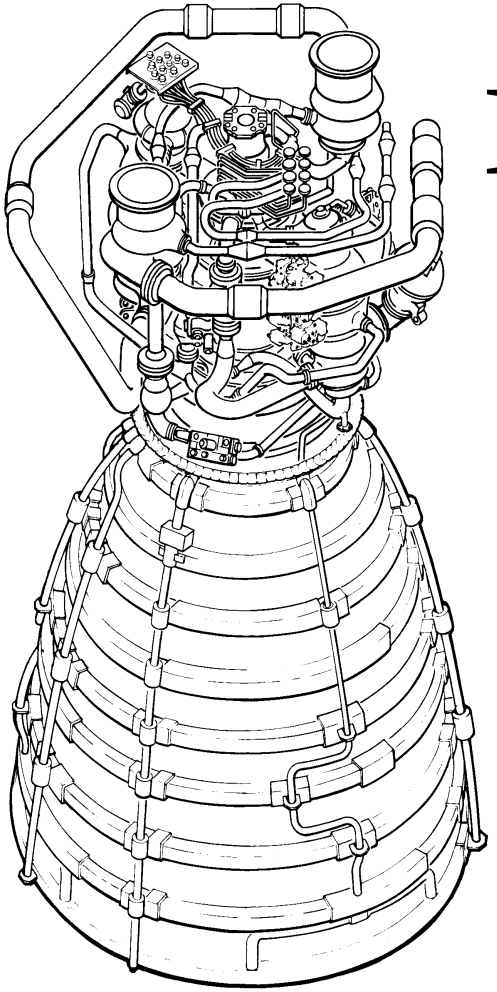

Endeavour STS-100

Space Shuttle Program

SSME Flight Readiness Review

April 5, 2001

G. HOPSON
05 April 2001

Endeavour STS-100

Agenda

- **Major Components**
- **Engine Performance**
- **First Flight ECPs -** None
- **Material Review Reassessment**

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SSME Major Components

Engine	ME-1 (2054) *Block IIA*	ME-2 (2043) *Block IIA*	ME-3 (2049) *Block IIA*
Last Hot-Fire	**STS-97**	**STS-97**	**STS-97**
Powerhead	2036	6013	6019
Main Injector	6010	2033	6011
MCC	6019	6006	6015
Nozzle	2030	5004	4028
Controller	F61	F55	F41
HPFTP	6113R1	6015R3	6017 (1)
LPFTP	4405 (1)	2130R3	4210
HPOTP	8017R1	8021	8016R4
LPOTP	6005	6001	2133

(1) changes from last flight.

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Predicted SSME Ignition Confirm Margins

Calculations use Block IIA Flight database sigmas

Parameter	Margin Sigma		
	ME-1 (2054)	ME-2 (2043)	ME-3 (2049)
HPFTP Minimum Speed	6.1	7.4	6.3
Min/Max Ignition Pc	4.7	4.7	**a [2.3]**
Antiflood Valve Min Open	22.9	25.1	24.0
HPFTP Max Turbine Temp (1760 Limits)	4.2	9.0	5.5
HPOTP Max Turbine Temp (1460 Limits)	5.3	4.2	3.5
HPOTP Min Turbine Temp (720 Min @ 4.0 secs)	5.8	7.9	7.7
Preburner Max Purge Pressure (715/100 Limits)	25.0	24.6	24.9
POGO GOX Min/Max Pressure	16.4	10.0	19.7

[ ] Less than 3 sigma margin

a 4.1 sigma margin using an engine run-to-run database

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Predicted SSME Performance at 104.5% P.L.

At Engine Start + 200 seconds
(MR = 6.032, OPI = 69 psia, FPI = 28 psia)
Calculations use Block IIA 14 Engine database sigmas

Parameter	Block IIA 14 Engine Average	ME-1 (2054)		ME-2 (2043)		ME-3 (2049)	
		Predict	Sigma	Predict	Sigma	Predict	Sigma
HPFT Disch Temp A, Deg R	1609	1656	1.0	**1481**	**b [-2.8]**	1594	-0.3
HPFT Disch Temp B, Deg R	1601	1598	-0.1	**1452**	**b [-3.3]**	1572	-0.6
HPOT Disch Temp A, Deg R	1227	1139	**a [-2.3]**	1185	-1.1	1270	1.1
HPOT Disch Temp B, Deg R	1212	1201	-0.3	1212	0.0	1278	1.7
HEX Interface Temp, Deg R	823	782	-1.8	809	-0.6	854	1.3
HPFTP Speed, rpm	34301	34352	0.2	34081	-0.9	34221	-0.3
LPFTP Speed, rpm	15708	15611	-0.3	15419	-0.9	15463	-0.8
HPOTP Speed, rpm	22325	22060	-1.8	22290	-0.2	22042	-1.9
LPOTP Speed, rpm	5026	5050	0.6	5012	-0.4	5062	1.0
OPOV Position, %	63.6	63.3	-0.3	63.2	-0.5	**65.3**	**c [2.2]**
FPOV Position, %	76.5	76.9	0.6	76.1	-0.5	76.9	0.6
PBP Disch Pressure, psia	6908	6868	-0.5	6913	0.1	6810	-1.2
HPFTP Disch Pressure, psia	5653	5685	0.9	5672	0.5	5653	0.0
HPOTP Disch Pressure, psia	3805	3802	-0.1	3813	0.3	3792	-0.4
	HPFTP U/N	6113R1		6015R3		* 6017	
	LPFTP U/N	* 4405		2130R3		4210	
	HPOTP U/N	8017R1		8021		8016R4	
	LPOTP U/N	6005		6001		2133	

***** Change since last hot-fire
[ ] Exceeds database two sigma

a Channel A-B delta large due to coolant flow distribution
b Powerhead influence, consistent for this engine
c Effect of high efficiency HPFTP and low PBP Disch Pres

Endeavour STS-100

Predicted Redline Margins at 104.5% P.L.

Calculations use Block IIA Flight database sigmas

Parameter	Redline Limit	Margin Sigma		
		ME-1	ME-2	ME-3
HPFT Discharge Temp ChA, Deg R	1860 Max	5.3	9.6	6.5
HPFT Discharge Temp ChB, Deg R	1860 Max	7.4	11.9	8.3
HPOT Discharge Temp ChA, Deg R	1660 Max	8.7	7.4	6.3
HPOT Discharge Temp ChB, Deg R	1660 Max	8.9	8.3	7.3
HPOT Discharge Temp ChA, Deg R	720 Min	4.5	5.4	7.0
HPOT Discharge Temp ChB, Deg R	720 Min	5.4	5.5	7.1
HPOTP IMSL Purge Pr, psia	159 Min	7.6	7.1	5.8
HPFTP Coolant Liner Pressure, psia	3392 Max	16.1	14.9	16.7
Low MCC Pc, psid				
Command-ChA Avg	200 Max	25.7	24.4	23.1
Command-ChB Avg	200 Max	30.7	29.4	28.1
FASCOS				
HPFTP (16 GRMS)	Not	17.6	15.0	14.6
HPOTP (11 GRMS)	Active	35.8	35.4	34.6

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Significant MR Review

	2054		2043		2049	
	MRs	**PMRB***	**MRs**	**PMRB***	**MRs**	**PMRB***
Powerhead	127	63	99	52	86	44
MCC	15	7	28	11	18	8
Nozzle	80	48	101	65	95	32
Controller	2	0	0	0	1	0
HPFTP	175	84	159	71	190	78
LPFTP	65	16	57	17	59	17
HPOTP/AT	184	49	152	51	243	61
LPOTP	26	10	36	17	38	15
Assembly Ops	141	36	122	39	119	40
Ducts/Interconnects	106	57	95	63	106	65
Totals	**921**	**370**	**849**	**386**	**955**	**360**

Total PMRB MRs = **1116**
Total MRs = **2725**

*MRs that would meet today's Rocketdyne PMRB criteria

All dispositions reassessed and found acceptable for flight

Endeavour STS-100

SSME Certification of Flight Readiness

- **Flight Readiness Review CoFR Exception**
  - NONE

Endeavour STS-100

SSME Readiness Statement

- **The Endeavour Main Engines are in a ready condition for STS-100**

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