MARS GLOBAL SURVEYOR

LAUNCH WINDOW ANALYSIS

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LAUNCH WINDOW ANALYSIS

LAUNCH WINDOW CONCERN (FROM EASTERN TEST RANGE):

MGS PROJECT NEEDS TO BE ABLE TO ACCEPT A VARIATION IN ITS NOMINAL LIFTOFF TIME IN ORDER TO ACCOMODATE THE ISSUANCE OF A COLLISION AVOIDANCE (COLA) WARNING NEAR THE TIME OF LAUNCH

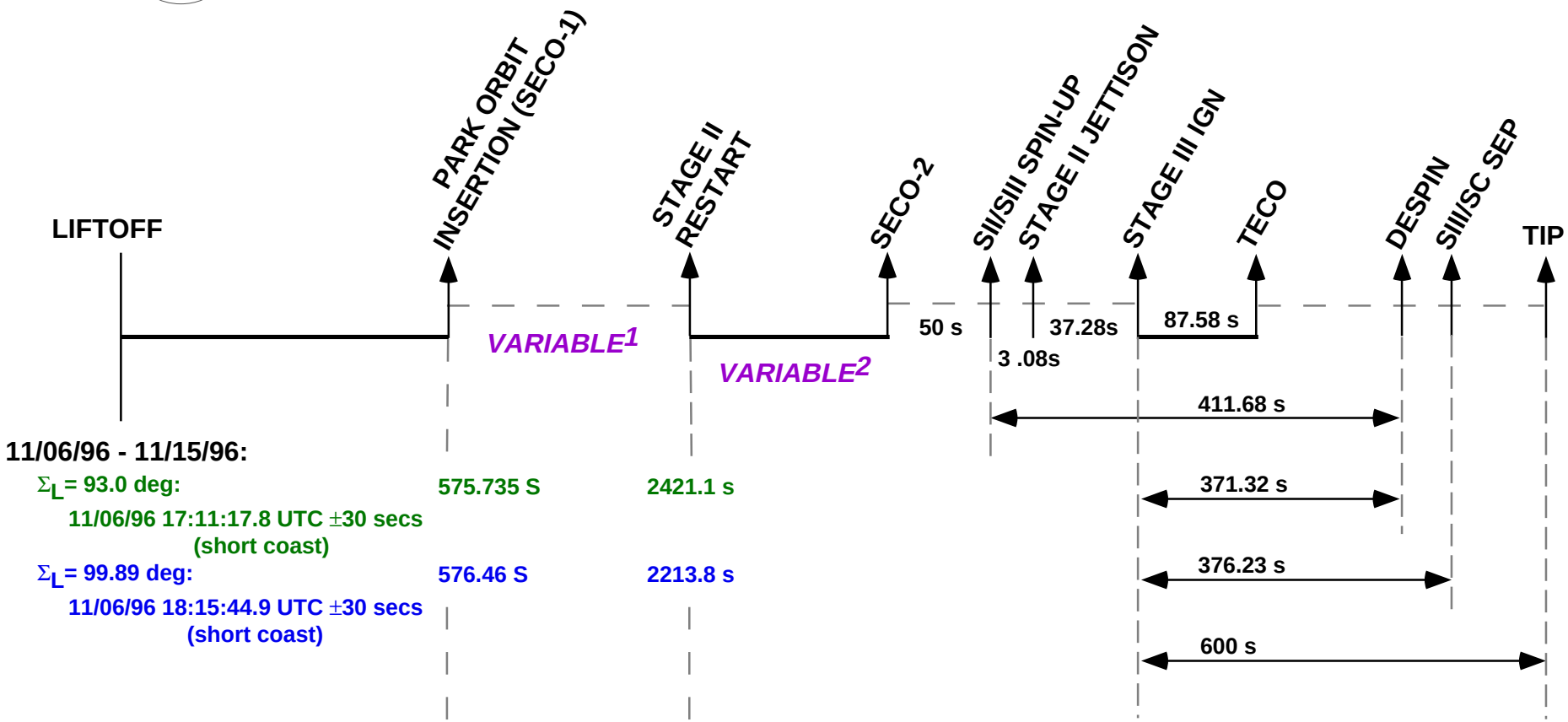
DEFINITIONS:

- LAUNCH PERIOD - SET OF CONTIGUOUS LAUNCH DATES WHICH PROVIDE OPPORTUNITIES FOR INJECTION ONTO INTERPLANETARY TRANSFER TRAJECTORIES TO MARS (MGS: 11/6/96 - 11/25/96)
- LAUNCH WINDOW - INTERVAL OF TIME DURING A LAUNCH DAY FOR WHICH A LAUNCH IS PLANNED (MGS: “INSTANTANEOUS” WINDOWS)

ANALYSIS APPROACH:

- ASSUME THE DELTA II FLIGHT PROFILES DEVELOPED BY JPL FOR THE MGS FINAL TARGET SPECIFICATION DOCUMENT (RECALL THAT DELTA FLIES A “FIXED EARTH RELATIVE” FLIGHT PROFILE)
- CREATE OFF-NOMINAL INJECTION STATE VECTORS WHICH ARE CORRUPTED BY A LIFTOFF TIME ERROR OF ±30 SECONDS
- CORRECT INJECTION ERRORS ABOVE AT TCM-1 (L+15 DAYS) - TARGET TO ACHIEVE THE BIASED PQ INJECTION TARGETS (B•T, B•R, TF)
- ASSESS ΔV PENALTY AT TCM-1

DELTA II 7925A FLIGHT PROFILE TIMELINE



11/06/96 - 11/15/96:

Σ_L = 93.0 deg: 575.735 S 2421.1 s
11/06/96 17:11:17.8 UTC ±30 secs
(short coast)

Σ_L = 99.89 deg: 576.46 S 2213.8 s
11/06/96 18:15:44.9 UTC ±30 secs
(short coast)

11/16/96 - 11/25/96:

Σ_L = 110.0 deg: 582.678 s 2027.815 s
11/16/96 18:36:32.8 UTC ±30 secs
(short coast)

[1]VARIABLE - Parking Orbit to Stage II Restart Burn Coast Time Varies For Each Launch Opportunity

[2]VARIABLE - Stage II Restart Burn Duration and Attitude Veries For Each Launch Opportunity

POST-SECO-2 Timeline Is The Same For All Launch Opportunities

Assume Stage III Burn Direction Same as Stage II

LAUNCH WINDOW ANALYSIS - RESULTS

1996 Launch Date DD-MM	PQ Biased DPTRAJ C3 (TIP) (km^2/s^2)	PQ Biased DPTRAJ DLA (TIP) ETEDate (deg)	PQ Biased DPTRAJ RLA (TIP) ETEDate (deg)	TIP Time (UTC) (SIII Ign + 10 Min) HH:MM:SS.S	PQ Biased[1] Injection B.T (km)	PQ Biased[1] Injection B.R (km)	PQ Biased Injection Arrival Date/Time (ET)	Flight Time Bias From Nom.[1] (hr)
06-Nov	10.1656	21.2986	173.2447	18:05:15.4	-44000.	-52000.	9/11/97 04:27:53	3.
06-Nov	10.1551	21.3232	173.2428	19:06:15.3	-44000.	-52000.	9/11/97 04:27:53	3.
15-Nov	8.9811	27.7711	171.7873	15:30:18.7	66000.	-50000.	9/15/97 13:21:07	12.
15-Nov	8.9725	28.2002	171.2898	16:43:34.0	66000.	-50000.	9/11/97 12:48:46	-84.5
16-Nov	8.9162	28.7509	171.5398	19:23:49.3	116000.	-46000.	9/16/97 17:19:29	16.
25-Nov	9.2576	36.4871	169.6936	16:04:54.0	82000.	-49000.	9/22/97 11:10:01	10.

1996 Launch Date DD-MM	LO-30 sec C3 (TIP) (km^2/s^2)	LO-30 sec DLA (TIP) ETEDate (deg)	LO-30 sec RLA (TIP) ETEDate (deg)	LO-30 sec ΔC3 (TIP) (km^2/s^2)	LO-30 sec ΔDLA (TIP) ETEDate (deg)	LO-30 sec ΔRLA (TIP) ETEDate (deg)	LO-30 sec TIP Time (UTC) HH:MM:SS.S	LO-30 sec Injection B.T (km)	LO-30 sec Injection B.R (km)	LO-30 sec Arrival Date/Time (ET)	LO-30 sec TCM-1 ΔV Penalty (m/s)
06-Nov	10.1661	21.2983	173.1184	0.0005	-0.0003	-0.1263	18:04:45.4	-111726.	-47104.	9/11/97 09:56:10	8.8
06-Nov	10.1549	21.3231	173.1176	-0.0002	-0.0001	-0.1252	19:05:45.3	-108183.	-47624.	9/09/97 11:11:12	8.8
15-Nov	8.9824	27.7712	171.6604	0.0012	0.0001	-0.1269	15:29:48.7	55783.	-69821.	9/14/97 04:11:26	8.2
15-Nov	8.9735	28.1999	171.1629	0.0010	-0.0002	-0.1269	16:43:04.0	32400.	-69119.	9/10/97 04:37:57	8.4
16-Nov	8.9155	28.7511	171.4157	-0.0007	0.0002	-0.1242	19:23:19.3	64730.	-67048.	9/15/97 12:48:08	7.9
25-Nov	9.2586	36.4870	169.5665	0.0011	-0.0001	-0.1271	16:04:24.0	30858.	-88017.	9/21/97 13:27:25	8.0

1996 Launch Date DD-MM	LO+30 sec C3 (TIP) (km^2/s^2)	LO+30 sec DLA (TIP) ETEDate (deg)	LO+30 sec RLA (TIP) ETEDate (deg)	LO+30 sec ΔC3 (TIP) (km^2/s^2)	LO+30 sec ΔDLA (TIP) ETEDate (deg)	LO+30 sec ΔRLA (TIP) ETEDate (deg)	LO+30 sec TIP Time (UTC) HH:MM:SS.S	LO+30 sec Injection B.T (km)	LO+30 sec Injection B.R (km)	LO+30 sec Arrival Date/Time (ET)	LO+30 sec TCM-1 ΔV Penalty (m/s)
06-Nov	10.1661	21.2983	173.3691	0.0005	-0.0003	0.1244	18:05:45.4	32120.	-56169.	9/12/97 21:06:16	8.6
06-Nov	10.1549	21.3231	173.3683	-0.0002	-0.0001	0.1255	19:06:45.3	36059.	-56426.	9/12/97 22:17:32	8.7
15-Nov	8.9824	27.7712	171.9110	0.0012	0.0001	0.1238	15:30:48.7	118995.	-31463.	9/16/97 18:04:32	8.0
15-Nov	8.9735	28.1999	171.4136	0.0010	-0.0002	0.1237	16:44:04.0	96621.	-31849.	9/12/97 17:07:48	8.2
16-Nov	8.9155	28.7511	171.6663	-0.0007	0.0002	0.1265	19:24:19.3	182602.	-23773.	9/17/97 23:56:46	8.1
25-Nov	9.2586	36.4870	169.8172	0.0011	-0.0001	0.1236	16:05:24.0	119253.	-15478.	9/23/97 05:08:13	8.1

LAUNCH WINDOW ANALYSIS - CONCLUSIONS

- PENDING

LAUNCH PERIOD DESIGN - NOMINAL INJECTION

Launch Attempt	Launch Day	1996 Launch Date DD-MM	Launch Azimuth (deg)	Park Orbit Inc (deg)	JPL Estimated Short Coast Lift-Off Time (UTC) HH:MM:SS.S	Liftoff Time Separation ΔT HH:MM:SS	Injection Time (UTC) (TECO) HH:MM:SS.S	TIP Time (UTC) (SIII Ign + 10 Min) HH:MM:SS.S	PQ Biased DPTRAJ C3 (TIP) (km^2/s^2)	PQ Biased DPTRAJ DLA (TIP) EME2000 (deg)	PQ Biased DPTRAJ RLA (TIP) EME2000 (deg)
1	1	06-Nov	93.00	28.470	17:11:17.8	-	17:56:43.0	18:05:15.4	10.1656	21.2815	173.2868
2	1	06-Nov	99.89	29.818	18:15:44.9	01:04:27	18:57:42.8	19:06:15.3	10.1551	21.3062	173.2849
3	2	07-Nov	93.00	28.470	17:00:50.9	-	17:46:36.0	17:55:08.4	9.9846	21.8151	173.3121
4	2	07-Nov	99.89	29.818	18:05:57.0	01:05:06	18:48:12.7	18:56:45.1	9.9747	21.8430	173.3104
5	3	08-Nov	93.00	28.470	16:48:12.0	-	17:34:22.2	17:42:54.6	9.7984	22.4474	173.1808
6	3	08-Nov	99.89	29.818	17:54:09.8	01:05:58	18:36:47.9	18:45:20.3	9.7890	22.4782	173.1780
7	4	09-Nov	93.00	28.470	16:35:21.2	-	17:21:59.1	17:30:31.5	9.6412	23.0918	173.1528
8	4	09-Nov	99.89	29.818	17:42:19.4	01:06:58	18:25:21.9	18:33:54.4	9.6324	23.1246	173.1488
9	5	10-Nov	93.00	28.470	16:20:05.9	-	17:07:17.2	17:15:49.6	9.4837	23.8150	172.9559
10	5	10-Nov	99.89	29.818	17:28:23.3	01:08:17	18:11:55.0	18:20:27.4	9.4755	23.8502	172.9506
11	6	11-Nov	93.00	28.470	16:04:47.3	-	16:52:33.9	17:01:06.3	9.3549	24.5143	172.8633
12	6	11-Nov	99.89	29.818	17:14:37.2	01:09:50	17:58:39.2	18:07:11.7	9.3473	24.5515	172.8567
13	7	12-Nov	93.00	28.470	15:46:14.8	-	16:34:45.2	16:43:17.6	9.2314	25.2983	172.6072
14	7	12-Nov	99.89	29.818	16:58:14.9	01:12:00	17:42:53.8	17:51:26.2	9.2246	25.3382	172.5995
15	8	13-Nov	93.00	28.470	15:24:50.7	-	16:14:13.9	16:22:46.3	9.1257	26.1236	172.3150
16	8	13-Nov	99.89	29.818	16:39:57.4	01:15:07	17:25:19.1	17:33:51.5	9.1198	26.1667	172.3063
17	9	14-Nov	93.00	28.470	15:02:15.4	-	15:52:36.8	16:01:09.2	9.0466	26.8873	172.1402
18	9	14-Nov	99.89	29.818	16:15:21.4	01:13:06	17:01:43.4	17:10:15.8	9.0287	27.1824	171.7576
19	10	15-Nov	93.00	28.470	14:29:56.9	-	15:21:46.3	15:30:18.7	8.9811	27.7543	171.8299
20	10	15-Nov	99.89	29.818	15:47:27.0	01:17:30	16:35:01.6	16:43:34.0	8.9725	28.1834	171.3326
21	11	16-Nov	110.00	36.500	18:36:32.0	-	19:15:16.9	19:23:49.3	8.9162	28.7341	171.5835
22	12	17-Nov	110.00	36.500	18:21:16.4	-	19:00:35.8	19:09:08.2	8.8939	29.6635	171.2614
23	13	18-Nov	110.00	36.500	18:07:03.0	-	18:46:54.9	18:55:27.3	8.8888	30.4871	171.0732
24	14	19-Nov	110.00	36.500	17:52:39.2	-	18:33:04.4	18:41:36.8	8.9003	31.2739	170.9072
25	15	20-Nov	110.00	36.500	17:34:25.5	-	18:15:34.8	18:24:07.2	8.9336	32.2347	170.6113
26	16	21-Nov	110.00	36.500	17:17:35.8	-	17:59:25.5	18:07:57.9	8.9721	33.0381	170.4474
27	17	22-Nov	110.00	36.500	16:59:16.0	-	17:41:50.6	17:50:23.0	9.0213	33.8373	170.2947
28	18	23-Nov	110.00	36.500	16:33:01.7	-	17:16:44.0	17:25:16.4	9.1017	34.8534	170.0216
29	19	24-Nov	110.00	36.500	16:05:40.6	-	16:50:34.1	16:59:06.5	9.1758	35.6671	169.8820
30	20	25-Nov	110.00	36.500	15:08:50.7	-	15:56:21.6	16:04:54.0	9.2576	36.4706	169.7374

TIP = Targeting Interface Point [1]Final Tgt Spec Targets

LAUNCH PERIOD DESIGN - NOMINAL INJECTION

PQ Biased DPTRAJ C3 (TIP) (km^2/s^2)	PQ Biased DPTRAJ DLA (TIP) ETEDate (deg)	PQ Biased DPTRAJ RLA (TIP) ETEDate (deg)	PQ Biased Injection Arrival Date/Time (ET)	PQ Biased[1] Injection B.T (km)	PQ Biased[1] Injection B.R (km)	Flight Time Bias From Nom.[1] (hr)	TCM-4 Nom. Arrival[2] Date/Time (ET)
10.1656	21.2986	173.2447	9/11/97 04:27:53	-44000.	-52000.	3.	9/11/97 01:27:53
10.1551	21.3232	173.2428	9/11/97 04:27:53	-44000.	-52000.	3.	9/11/97 01:27:53
9.9846	21.8321	173.2700	9/12/97 06:26:09	-34000.	-54000.	5.	9/12/97 01:26:09
9.9747	21.8601	173.2683	9/12/97 06:26:09	-34000.	-54000.	5.	9/12/97 01:26:09
9.7984	22.4645	173.1386	9/12/97 07:26:09	-23000.	-55000.	6.	9/12/97 01:26:09
9.7890	22.4952	173.1359	9/12/97 07:26:09	-23000.	-55000.	6.	9/12/97 01:26:09
9.6412	23.1088	173.1106	9/13/97 08:24:28	-13000.	-55000.	7.	9/13/97 01:24:28
9.6324	23.1417	173.1066	9/13/97 08:24:28	-13000.	-55000.	7.	9/13/97 01:24:28
9.4837	23.8320	172.9136	9/13/97 09:24:28	-2000.	-55000.	8.	9/13/97 01:24:28
9.4755	23.8672	172.9083	9/13/97 09:24:28	-2000.	-55000.	8.	9/13/97 01:24:28
9.3549	24.5313	172.8210	9/14/97 10:22:47	9000.	-55000.	9.	9/14/97 01:22:47
9.3473	24.5685	172.8144	9/14/97 10:22:47	9000.	-55000.	9.	9/14/97 01:22:47
9.2314	25.3153	172.5648	9/14/97 11:22:47	19000.	-55000.	10.	9/14/97 01:22:47
9.2246	25.3552	172.5571	9/14/97 11:22:47	19000.	-55000.	10.	9/14/97 01:22:47
9.1257	26.1405	172.2725	9/14/97 11:22:47	35000.	-54000.	10.	9/14/97 01:22:47
9.1198	26.1836	172.2638	9/14/97 11:22:47	35000.	-54000.	10.	9/14/97 01:22:47
9.0466	26.9042	172.0976	9/15/97 11:21:07	50000.	-53000.	10.	9/15/97 01:21:07
9.0417	27.1992	171.7150	9/15/97 11:21:07	50000.	-53000.	10.	9/15/97 01:21:07
8.9811	27.7711	171.7873	9/15/97 13:21:07	66000.	-50000.	12.	9/15/97 01:21:07
8.9725	28.2002	171.2898	9/15/97 13:21:07	66000.	-50000.	12.	9/15/97 01:21:07
8.9162	28.7509	171.5398	9/16/97 17:19:29	116000.	-46000.	16.	9/16/97 01:19:29
8.8939	29.6802	171.2186	9/16/97 19:19:29	132000.	-41000.	18.	9/16/97 01:19:29
8.8888	30.5037	171.0303	9/17/97 20:17:52	148000.	-35000.	19.	9/17/97 01:17:52
8.9003	31.2906	170.8641	9/18/97 19:16:14	138000.	-35000.	18.	9/18/97 01:16:14
8.9336	32.2514	170.5681	9/18/97 18:16:14	129000.	-35000.	17.	9/18/97 01:16:14
8.9721	33.0547	170.4041	9/19/97 16:14:40	119000.	-37000.	15.	9/19/97 01:14:40
9.0213	33.8539	170.2512	9/20/97 15:13:05	110000.	-39000.	14.	9/20/97 01:13:05
9.1017	34.8699	169.9779	9/20/97 14:13:05	101000.	-42000.	13.	9/20/97 01:13:05
9.1758	35.6836	169.8383	9/21/97 13:11:32	91000.	-45000.	12.	9/21/97 01:11:32
9.2576	36.4871	169.6936	9/22/97 11:10:01	82000.	-49000.	10.	9/22/97 01:10:01
				[1]VJA	[1]VJA	[1]VJA	[2]WJL