



Displays designed



ECLS Sum

Smoke

Cabin	1.3	Payload	A↑ B
L Flt Dk	0.0	R Flt Dk	-0.1
Av Bay 1	2.4↑	Av Bay 1	2.3↑
Av Bay 2	-0.1	Av Bay 2	0.3
Av Bay 3	0.0	Av Bay 3	0.2

Atmospher

Cabin P	14.20		
dP/dt HW	-.20↓	BU	-.00
dP/dt Equiv	.00		
% O2	22.2		
ppO2 A	3.26	B	0.00↓
		C	3.26
		1	2
PCS O2 Flow	0.0		0.0
N2 Flow	5.0H		0.0
N2 Qty	131		131

Fans

Av Bay	1	2	3
Fan Sw	AB	AB	AB
Temp	95	90	80
Fan ΔP	3.34	3.36	4.20
IMU Fan	ABC	ΔP	4.44
Cab Fan	AB	ΔP	6.00
HX Out T			67

Water Loop

	1	2
Pump Sw	Off/B	On
Accum Qty %	45	55
Pump Out P	29	63
Out T	89	66
ΔP	0	39
Ich Flow	4	958
Out T	39	43
Cab HX In T	39	43

Freon Loop

	1	2
Pump Sw	B	B
Accum Qty %	32	32
Freon Flow	2165	2165
PL HX Flow	286	286
Aft CP Flow	277	277
Rad In T	113	105
Rad Out T	44	43
Isol Vlv	Rad	Isol
NH3 Pressure	140	250
Evap Out T	30↓	30↓

This shows the Orbit version of the display (more data shown for Atmosphere, Water Loop, Freon Loop) with some malfunctions. The data that was hidden is not needed for any AESP, APCL, EPCL, ASC, ENT, or ORB OPS procedures.

New FDA Class 1 indication: red background with white letters (cabin leak and smoke)

SMOKE

- Av bay 1 has a real fire, av bay 3 has a false fire, Payload A has indications

ATMOSPHERE

- Hardware dP/dt sensor failed, false indication of cabin leak
- PPO2 B is failed
- N2 flow sys 1 sensor OSH

FREON LOOP

- Rad isolation valve 2 has tripped
- Evap Out T Low caused by NH3 leak



ECLS Atmos

Pressure			IMU Fan		
Cabin P		14.70	IMU Fan	A	B C
Ext AL P		14.70	ΔP		4.44
AL-0vbd ΔP		14.70	Hum Sep		
AL-Cabin ΔP		0.00	Humidity Sep	A	B
AL-Vest ΔP		0.00	Waste H2O Qty		32
Air			PCS		
ppO2 A	3.26	B 3.26 C 3.26	O2 Flow	0.0	0.0
ppCO2		2.8	Reg P	100	100
Cabin T		68	N2 Flow	0.0	0.0
HX Out T		67	Reg P	100	100
Humidity %		34	Cntl Vlv	O2	N2
CO2 Cntlr					
Filter ΔP		0.05			
ppCO2		2.6			
Temp		67.7			
Vacuum P		0.0			
Controller		1 2			
Bed A Press	14.7	0.0			
B Press	0.0	0.0			
ΔP	2.25	0.00			

There are six main sections.

Co-location and/or better arrangement of data that was formerly spread out over several displays. Some data hidden based on C-load values.

PRESSURE

- AL-Vest DP is blanked if no vestibule

AIR

- New Humidity value - "weather report"

CO2 CNTLR

- Will be blank if not installed

IMU FAN

- Added fan switch settings

HUM SEP

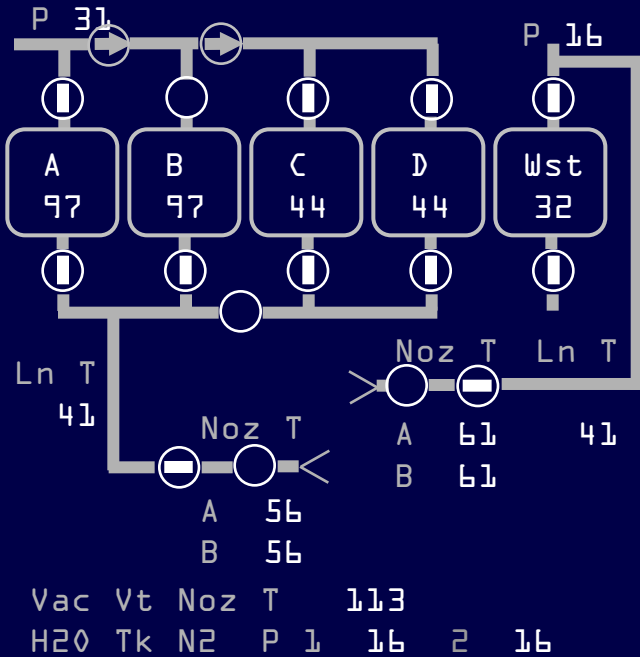
- Added fan switch settings
- Waste H2O qty needed for some mal procedures

PCS

- O2/N2 system

ECLS H2O Thm

Supply/Waste H2O



Airlock Lines

	1	2
LCG Sply P	14.70	14.70
T	60	60
O2 Sply Ln T	60	60
H2O Sply T	60	60
H2O Xfer P		60

FES Temps

	Duct	Noz
Hi Load Inbd	259	
Outbd	259	315
Topping Fwd	247	
Aft	247	
L	157	53
R	157	53
Feedline T	A	B
Fwd	75	75
Mid 1	75	75
2	79	75
Aft	77	77
Topping	77	77
Accum	77	77
Hi Load	77	77
Evap Out T	39	39

Airlock Struc

Int Up	Blkhd T	60
Lwr	Blkhd T	60
Ext Aft	Struc T	60
Vest Temp	1	60
	2	60

There are four main sections.

Co-location and/or better arrangement of data that was formerly spread out over several displays. Some data hidden based on C-load values.

SUPPLY/WASTE H2O

- Graphic shows H2O system layout
- Valves shown as either OP or "not OP" (open circle) due to telemetry limitations

FES TEMPS

- Only used in FES troubleshooting

AIRLOCK LINES

- For O2, H2O transfer between shuttle and airlock

AIRLOCK STRUC

- Bulkhead and structure temps
- Vest temps will be blanked if vestibule not installed



Mech PLBD

AC Power 11 On
 12 Off
 Mode 13 Auto

PLBD Switch

Status 21 Bypass 22 Open
 Fail 23 Stop
 24 Close

BFS

	Man	Op/Cl	Auto	Microswitches	Doors
Sequence Fail	Sel		Seq	Latches	
Center			Fail	CC 00	C RRR 0
Latches 5- 8	30		↓	00 10	ABC
9-12	31	Op		00 11	
1- 4	32	?		01 11	
13-16	33	Op		00 11	
Stbd					
Latches Fwd	34			00 00	
Aft	35			00 00	
Door Fwd	36	Rdy			1 111 0
Aft					0 111 0
Port					
Latches Fwd	37	Cl		11 00	
Aft	38	Cl		11 00	
Door Fwd	39	Cl			1 111 0
Aft					1 101 0

Used for opening and closing the Payload Bay Doors. Combines of BFS SM Spec 63 and PASS SM OPS 202

- Better arrangement of data and fields
- gathered all switch data in one location (was some at top, some at bottom of page)
 - extra blank space between CL, OP, and RDY m/s for easier reading
 - moved door m/s to separate lines for easier reading (was on line with latches)
 - add color to switch status, auto sequence fail, OP/CL dilemma statuses

Added info fields

- BFS - crews need info whether BFS or PASS SM software in use
- Config Fail, Sequence Fail - new displays no longer have a fault line (all msgs go to Fault Sum display)

Mismatched microswitch pairs or triplets turn yellow to bring to crew's attention



Fault Limits

```

Parameter
  11 ID XXXXXXX
  Value= ±XXXXXXXXS
  
```

```

Gnd U/L
  XXX
  
```

Limits

Alert		Backup CW	
Low	Hi	Low	Hi
21 • ±XXXXXXXX	22 ±XXXXX.XX	31 • ±XXXXXXXX	32 ±XXXXX.XX
23 • ±XXXXXXXX	24 ±XXXXX.XX		
25 • ±XXXXXXXX	26 ±XXXXX.XX		
27 Filter XX		37 Filter XX	
28 Ena		38 Ena	
29 • Inh		39 • Inh	

Constant

```

41 ID XXXXXXX
42 Value= ±XXXXXXXXXXXXXXXX
  
```

FDA

```

51 • Ena
52 Inh
  
```

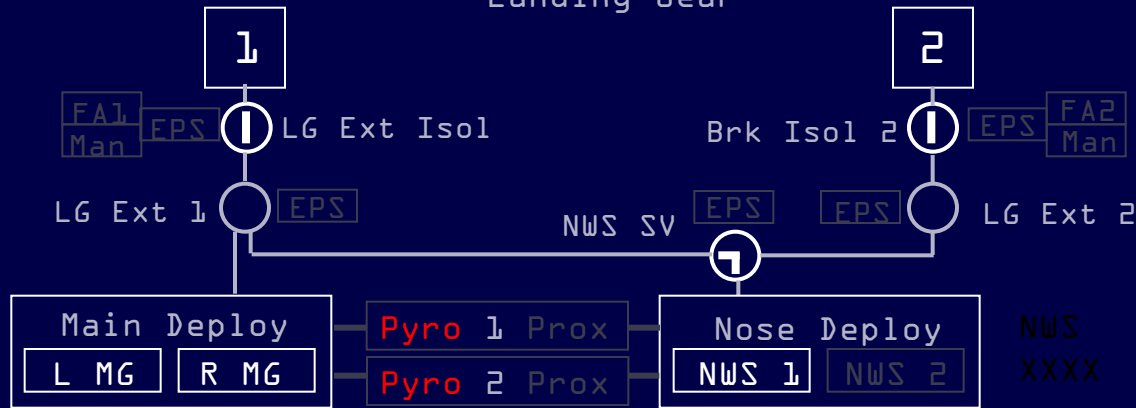
Identical to current SPEC 60 except:

- Checkpoint commands moved to DPS displays
- Comm buffer info moved to Comm displays

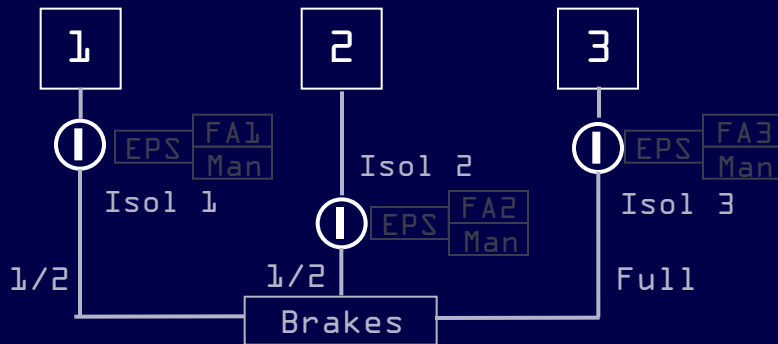
Used for changing Class 2 (Backup CW - Master Alarm) and Class 3 (SM Alert) limits

Hyd Landing

Landing Gear



Brakes



Drag Chute

	CDR	PLT
Arm	X	X
Dpy	X	X
Jet	X	X

SSME Repo Complete

Brake Press

Hyd	L		R	
	0B	IB	IB	0B
1-3	70	70	70	70
2-3	70	70	70	70

Tire Press

Nose	L		R	
	L	L	L	L
Mn IB	L	L	L	L
Mn 0B	L	L	L	L

New display shows schematic of landing gear and brakes systems, plus other data relevant to landing:

- APU status
- Valve status (open or not open)
- Landing gear pyros and prox boxes
- Gear up/down status
- NWS selection
- Drag chute status
- SSME Repositioning, NWS
- Fail status lights duplicate hardware

EPS bus loss logic


- Valves have fail flags next to them for EPS (valve is failed present position), FA# (GPC command to valve won't work), MAN (switch won't work)
- Pyros, prox box, drag chute, NWS status (red = failed)



Mech PL Ret

	Latch				
	1	2	3	4	5
	AB	AB	AB	AB	AB
PL Sel 1					
Latched	11	11	10	11	00
Rdy-for-Lat	11	11	11	11	00
Released	00	00	00	00	00
PL Sel 2					
Latched	00	00	00	00	00
Rdy-for-Lat	00	00	00	00	00
Released	00	00	00	00	00
PL Sel 3					
Latched	00	00	00	00	00
Rdy-for-Lat	00	00	00	00	00
Released	00	00	00	00	00

Better arrangement of data
 (latch/release formerly on
 line to save space, etc.)



Mismatched microswitch pairs
 turn yellow to bring to crew's
 attention

Mech PLBD

AC Power 11 On
12 Off

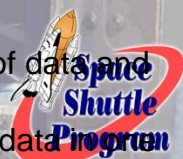
Mode 13 Auto

PLBD Switch

Status 21 Bypass 22 Open
Fail 23 Stop
24 Close

BFS

	Man	Op/Cl	Auto	Microswitches		
Sequence Fail	Sel		Seq	Latches	Doors	
Center			Fail	CC 00	C RRR 0	
Latches 5- 8	30		↓	AB AB	ABC	
9-12	31	Op		00 10		
1- 4	32	?		00 11		
13-16	33	Op		01 11		
Stbd						
Latches Fwd	34			00 00		
Aft	35			00 00		
Door Fwd	36	Rdy			1 111 0	
Aft					0 111 0	
Port						
Latches Fwd	37	Cl		11 00		
Aft	38	Cl		11 00		
Door Fwd	39	Cl			1 111 0	
Aft					1 101 0	



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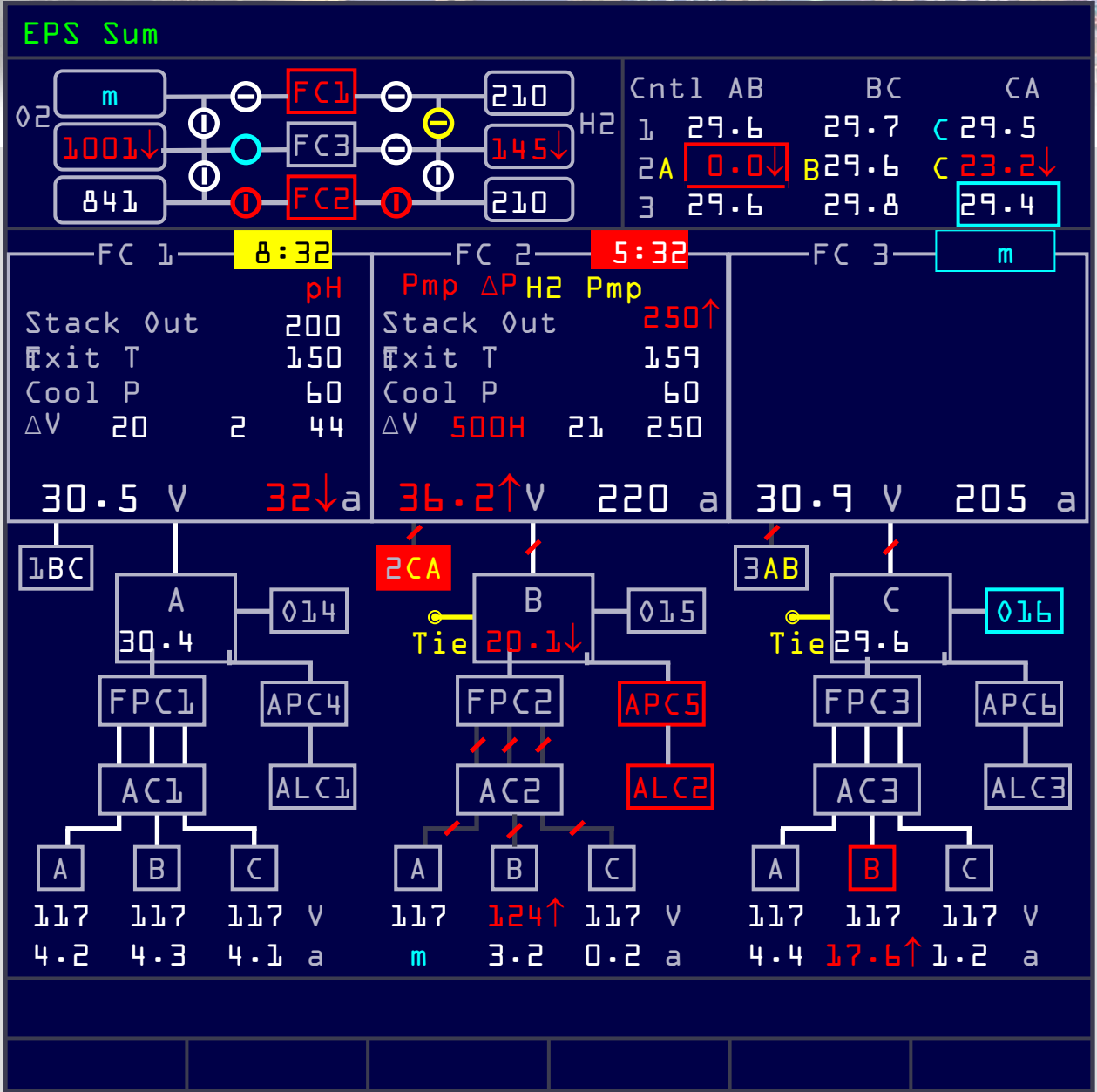
Added info fields

- BFS - need info whether BFS or PASS SM software in use
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Displays co-designed



Cryo section:

- status of fuel cells, reac valves, manifold valves, tank pressures

Control bus:

- RPC status
- box around bus shows Bus Loss Logic status (red = failed, cyan = missing data prevents accurate determination)

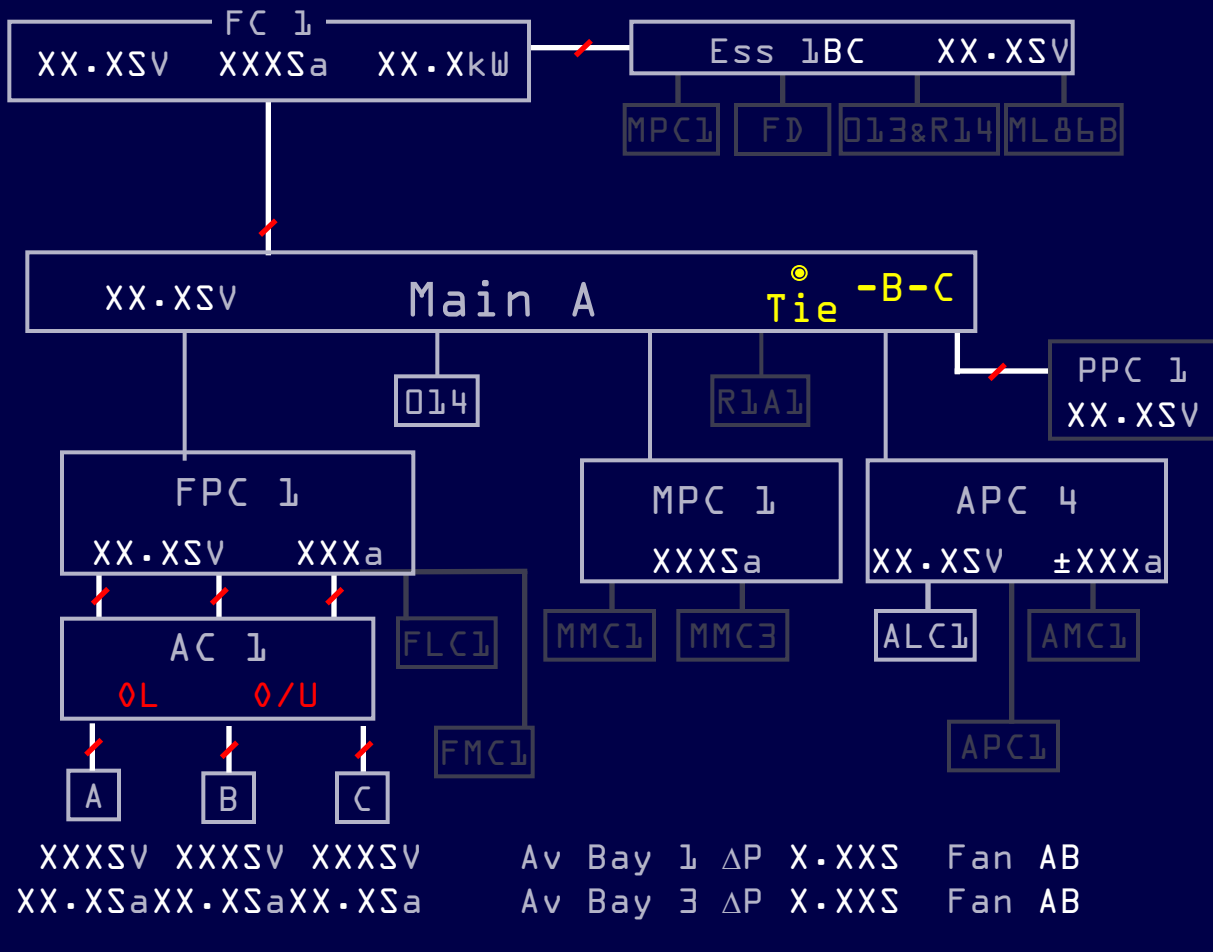
Fuel cell:

- dynamic countdown timer (running in background) based on same calcs as MCC uses on console, tells crew how long they have to shut down FC (yellow -> red -> flashing red)
- if anything inside the box goes out of limits, all data appears (except for pump/pH), otherwise blank

Buses:

- lost bus turns red
- connection TLM is white (nominal) or red slash (disconnected), no TLM is gray
- yellow bus tie status

EPS Main A



Total		XXXXamps	XX.XkW
-------	--	----------	--------

Box color:

- It gray = status OK
- red = bus lost
- cyan = bus loss logic can't tell
- dk gray = info only - no bus loss logic, placeholder for future (INCR 2)

Connection lines:

- white = TLM shows connected
- dk gray w/red slash = TLM shows disconnected
- cyan = TLM missing
- It gray = no TLM
- dk gray = connect to bus w/o logic (bus ID not supported yet)

Essential bus:

- yellow letter = tripped RPC

Bus Tie status

- "Tie" = this bus
- -A, -B, -C = other bus

EDO

- Pallet bus info when installed

Total power

- total amps, kW for all 3 fuel cells

- AC bus overload, over/undervolt indications

- Av bay fan info for 3-phase motor stop mals



Fu Cell

	1	2	3
Power	7.7	5.6	6.6
Voltage	30.2	30.2	30.4
Current	254	186	218
Δamps	68	-32	-36

Stk Out T	204	199	205
In T	180	179	180
Exit T	154	151	150
Cool Press	60	60	60
Pump			ΔP
H2 Pump	0.6	m	0.5
Ready	Yes	Yes	No

O2 Flow	0.0↓	4.1	4.1
Reac	C1		
H2 Flow	-0.2↓	0.2	0.2
Reac	C1		
Total			
Current	658	Power	19.9

		1	2	3
ΔV	SS1	20	40	20
	SS2	500H	2	12
	SS3	18	168↑	20

		H2O		
FC pH			↑	
Common H2O Ln pH				↑
Pri Ln T	140		m	140
Alt Ln T	78	82		76
Rlf Vlv T	75	80		90
Line T		77		
Noz T A	204		B	197
Htr Sw		Off		

Purge				
Ln O2 T		76		
H2 T1	84	T2	73	
			FC2	

Pump Loss Timer		
FC1	FC2	FC3
11 Ena	12 Inh	13 Ena
	:48	5:22

Co-location and/or better arrangement of data that was formerly spread out over several displays (SM SYS SUM 1 & 2, SPEC 69)

Add FC power (kW), stack in T

- Pump loss timer
 - Tells crew how long they have to shut down FC
 - Same comps as used in MCC, based on current state (pumps, temps, etc.), always running in background
 - Yellow if > 5:00, red if < 5:00, flashing red if < 1:00
 - Item entry to enable/disable timer (sensor failures will trick it)



EPS Cryo

O2 Tk		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
Manf	P	870	870							
	Vlv	C1	Op							
Cnt1	P	1000	1000	850	m	870	870	870	870	870
Tk	P	1000	1000↑	850	860	870	870	870	870	870
Qty	%	95	95	95	95	95	95	95	95	95
Fluid	T	-282	-268	-268	-282	-282	-282	-282	-282	-282
Htr	T1	-282	-268	-268	-282	-282	-282	-282	-282	-282
	T2	-282	-268	-268	-282	-282	-282	-282	-282	-282
Htr	Cur	Snsr		Trip						
	<u>1</u>	A/B	/	/	/	A/	m/m	/	/	/
	<u>2</u>	A/B	/	/	/	/	/	/	/B	/

H2 Tk		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
Manf	P	260	260							
	Vlv	C1	Op							
Cnt1	P	260	260	145L	260	260	260	260	260	260
Tk	P	260	260	260	260	260	260	260	260	260
Qty	%	95	95	95	95	95	95	95	95	95
Fluid	T	-400	-400	-400	-400	-400	-400	-400	-400	-400
Htr	T	-400	-400	-400	-400	-400	-400	-400	-400	-400

EDO Pallet	Strc	T	Stbd	A	20	B	20
			Port	A	20	B	20



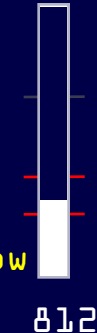
Co-location and/or better arrangement of data that was formerly spread out over several displays (SM SYS SUM 2, SPEC 68, SPEC 168)

- Tanks 4-9 are installed on mission-specific basis - field will be blank if not present (C-load)
- 4-5 are individual tanks
 - 6-9 are EDO pallet
 - Pallet structure temps



Co-location and/or better arrangement of data that formerly spread out over several displays (SM and GNC)

APU Hyd Sum

1	2	3
Inh Hi Speed 113 Accum 3000 	Speed 01 Accum 2600 A 65 B 65 ↓ Low C 65 65 	RPC A Speed 103 Accum 3000 A 800 B 812 ↓ Low C 820 812 
Fuel	Fuel — Cool 3:20	Fuel
Inj T 1200 Qty 100	Inj T 1500 Qty 100	Inj T 1200 Qty 100
Oil	Oil	Oil
In T 250 Out T 270 Out P 65	In T 250 Out T 270 Out P 19	In T 250 Out T 270 Out P 65
Rsvr Pmp Lk	Rsvr Pmp Lk	Rsvr Pmp Lk
T 90 P1 15 Qty 70 P2 15	T 90 P1 15 Qty 70 P2 15	T 90 P1 15 Qty 70 P2 15
WSB H2O Qty 80	WSB H2O Qty 80	WSB H2O Qty 80
PRL? Mode 11 Aut Ovrd 21	PRL ↓ Mode 12 Man Ovrd 22 Des	PRL Mode 13 Man Ovrd 23 Sel

Enhancements over current displays:

- Speed and Auto-Shutdown status shown
- Add Cooldown timer
- Shows all three Hyd P sensors
- Better insight into PRL
- Add second Pump Leak P snsr
- Add APU RPC fail status



APU Details

APU				Fuel Temp			
	1	2	3		1	2	3
Fuel Qty	77	77	77	Tank	70	68	71
Tk P	226	222	228	Skin	69	67	69
Out P	226	222	228	Serv Ln	70	69	70
Tk Vlv A	OP	OP	OP	Tk Vlv A	55	57	56
B	OP	OP	OP	B	55	57	56
Pmp Lk P1	15	15	15	Test Ln	70	72	74
P2	15	15	15	Feed Ln	70	68	71
Line P	226	222	228	Pump In	70	68	71
Inj T	1200	1180	1230	Body	83	84	79
GG Bed T	500H	500H	500H	Drn Ln 1	72	71	73
EGT	1070	1070	1070	2	77	77	78
B/U	1070	1070	1070	Pump Out	70	68	71
Speed	106	103	99	Bypass Ln	70	68	71
Oil In T	175	176	174	GG Sply Ln	69	67	70
Out T	194	195	193	Heatsink	89	88	84
Out P	56	57	57				
GBx P	17	18	17	Injector Cooling			
N2 P	258	259	258		1	2	3
Brg T1	194	195	193	Line T	85	85	85
T2	194	195	193	Tank P	117		
				T	66		

Co-location and/or better arrangement of data that formerly spread out over several displays.

Some of this data was not available in BFS to crew and some not available in PASS (but always available to MCC).

Hyd Details

	Hyd				Temp		
Press A	3161	3164	3142	Circ Pmp In	109	98	109
B	3161	3164	3142	Body	117	103	96
C	3161	3164	3142	Rsvr	113	106	101
Accum P	3152	3152	3152	HX In	152	152	151
Circ Pmp P	80	80	80	Out	142	142	141
Rsvr P	80	80	80	Elevon L 0B	109	98	109
Qty	57	57	57	IB	117	103	96
	WSB			R IB	113	106	101
Cntlr	A	A	A	0B	109	98	109
H2O Qty	95	95	95	Rud SB PDU	117	103	96
N2 P	2458	2465	2464	Fus	113	106	101
T	83	84	84	BdyFlp PDU	109	86	106
Reg P	34	34	34	Fus	110	86	92
Byp Vlv	Byp	Byp	Byp				
Vent T	153	153	153	L Brake Whl		70	72
Tank T	83	83	83	Fus		68	69
Blr T	174	174	174	R Brake Whl	70	72	71
	Hyd Switching Vlv			Fus	70	72	67
	Pri	Sec1	Sec2	NG Uplock	71		
Elevon L 0B	3●	1	2	MFus 1	69		
IB	2●	1	3	2	75		
R IB	3●	1	2	MG Uplock L	70		
0B	2●	1	3	R	67		
Rud Spdbk	1●	2	3	Fus	72		

Co-location and/or better arrangement of data that formerly spread out over several displays.



Some of this data was not available in BFS to crew and some not available in PASS (but always available to MCC).



Fault Sum

ECLSS			
Water Loop	1	2	
Freon Loop	1	2	
Evap Out T	XXXX	XXXX	
Av Bay	1	2	3
Cabin	Atmos	Fan	

DPS					
GPC	X	X	X	X	
1	FF	1	2	3	4
	FA	1	2	3	4
2	BFS	1	2	3	4
	PL	1	2		
3	CDP	A	B	C	
	GNC				
4	IMU	1X	2X	3X	
	XXX	1X	2X	3X	
5	ADTA	1X	2X	3X	
	AA	1X	2X	3X	4X
	RGA	1X	2X	3X	4X
	FCS	1	2	3	4
Fdbk	1	2	3	4	

Fire/Smoke

dP/dt

XXX
XXXXX

BFS
GNC
Fail

BFS
Stand
alone

Msg
XX XX

UL XXX +hh:mm:ss
T2 +hh:mm:ss
RCS

X Y Z
Low Z Brk Low Z Att
OMS MPS

L R Center
Left Right

APU Hyd
Hyd 1? 2? 3?
Inh Hi Inh Hi Inh Hi
XXXX XXXX XXXX

EPS
Cryo 02 H2
FC 1 2 3
mm:ss mm:ss mm:ss

Main T-A T-B T-C
Subbus a b c
AC 1 2 3
Ess 1BC 2CA 3AB
Cntl AB1 BC1 CA1
AB2 BC2 CA2
AB3 BC3 CA3

XXXXX XXXXXXXXXXXXXXXXXXXX XXXXX XXXXXXXXXXXXXXXXXXXX
XXXXX XXXXXXXXXXXXXXXXXXXX XXXXX XXXXXXXXXXXXXXXXXXXX
XXXXX XXXXXXXXXXXXXXXXXXXX XXXXX XXXXXXXXXXXXXXXXXXXX

All fields shown

Center column

- Fire/Smoke and dP/dt lights same as on ECLSS SUM display
- other three boxes are DPS (3rd box is "Set Split" or "Non Univ", 4th box is BFS total fail or just BFS GNC fail)

DPS

- current GPC/MDM/CDP status, strings, BFS tracking

GNC (nav, cntl)

- LRU status ("XXX" = "TAC" or "GPS")

APU Hyd

- "?" is for PRL status
- "XXXX" is for cooldown timer
- "Inh Hi" is for switch settings

EPS

- Cryo/FC red if any problem
- FC shutdown timers
- bus tie info, bus/subbus status ("a" if FPC1, MPC1, APC4, ALC1, or O14)
- AC, ESS, Cntl if any problems

UL = uplink

T2 = 2nd timer, from TIME display