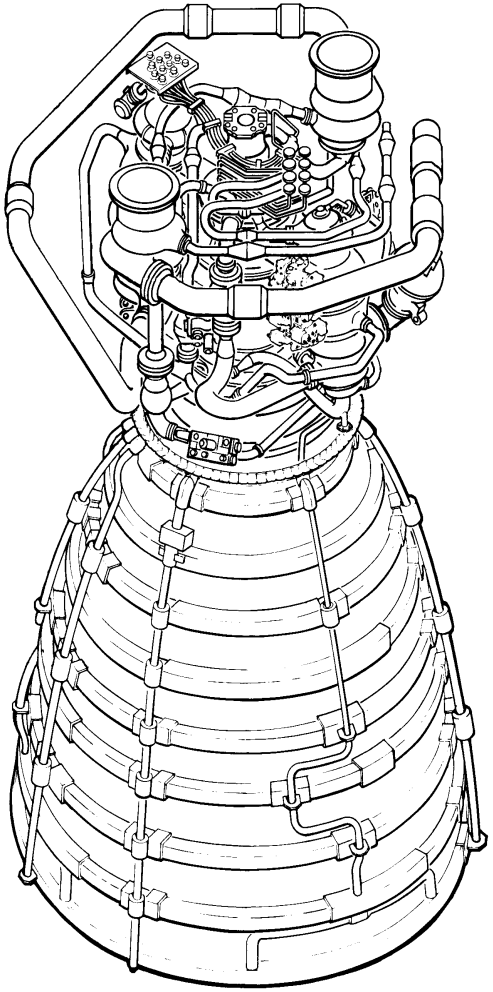

Discovery STS-102

Space Shuttle Program

SSME Flight Readiness Review

February 27, 2001

G. HOPSON
27 February 2001

Discovery STS-102

Agenda

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

Discovery STS-102

SSME Major Components

Engine	ME-1 (2048) *Block IIA*	ME-2 (2053) *Block IIA*	ME-3 (2045) *Block IIA*
Last Hot-Fire	**STS-92**	**STS-92**	**STS-92**
Powerhead	6021	6020	6008
Main Injector	6015	6020	4026
MCC	6012	6018	6008
Nozzle	4026 (1)	5006	4023
Controller	F45	F44	F34
HPFTP	6011R1	4214 (1)	6016 (1)
LPFTP	4207	5101	6003
HPOTP	8019R1	8031	8023R1
LPOTP	2236	2135	4506

(1) Changes from last hot-fire.

Discovery STS-102

Predicted SSME Ignition Confirm Margins

Calculations use Block IIA Flight database sigmas

Parameter	Margin Sigma		
	ME-1 (2048)	ME-2 (2053)	ME-3 (2045)
HPFTP Minimum Speed	7.4	6.9	8.1
Min/Max Ignition Pc	4.7	4.9	4.7
Antiflood Valve Min Open	25.1	24.0	25.1
HPFTP Max Turbine Temp (1760 Limits)	5.9	5.1	6.4
HPOTP Max Turbine Temp (1460 Limits)	4.8	3.6	6.3
HPOTP Min Turbine Temp (720 Min @ 4.0 secs)	6.0	7.4	5.5
Preburner Max Purge Pressure (715/100 Limits)	25.4	24.4	25.2
POGO GOX Min/Max Pressure	3.1	3.4	4.3

Discovery STS-102

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 (2048)		ME-2 (2053)		ME-3 (2045)	
		Predict	Sigma	Predict	Sigma	Predict	Sigma
HPFT Disch Temp A, Deg R	1609	1593	-0.3	1600	-0.2	1577	-0.7
HPFT Disch Temp B, Deg R	1601	1602	0.0	1620	0.4	1554	-1.0
HPOT Disch Temp A, Deg R	1227	1240	0.3	1252	0.7	1149	-2.0
HPOT Disch Temp B, Deg R	1212	1258	1.2	1281	1.8	1168	-1.1
HEX Interface Temp, Deg R	823	842	0.8	855	1.4	811	-0.5
HPFTP Speed, rpm	34301	34114	-0.8	34488	0.8	33859	-1.8
LPFTP Speed, rpm	15708	15929	0.7	15539	-0.6	15549	-0.5
HPOTP/AT Speed, rpm	22325	22340	0.1	22265	-0.4	22400	0.5
LPOTP Speed, rpm	5026	5002	-0.7	4970	-1.5	5067	1.1
OPOV Position, %	63.6	64.8	1.6	64.5	1.2	63.8	0.3
FPOV Position, %	76.5	75.5	-1.3	**78.7**	**a [3.1]**	75.0	-2.0
PBP Disch Pressure, psia	6908	6914	0.1	**6716**	**b [-2.4]**	7022	1.4
HPFTP Disch Pressure, psia	5660	5657	-0.1	5677	0.5	5611	-1.4
HPOTP Disch Pressure, psia	3805	3797	-0.3	**3731**	**b [-2.6]**	3823	0.6
	HPFTP U/N	6011R1		* 4214		* 6016	
	LPFTP U/N	4207		5101		6003	
	HPOTP U/N	8019R1		8031		8023R1	
	LPOTP U/N	2236		2135		4506	

[ ] Exceeds database two sigma
a Effect of low PBP Discharge Pressure and high HPFTP turbine flow area
b Low lox side resistance. Consistent with engine's history

Discovery STS-102

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	6.4	6.3	7.1
HPFT Discharge Temp ChB, Deg R	1860 Max	7.2	6.8	8.9
HPOT Discharge Temp ChA, Deg R	1660 Max	6.9	6.7	8.5
HPOT Discharge Temp ChB, Deg R	1660 Max	7.8	7.2	9.5
HPOT Discharge Temp ChA, Deg R	720 Min	5.2	6.6	4.4
HPOT Discharge Temp ChB, Deg R	720 Min	5.6	6.9	4.5
HPOTP/AT IMSL Purge Pr, psia	159 Min	4.1	4.8	7.3
HPFTP Coolant Liner Pressure, psia	3392 Max	15.2	14.2	16.2
Low MCC Pc, psid				
Command-ChA Avg	200 Max	24.4	24.2	24.0
Command-ChB Avg	200 Max	28.5	30.4	30.5
FASCOS				
HPFTP (16 GRMS)	Not	16.8	17.1	16.5
HPOTP (11 GRMS)	Active	33.7	31.0	34.6

Discovery STS-102

Significant MR/PR Review

	2048		2053		2045	
	MRs	* PMRB	MRs	* PMRB	MRs	* PMRB
Powerhead	72	39	72	37	129	81
MCC	18	9	15	10	19	8
Nozzle	82	30	74	33	94	55
Controller	2	1	2	1	1	1
HPFTP	61	8	154	43	173	29
LPFTP	34	11	39	12	46	8
HPOTP/AT	161	65	156	52	136	58
LPOTP	26	5	45	6	35	6
Assembly Ops	128	33	121	34	129	37
Ducts/Interconnects	123	83	118	76	67	40
	707	**284**	**796**	**304**	**829**	**323**

Total PMRB MRs = 911
Total MRs = 2332

*MRs that would meet today's Rocketdyne PMRB criteria

All dispositions reviewed and found acceptable for flight

Discovery STS-102

SSME Certification of Flight Readiness

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

Discovery STS-102

SSME Readiness Statement

- **The Discovery Main Engines are in a ready condition for STS-102**

G.D. Hopson
Manager
SSME Project

J. S. Paulsen
Program Manager
Space Shuttle Main Engine