	E:16:36.4	17	
VWS	0	0										****
TWS	0 0	0 0										
MHS	0 0	0 0										
IWS	0 0	0 0										
HWS	0	0 0	•									
 Ctlr Name CDWS	 Msg Nr 0 0	 Trai # - 0 0	 nsiti Keyw	 on ord	 Orde # -	 r Keyword	111111	 Element & Plan	 , , , , , , ,	11111111	 Lot Ty & Qty	 vpe v
SYNC	WARM	1 CI	DWS_L	OT_TYPE	RCV_TF	AY DBUR	R_LOT	SHIP_TR	AY :	SHUTDOWN	EXII	

SET_CMDS Menu Figure 7

CDWS

SET_C CDWS SYNC IIIII Ctlr Name CDWS	MDS HWS WARM MSG Nr 0 0	IWS 1 CDWS Transi # - Ke 0 0	MHS LO III Ltion ywo:	TWS I_TYPE IIIIII n rd	VWS VI RCV_TR Orde # -	SION EXIT AY DBURR_I r Keyword	LOT SHIP_TR Element & Plan	AY SHUTDOWN	EXIT IIIIIIIIIIIIII Lot Type & Qty
HWS	0 0	0 0							
IWS	0 0	0 0							
MHS	0 0	0 0							
TWS	0 0	0 0							
VWS	0 0	0 0							
CYC	 LE:		3	SCRN:	SUMMARY	SYS:CDWS	COMM: IDLE	TIME:16:36	.45

CDWS SYNC	WAR	1 CI	WS_L	OT_TYPE	RCV_TRA	Y DBURR_	LOT S	SHIP_T	RAY	SHUTDOWN	EXIT
 Ctlr Name CDWS	 Msg Nr 1 0	 Trar # - 1 0	 nsiti Keywa SYNC	 on ord	 Order # - K	eyword	 F	 Clemen & Pla	l t n Id	11111111	 Lot Type & Qty
HWS	0 0	0 0									
IWS	0 0	0 0									
MHS	0 0	0 0									
TWS	0 0	0 0									
VWS	0 0	0 0									
CYCI	LE:		5	SCRN:SU	MARY	SYS:CDWS	COMM	: IDLE	TIM	E:16:36.	51

CDWS Menu Figure 9

SET_C CDWS SYNC Ctlr Name CDWS	CMDS HWS WARN MSG Nr 1 1	IWS 4 CI Trar # - 1 1	5 MH: DWS_LG IIIII nsitic Keywo SYNC SHUTI	S TWS DT_TYPE Dn Dord DOWN	VWS V: RCV_TI IIIIIII Orde # -	ISION EX RAY DBUF !!!!!!!!! er' Keyword	(IT RR_LOT	SHIP_TR Element & Plan	AY SHUTDC	0WN EX3 Lot 7 & Qt	ТТ :уре :у
HWS	0 0	0 0									
IWS	0 0	0 0									
MHS	0 0	0 0									
TWS	0 0	0 0						*****			
VWS	0 0	0 0									
CYCL	E:		12	SCRN: SU	MMARY	SYS:CDW	S COMM	1:IDLE	TIME:16:3	 7.11	

SET_CMDS Menu Figure 10

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SET	CMDS	Menu
F	Iqure	12

SET_C CDWS SYNC Ctlr Name CDWS	CMDS HWS WARJ IIIII MSG Nr 1 1	IWS M CI Tran # - 1 1	S MH DWS_L IIIII nsiti Keyw WARM READ	S TWS OT_TYPE on ord _STARTUP Y	VWS VI RCV_TH Orde # -	ISION RAY DE !!!!!! er Keywoi	EXIT SURR_ cd	LOT S E	HIP_TR lement & Plan	AY : iiii Id	SHUTDOW1	N EXI Lot T & Qt	T ype y
HWS	0 0	0 0				88 93 93 93 93 93 93 93 93 93		~~~~					600 CP 600 600 60 60 60 60 60
IWS	0 0	0 0		*******	****								
MHS	0	0 0											
TWS	0 0	0 0											
VWS	0 0	0	**										
CYC	LE:		19	SCRN:SU	MMARY	SYS:(CDWS	COMM:	IDLE	TIM	E:16:37	. 31	

CDWS Menu Figure 11

SYNC	WARI	M C	DWS_L	OT_TYPE	RCV_TF	AY DBU	JRR_LOT	SHIP_T	RAY	SHUTDOWN	EXIT	
 Ctlr Name CDWS	 Msg Nr 1 1	 Tra: # - 1 1	 nsiti Keyw WARM SHUT	 on ord _STARTUP DOWN	 Orde # -	 r Keyword	1	 Elemen & Pla	 t n Id	 La	ililili ot Type ⊊Qty	11
HWS	0 0	0 0										60 60
IWS	0 0	0 0			*****							
MHS	0 0	0 0							3 - 			
TWS	0 0	0 0										B est
VWS	0 0	0 0		GB	- 40 cs cs cs cs 40	62 68 63 69 68 68 68 68		8 ******	80 450 460 463 48			2 600
CYCI			13	SCRN:SUM	MARY	SYS:CE	WS CO	MM: TDLE	 ጥፕሥ	E • 16 • 37 14		30

CDWS SYNC

ORDER ENTRY Screen Figure 14

3 SCRN:SEQS

SYS:CDWS COMM:IDLE TIME:16:11.51

BATCH_ID SEQ PART_ID FILE IWS_510 IWS_520 IWS_530 CWS_400 CWS_440 CWS_440 CWS_410 CWS_430 1 MIXED_510 2 MIXD_520 PLAN5 PLAN22 3 MIXED_530 PLAN6 4 DOG PLAN20 5 LCLEVIS PLAN21 6 BLOCK_FH PLAN7 CWS_430 TWS_303 TWS_305 VWS_200 7 PIPECLAMP_FV PLAN8 8 NIPPLE PLAN19 9 SLBEARING PP_CELL_183 10 LCLEVIS PLAN10

ORDER ENTRY

. ORDERS Menu Figure 13

CYCLE:

CYCLE:

3 SCRN:STARTUP

SYS:CDWS COMM:IDLE TIME:16:11.50

AMRF Cell Version 2.2 August 1987

ORDERS ENTRY STATUS HISTORY EXIT

ORDER ENTRY

SEQ	PART_ID	BATCH_ID	FILE
1 2 3 4 5 6	MIXED_510 MIXED_520 MIXED_530 DOG LCLEVIS BLOCK_FH	IWS_510 IWS_520 IWS_530 CWS_400 CWS_440 CWS_410	PLAN5 PLAN22 PLAN6 PLAN20 PLAN21 PLAN7
7	PIPECLAMP_FV	CWS_430	PLAN8
8	NIPPLE	TWS_303	PLAN19
9	SLBEARING	TWS_305	PP_CELL_183
10	LCLEVIS	VWS_200	PLAN10

ORDER ACCEPTED

SYS:CDWS COMM:IDLE TIME:15:14.42 CYCLE: 4 SCRN:SEQS

> ORDER ENTRY Screen Figure 15

ORDERS ENTRY STATUS HISTORY EXIT

.

ORDER ENTRY

SEQ	PART_ID	BATCH_ID	FILE
1	MIXED_510	IWS_510	PLAN5
3	MIXED_520 MIXED_530	IWS_520 IWS_530	PLAN22 PLAN6
4	DOG	CWS_400	PLAN20
6	BLOCK_FH	CWS_440 CWS_410	PLANZI PLAN7
7	PIPECLAMP_FV NIPPLE	CWS_430	PLAN8
9	SLBEARING	TWS_305	PLANIG PP_CELL 183
10	LCLEVIS	VWS_200	PLAN10 -

CYCLE:

5 SCRN:SEQS SYS:CDWS COMM:IDLE TIME:15:14.46

9

ORDERS Menu Figure 16

15

 Ctlr Name CDWS	 Msg Nr 1 1	 Tran # - 1 1	Keywo WARM READS	SHUTDOWN	 Orden # - 1	[°] r Keyword		 Element & Plat	 t n Id	111111	 Lot & Q	 Type ty
HWS	0 0	0 0										
IWS	0 0	0 0										
MHS	0 0	0 0										
TWS	0 0	0 0										
VWS	0 0	0 0										
CYCI	JE :		22	SCRN: SUMM	IARY	SYS:CDV	NS COM	M:IDLE	TIM	E:16:37	.42	

CELL Menu Figure 17

SYNC WARM CDWS_LOT_TYPE RCV_TRAY DBURR_LOT SHIP_TRAY SHUTDOWN EXIT

SET_C		SET_	CMDS	SEI	STATS	ORI	DERS TIPE	SCREEN	EXII	
ENTRY Ctlr Name CDWS	2 STF Msg Nr 0 0	Tran # - 0 0	HISI IIIIII NSITIC Keywo	 on ord		 Orde: # - 1	 r Keyword	 Elem & P	 ent lan Id	Lot Type & Qty
HWS	0 0	0 0								
IWS	0 0	0 0				2	EXECUTE NO_STATUS	RECE	IVE_TRAY	MIXED 4
MHS	0 1	0 0	READ	(
TWS	0 0	0 0								
VWS	0 0	0 0								
CYCI	LE:		6	SCRI	N:SUMM	ARY	SYS:CDWS	COMM: IDI	E TIME:1	6:11.59

CELL

CDWS

CYCI	LE:		14	SCRN:SU	MARY	SYS:C	DWS	COMM: II	DLE TI	ME:16:56.2	.7
VWS	0 0	0									
TWS	0 0	0 0									
MHS	0 0	0 0									
IWS	0 0	0 0									
HWS	0 0	0 0									
' Ctlr Name CDWS	 Msg Nr 1 1	 Trar # - 1 1	 sitic Keywo WARM SHUTI	IIIIIIII on ord SHUTDOWN OOWN	 Orde # - N	 r Keywor	 :d	 Ele &	 ement Plan Id		 ot Type & Qty
CDWS SYNC	WARN	1 CE	WS_LC	DT_TYPE	RCV_TR	AY DE	BURR_L	OT SHI	IP_TRAY	SHUTDOWN	EXIT

CDWS Menu Figure 19

EXIT YES NO •

EXIT Menu Figure 20

16

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Document describes a compute	er program; SF-185, FIF	PS Software Summary, is attache	d.	
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This manual is designed t	o show a novice	e user how to startup,	operate, a	and shutdown
the cell controller. The	e manual assumes	s the operator knows t	he basic of	eration of
a PC-clone computer. The	ere are four maj	or sections to this n	nanual, basi	c operation of
the cell screen managemer	nt system, start	up of the cell, opera	ation of the	e cell,
and shutdown of the cell.				
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