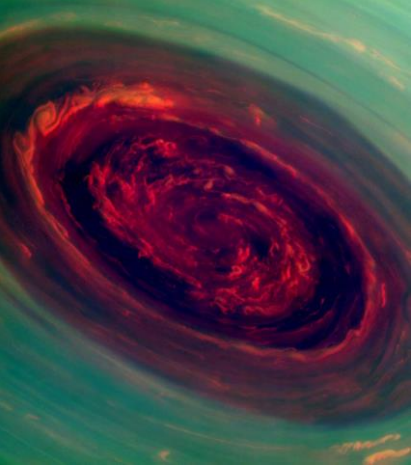

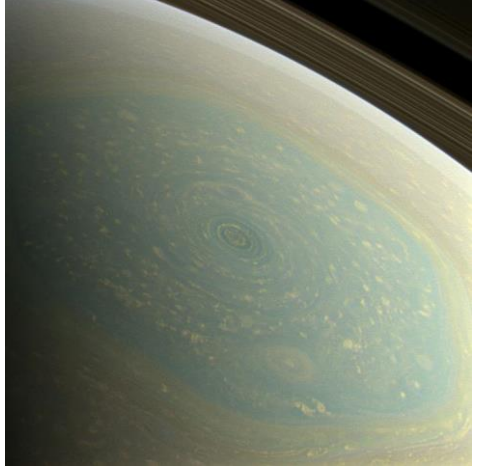
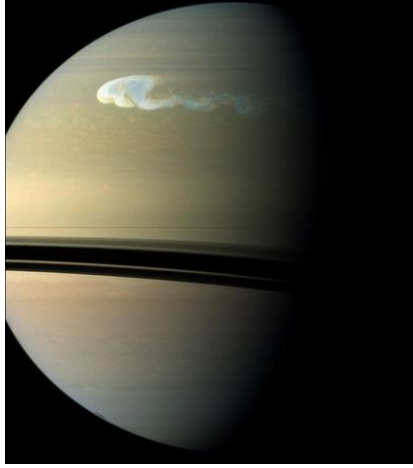

Science Planning & Sequence Team
CASSINI

SATURN TARGET WORKING TEAM

Rev 30 Segment Legacy Package

Segment Boundary: Oct 10, 2006 – Oct 11, 2006
2006-283T19:00:00 – 2006-284T19:00:00 (SCET)

Integration Began 12/16/2002
Segment Delivered to S24 Sequence 01/27/2003
Lead Integrator was Jerod Gross
Segment Updated/re-delivered to S24 Sequence 05/12/2006
by Barbara Larsen

Legacy Package Assembled by Keven Uchida

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*** N.A. = Slide present but content not available.**

Segment Overview and Final Products

Segment Summary

- This is a one day long Prime Mission inbound segment, with periapse occurring approximately 4 hours after segment end. The S/C is in an inclined orbit.
- Despite this being a very short segment, as the spacecraft sped toward periapsis it covered a relative wide range of Saturn distances and Saturn phase angles (page 7). The view throughout the segment was limited to Saturn's southern hemisphere (sub-s/c latitude -16 to -45 degrees).
- The first planning proposal contained only CIRS-led observations (compositional maps of Titan and regional maps of Saturn), but upon iteration, an ISS observation of Hyperion and an OPNAV satellite observation was added to the timeline.
- Initially, science data volume was oversubscribed, but upgrading the last DSN station to a 70m remedied the issue and, in fact, provided the segment with a comfortable downlink margin.
- There were no ORS boresight constraints/issues in this segment.

Final Sequenced SPASS (1 of 1)

Request	Riders	Start (SCET)	Start (Epoch)	Duration	End (SCET)	Primary	Secondary	Comments
SATURN rev 30 Segment		2006-283T19:00:00		001T00:09:00	2006-284T19:09:00			
SP_030TI_WAYPTTURN283_PRIME	M	2006-283T19:00:00		000T00:30:00	2006-283T19:30:00	ISS_NAC to Titan	NEG_X to NEP	
NEW WAYPOINT		**2006-283T19:30:00**		**001T00:00:00**	**2006-284T19:30:00**	**ISS_NAC to Titan**	**NEG_X to NEP**	
CIRS_030TI_COMPMAP007_PRIME	I, M, U, V	2006-283T19:30:00		000T03:50:00	2006-283T23:20:00	CIRS_FPB to Titan (-0.17,0.0,0.687 deg. offset)	NEG_X to Sun	
ISS_030HY_OPPSGA001_PRIME	C, M, U	2006-283T23:20:00		000T00:50:00	2006-284T00:10:00	UVIS_FUV to Hyperion	NEG_X to NEP	
CIRS_030SA_REGMAP013_PRIME	M, U, V	2006-284T00:10:00		000T08:59:00	2006-284T09:09:00	CIRS_FPB to Saturn	NEG_X to Sun	
NAV_030SK_OPNAV841_PRIME	M, N	2006-284T09:09:00		000T00:59:00	2006-284T10:08:00	ISS_NAC to Satellites	NEG_X to NEP	Starts at waypoint, ends at Earth point
NAV_030EA_DLTURN841_PRIME	M	2006-284T10:08:00		000T00:01:00	2006-284T10:09:00	XBAND to Earth	NEG_X to NSP	
SP_030EA_G70METNON284_PRIME	C, M	2006-284T10:09:00		000T09:00:00	2006-284T19:09:00	XBAND to Earth	NEG_X to NSP	No Roll for CDA.

Final Sequenced SMT and Data Volume

DATA VOLUME SUMMARY --- TRANSFER FRAME OVERHEAD INCLUDED (80 BITS PER 8800-BIT FRAME)

			OBSERVATION_PERIOD							DOWNLINK_PASS							
			P4						P5	RECORDED		PLAYBACK					
DOWNLINK PASS NAME	Start doy hh:mm	End doy hh:mm	START (Mb)	SCI (Mb)	HK+E (Mb)	TOTAL (Mb)	CPACTY (Mb)	MRGN (Mb)	OPNAV (Mb)	SCI (Mb)	ENGR (Mb)	TOTAL (Mb)	CPACTY (Mb)	MARGN (Mb)	NET_MARGN (%)	CAROVR (Mb)
SP_030EA_G70METNON284_PRIME	284 10:09	284 19:09	0	2170	52	2221	3537	1316	5	726	53	3008	3750	741	796	5%	0

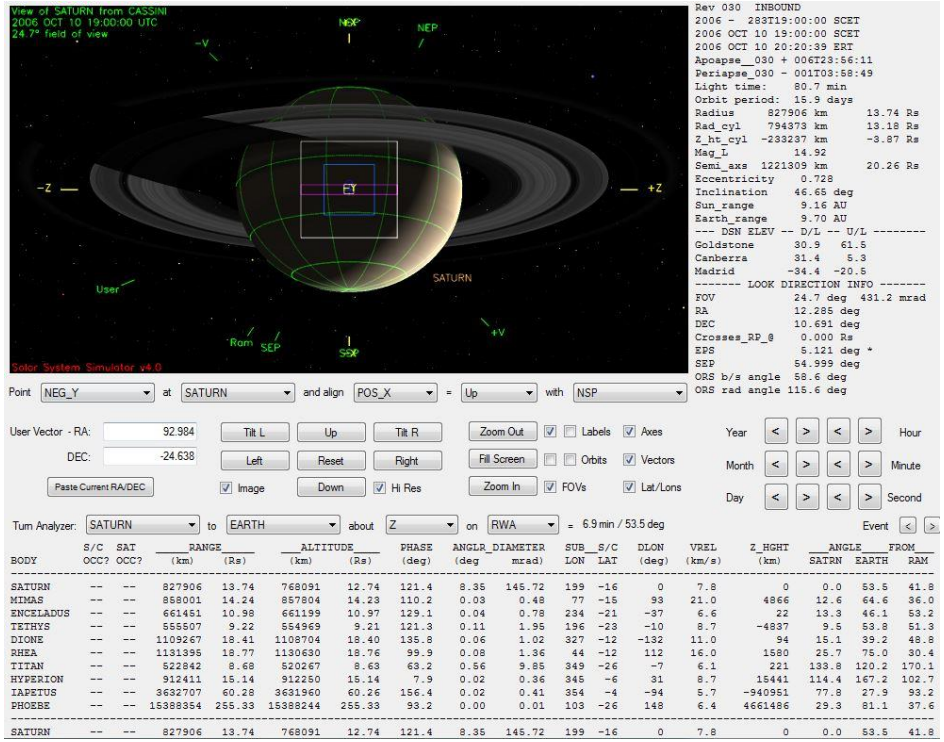
DATA VOLUME REPORT --- TRANSFER FRAME OVERHEAD NOT INCLUDED

Event	Start doy hh:mm	End doy hh:mm	CAPS (Mb)	CDA (Mb)	CIRS (Mb)	INMS (Mb)	ISS (Mb)	MAG (Mb)	MIMI (Mb)	RADAR (Mb)	RPWS (Mb)	UVIS (Mb)	VIMS (Mb)	PROBE (Mb)	ENGR (Mb)	TOTAL (Mb)
OBSERVATION_NOR	283 19:00	284 10:09	436.7	28.0	190.6	2.7	439.0	65.9	147.6	0.0	381.8	28.3	429.3	0.0	0.0	2149.9
OBSERVATION_OPN	283 19:00	284 10:09	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4
SP_030EA_G70METNON284_PRIME	284 10:09	284 19:09	259.2	16.9	86.4	1.6	0.0	39.1	80.0	0.0	233.7	2.5	0.0	0.0	0.0	719.4
DAILY TOTAL SCIENCE	283 19:00	284 19:09	695.9	44.8	277.0	4.3	439.0	105.0	227.6	0.0	615.5	30.8	429.3	0.0		

Segment Geometry

Seg Start (Left)

Seg End (below)




```
Rev 030  INBOUND
2006 -  283T19:00:00 SCET
2006 OCT 10 19:00:00 SCET
2006 OCT 10 20:20:39 ERT
Apoapse__030 + 006T23:56:11
Periapse_030 - 001T03:58:49
Light time:    80.7 min
Orbit period:  15.9 days
Radius      827906 km      13.74 Rs
Rad_cyl     794373 km      13.18 Rs
Z_ht_cyl   -233237 km      -3.87 Rs
Mag_L          14.92
Semi_axs   1221309 km      20.26 Rs
Eccentricity    0.728
Inclination    46.65 deg
Sun_range       9.16 AU
Earth_range     9.70 AU
--- DSN ELEV -- D/L -- U/L --------
Goldstone      30.9    61.5
Canberra       31.4     5.3
Madrid        -34.4   -20.5
------- LOOK DIRECTION INFO -------
FOV            24.7 deg  431.2 mrad
RA             12.285 deg
DEC            10.691 deg
Crosses_RP_0    0.000 Rs
EPS             5.121 deg *
SEP            54.999 deg
ORS b/s angle  58.6 deg
ORS rad angle 115.6 deg
```

Point NEG_Y at SATURN and align POS_X = Up with NSP

User Vector - RA: 92.984 DEC: -24.638 Paste Current RA/DEC

Tilt L | Up | Tilt R | Left | Reset | Right | Down

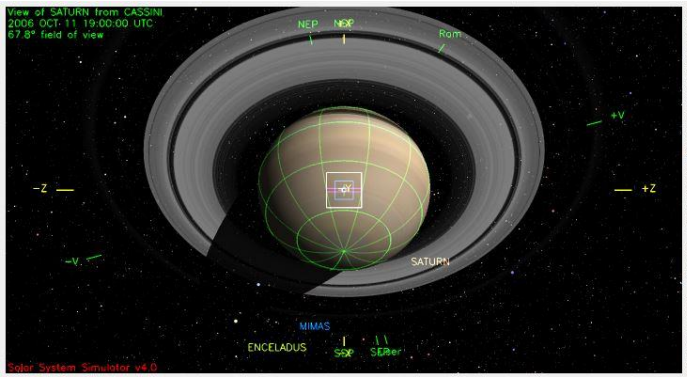
Zoom Out | Fill Screen | Zoom In

☐ Image ☑ Hi Res ☐ Labels ☑ Axes ☐ Orbits ☑ Vectors ☑ FOVs ☑ Lat/Lons

Year Month Day Hour Minute Second

Turn Analyzer: SATURN to EARTH about Z on RWA = 6.9 min / 53.5 deg Event

BODY	S/C OCC?	SAT OCC?	RANGE (km)	RANGE (Rs)	ALTITUDE (km)	ALTITUDE (Rs)	PHASE (deg)	ANGLR_DIAMETER (deg)	ANGLR_DIAMETER mrad)	SUB_S/C LON	SUB_S/C LAT	DLON (deg)	VREL (km/s)	Z_HGHT (km)	ANGLE FROM SATURN	ANGLE FROM EARTH	ANGLE FROM RAM
SATURN	--	--	827906	13.74	768091	12.74	121.4	8.35	145.72	199	-16	0	7.8	0	0.0	53.5	41.8
MIMAS	--	--	858001	14.24	857804	14.23	110.2	0.03	0.48	77	-15	93	21.0	4866	12.6	64.6	36.0
ENCELADUS	--	--	661451	10.98	661199	10.97	129.1	0.04	0.78	234	-21	-37	6.6	22	13.3	46.1	53.2
TETHYS	--	--	555507	9.22	554969	9.21	121.3	0.11	1.95	196	-23	-10	8.7	-4837	9.5	53.8	51.3
DIONE	--	--	1109267	18.41	1108704	18.40	135.8	0.06	1.02	327	-12	-132	11.0	94	15.1	39.2	48.8
RHEA	--	--	1131395	18.77	1130630	18.76	99.9	0.08	1.36	44	-12	112	16.0	1580	25.7	75.0	30.4
TITAN	--	--	522842	8.68	520267	8.63	63.2	0.56	9.85	349	-26	-7	6.1	221	133.8	120.2	170.1
HYPERION	--	--	912411	15.14	912250	15.14	7.9	0.02	0.36	345	-6	31	8.7	15441	114.4	167.2	102.7
IAPETUS	--	--	3632707	60.28	3631960	60.26	156.4	0.02	0.41	354	-4	-94	5.7	-940951	77.8	27.9	93.2
PHOEBE	--	--	15388354	255.33	15388244	255.33	93.2	0.00	0.01	103	-26	148	6.4	4661486	29.3	81.1	37.6
SATURN	--	--	827906	13.74	768091	12.74	121.4	8.35	145.72	199	-16	0	7.8	0	0.0	53.5	41.8




```
Rev 030  INBOUND
2006 -  284T19:00:00 SCET
2006 OCT 11 19:00:00 SCET
2006 OCT 11 20:20:30 ERT
Apoapse__030 + 007T23:56:11
Periapse_030 - 03:58:49
Light time:    80.5 min
Orbit period:  15.9 days
Radius      356596 km       5.92 Rs
Rad_cyl     253447 km       4.21 Rs
Z_ht_cyl   -250849 km      -4.16 Rs
Mag_L          11.71
Semi_axs   1219803 km      20.24 Rs
Eccentricity    0.728
Inclination    46.64 deg
Sun_range       9.16 AU
Earth_range     9.68 AU
--- DSN ELEV -- D/L -- U/L --------
Goldstone      30.1    60.9
Canberra       31.8     6.1
Madrid        -34.5   -21.0
------- LOOK DIRECTION INFO -------
FOV            67.8 deg 1183.9 mrad
RA            100.825 deg
DEC            41.760 deg
Crosses_RP_0    0.000 Rs
EPS             5.179 deg *
SEP            55.914 deg
ORS b/s angle 138.2 deg
ORS rad angle  68.8 deg  *
```

Point NEG_Y at SATURN and align POS_X = Up with NSP

User Vector - RA: 92.984 DEC: -24.638 Paste Current RA/DEC

Tilt L | Up | Tilt R | Left | Reset | Right | Down

Zoom Out | Fill Screen | Zoom In

☑ Image ☑ Hi Res ☐ Labels ☑ Axes ☐ Orbits ☑ Vectors ☑ FOVs ☑ Lat/Lons

Year Month Day Hour Minute Second

Turn Analyzer: SATURN to EARTH about Z on RWA = 12.9 min / 133.5 deg Event

BODY	S/C OCC?	SAT OCC?	RANGE (km)	RANGE (Rs)	ALTITUDE (km)	ALTITUDE (Rs)	PHASE (deg)	ANGLR_DIAMETER (deg	ANGLR_DIAMETER mrad)	SUB_S/C LON	SUB_S/C LAT	DLON (deg)	VREL (km/s)	Z_HGHT (km)	ANGLE FROM SATURN	ANGLE FROM EARTH	ANGLE FROM RAM
SATURN	--	--	356596	5.92	299222	4.96	41.8	19.46	339.65	195	-45	0	13.5	0	0.0	133.5	51.8
MIMAS	--	--	505810	8.39	505606	8.39	30.7	0.05	0.82	12	-29	166	27.0	3848	15.2	144.2	66.7
ENCELADUS	--	--	541118	8.98	540863	8.97	24.8	0.05	0.95	17	-28	155	25.1	-29	19.6	150.0	71.4
TETHYS	--	--	506431	8.40	505895	8.39	70.3	0.12	2.13	327	-29	-106	19.8	4217	34.7	104.5	46.4
DIONE	--	--	676152	11.22	675589	11.21	40.5	0.10	1.67	356	-22	-168	23.0	-105	23.6	134.3	68.5
RHEA	--	--	754391	12.52	753625	12.50	4.2	0.12	2.03	19	-19	127	19.6	3134	39.0	172.5	87.6
TITAN	--	--	1185944	19.68	1183369	19.64	64.4	0.25	4.34	12	-12	66	12.3	-2807	89.9	119.9	103.6
HYPERION	--	--	1538310	25.52	1538169	25.52	27.7	0.01	0.21	34	-34	108	15.4	7650	64.3	157.2	104.4
IAPETUS	--	--	3237305	53.72	3236558	53.70	149.1	0.03	0.46	6	-3	-4	10.5	-947573	147.6	35.5	98.5
PHOEBE	--	--	14849633	246.39	14849522	246.39	91.1	0.00	0.02	312	-26	-117	13.1	4611895	56.9	83.1	48.9
SATURN	--	--	356596	5.92	299222	4.96	41.8	19.46	339.65	195	-45	0	13.5	0	0.0	133.5	51.8

	Saturn Range	Phase Angle	Sub-S/C Lat.
Segment Start	13.74	121.4	-16
Segment End	5.92	41.8	-45

Solar Geometry – ORS Boresight Concerns

No ORS Boresight Solar Constraints on Science Pointing

Weekly Science Highlights

Oct 10 - 11, 2006 (DOYS 283 - 284)

- TITAN
  - CIRS Composition Mapping to obtain measurements of nitriles, hydrocarbons and an oxygen compound, CO2, as a function of latitude and emission angle (at equator) on Titan. Titan's gas composition exhibits significant variation with latitude and season.
  - ISS Photopolarimetry at 146-160° Phase
- SATURN
  - CIRS Regional Map of atmospheric composition at about 12Rs.
- ICY Satellites
  - ISS HYPERION Opposition Surge
- MAPS Magnetospheric Survey

Segment Integration Planning

Timeline Gaps and Suggested Observations

Rev 30 Inbound v.1 Strawman TOL

- **Strawman**

Request	Start	Dur	End	Original Request Start
SP Turn	283T18:00	0:30	283T18:30	
CIRS_030TI_COMPMAP007_PRIME	283T18:30	6:00	284T00:30	283T17:36
CIRS_030SA_REGMAP013_PRIME	284T00:30	9:09	284T09:39	284T00:00; (Dur was 11:00)
SP Turn	284T09:39	0:30	284T10:09	
Gold HEF	284T10:09	9:00	284T19:09	

- **Questions**
  - Do we need to do any OpNavs in this segment?
  - Can CIRS live with changes to TI and SA timing?
  - Does ISS need any HY requests between 283T23:35 and 23:55?

Initial SMT and Data Volume

Beginning of Integration:

Rev 30 SMT Results

- Using the HEF would have required cutting 50% (~700 Mb) of the science data collected, so I upgraded to the 70-m (which is available). Does MP concur?
- Also, does any of the observations (aside from OpNav) require any telem modes besides S_N_ER_3?

DATA VOLUME SUMMARY

	OBSERVATION PERIOD								DOWNLINK PASS						
	P4						P5	RECORDED	PLAYBACK						
	Start	End	START	SCI	HK+E	TOTAL	CPACTY	MARGIN	OPNAV	SCI	ENGR	TOTAL	CPACTY	MARGIN	CAROVR
DOWNLINK PASS NAME	doy hh:mm	doy hh:mm	(Mb)	(Mb)	(Mb)	(Mb)	(Mb)	(Mb) (%)	(Mb)	(Mb)	(Mb)	(Mb)	(Mb)	(Mb) (%)	(Mb)
SP_030EA_G70METNON284_PRIME	284 10:09	284 19:09	0	1215	54	1270	3534	2264 64%	17	227	53	1567	3525	1958 56%	0

DATA VOLUME REPORT

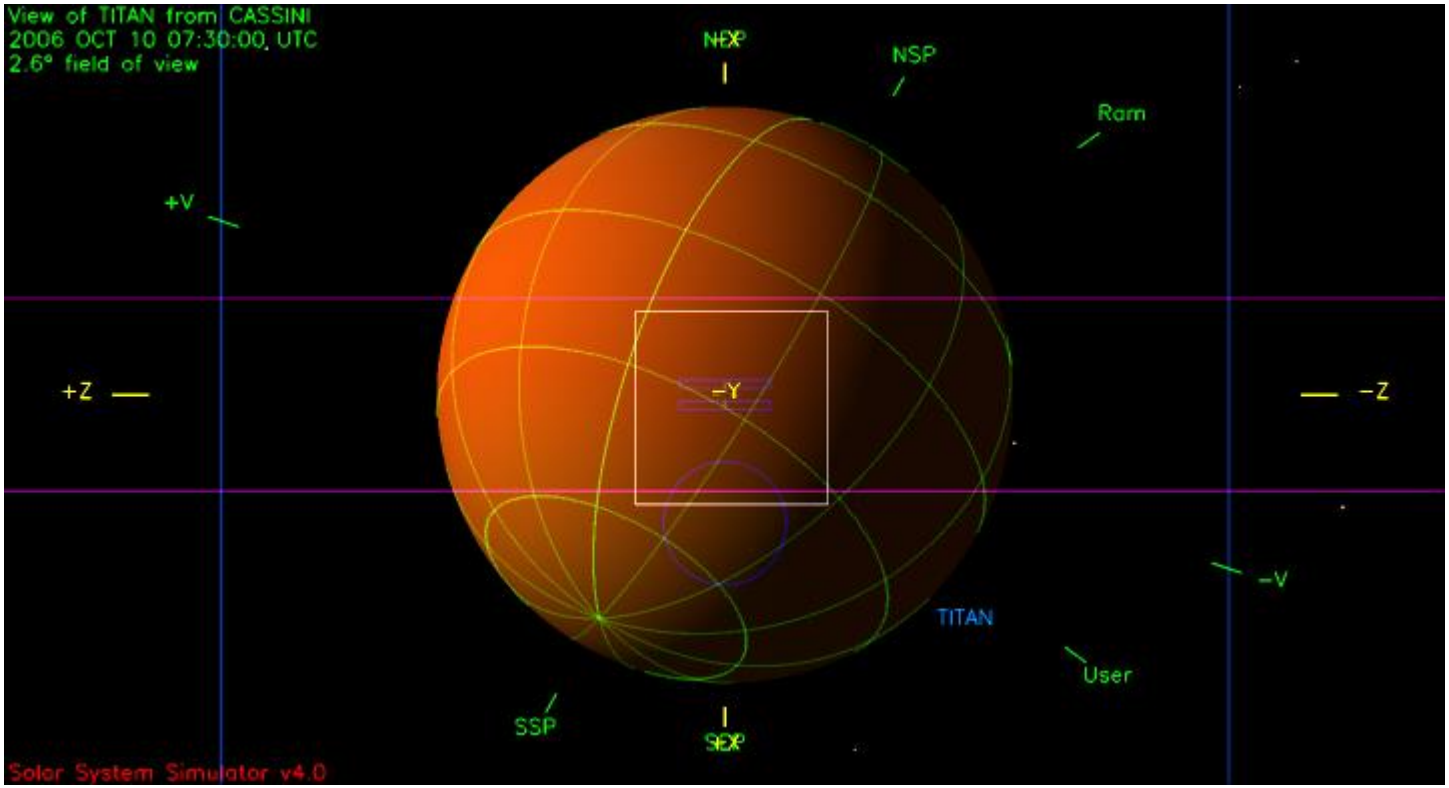
Event	Start doy hh:mm	End doy hh:mm	CAPS (Mb)	CDA (Mb)	CIRS (Mb)	INMS (Mb)	ISS (Mb)	MAG (Mb)	MIMI (Mb)	RADAR (Mb)	RPWS (Mb)	UVIS (Mb)	VIMS (Mb)	PROBE (Mb)	ENGR (Mb)	TOTAL (Mb)
OBSERVATION_NOR	283 18:00	284 10:09	58.1	11.5	199.0	2.9	96.3	34.9	52.3	0.0	76.2	14.1	670.0	0.0	0.0	1215.4
OBSERVATION_OPN	283 18:00	284 10:09	0.0	0.0	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4
SP_030EA_G70METNON284_PRIME	284 10:09	284 19:09	32.4	6.1	86.4	1.6	0.0	19.4	29.2	0.0	49.3	2.5	0.0	0.0	0.0	226.9

Waypoint Selection

- **FR-Safe Waypoints Options**
  - NAC to Titan, -X to Sun puts Saturn on SRU & CIRS radiators (delta-T ~4.7 K) - **no good!**
  - Basically, anything with Z oriented north-south violates radiator and/or warm-body FRs
  - NAC to Titan, -X to NEP is safe (NSP and NTP violate FRs, as well)

Waypoints Chosen

Waypoint 1 (2006-283T19:30:00 – 284T19:30:00): NEG_Y to Titan, NEG_X to NEP.



Notes and Liens

- Timing
  - Start 2006-283T19:00
  - End 2006-284T19:09
- Pointing
  - Waypoints have been re-validated
  - Downlink attitudes have been re-validated
  - SP turns are safe
- Data Volume
  - 500 Mb of margin remain
- CIMS
  - All requests are currently approved
- OpModes
  - DFPW
- DSN
  - DSS-14