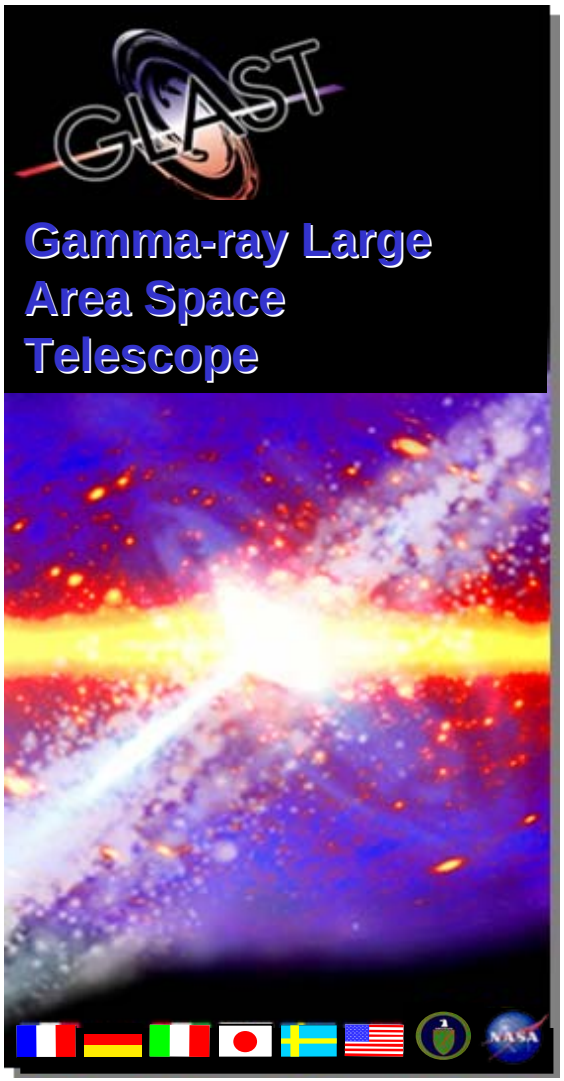


GLAST Large Area Telescope

LAT Thermal Vacuum Test

Test Readiness Review

Jesse Armiger
Thermal Vacuum Test Director

Naval Research Laboratory

Agenda

- Thermal Vacuum Test Overview
- Operations and Safety
- Flight TCS Hardware
- Thermal STE
- Test Readiness
- Conclusions

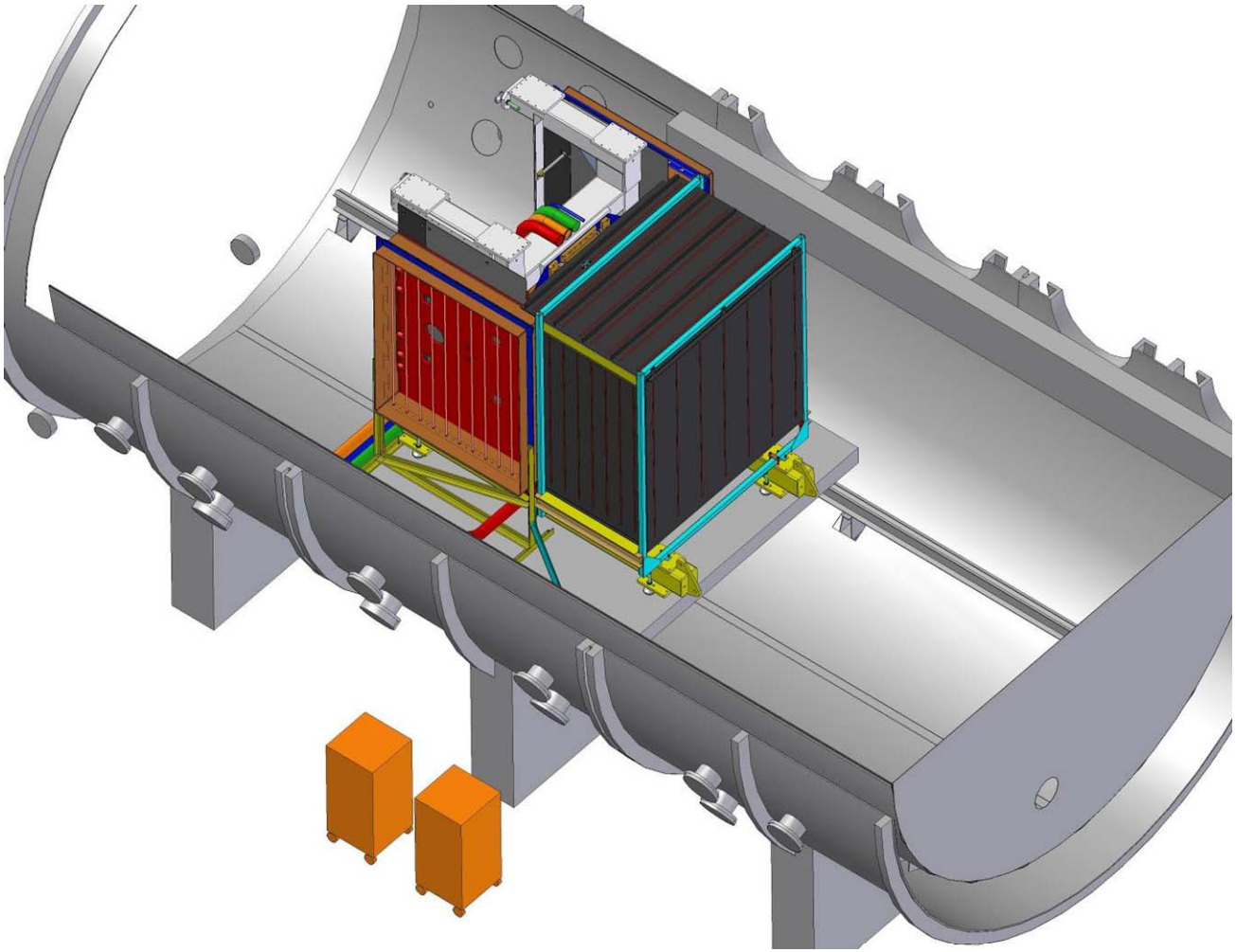
Thermal Vacuum Test Overview

Thermal Vacuum Test Overview

- **Purpose**
  - **Demonstrate the LAT instrument meets electrical functional and performance requirements under expected on-orbit conditions plus proto-qualification margins**
    - **Hot And Cold Performance Testing (CPTs)**
  - **Verify the design and workmanship of the LAT and Thermal Control Subsystem (including unit mounting interfaces, VCHP performance, and flight heater operation)**
    - **Thermal Cycling and TCS Testing**
  - **Validate thermal math models and demonstrate that all units are maintained within acceptance temperature ranges**
    - **Thermal Balances**

Thermal Vacuum Test Overview

- **LAT configured for test in “Big Blue”**



Thermal Vacuum Test Overview

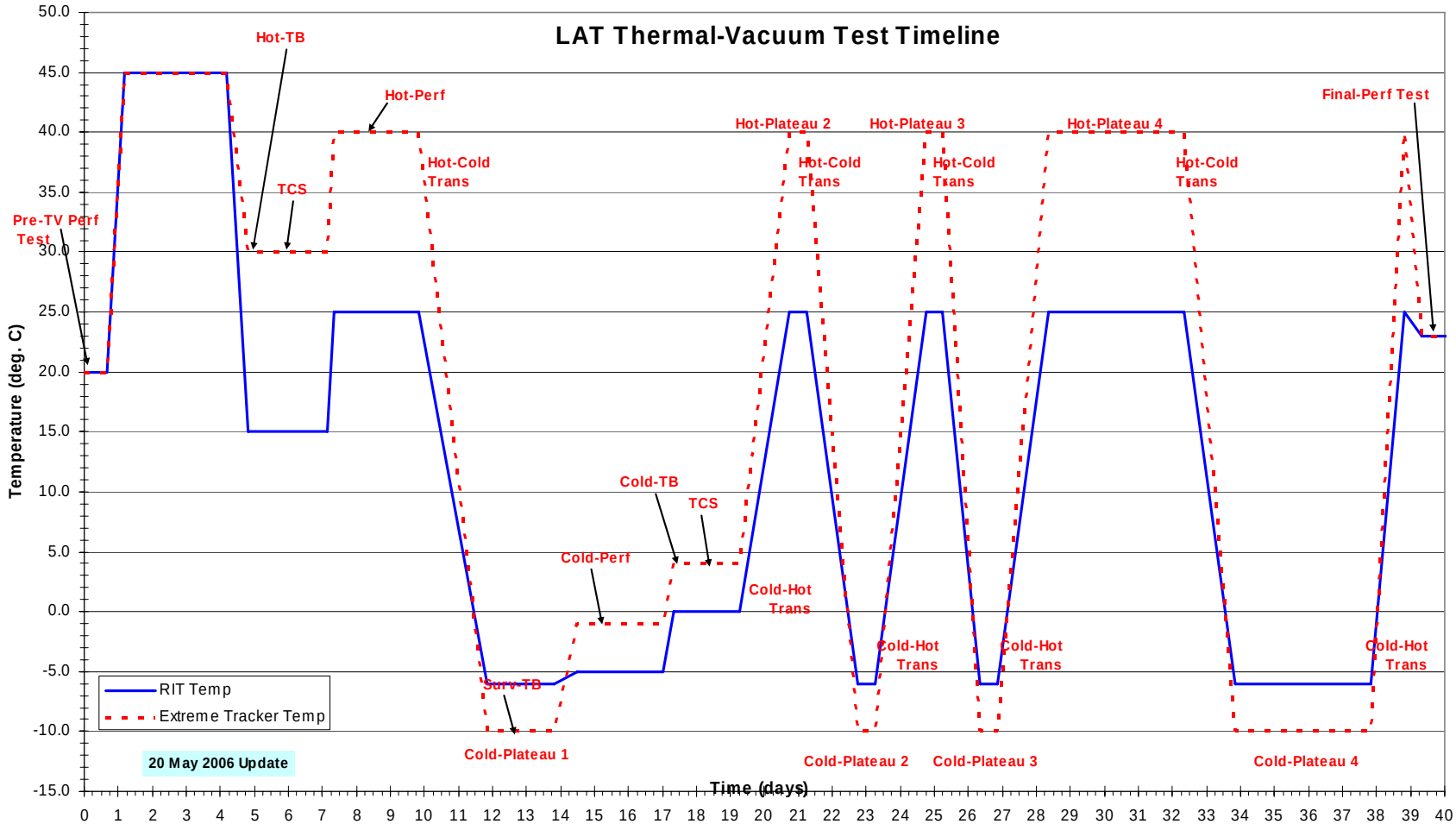
- **General thermal vacuum test requirements**

Requirement	Value
Chamber Pressure	< 1x10-5 Torr
Performance Testing (Protoqualification Levels)	
Temperature Goals{1}	Maximum Predict + 10 deg. C Minimum Predict - 5 deg. C
Temperature Tolerances	Hot: +0/-3 deg. C Cold: -0/+3 deg. C
Thermal Balance	
Temperature Rate of Change	< 0.1 deg.C/hr.
Thermal Cycling	
Minimum Dwell Time at Plateaus	> 12 hours
Maximum Temperature Transition Rate	
LAT and Subsytems	< 20deg./hr.
Cal Crystal Detector Elements	< 10deg./hr.
Minimum Number of Cycles	4

{1} During hot performance testing, sink temperatures will be adjusted until at least one subsystem temperature is 10 deg. C beyond its max. temperature predict. During cold performance testing, sink temperatures will be adjusted until at least one subsystem temperature is 5 deg. C beyond its min. temperature predict. The cold margin requirement is 5 deg. C less because the LAT is actively controlled with heaters. The goal will be to force as many LAT temperatures as feasible 10 deg. C beyond their max. predicts and 5 deg. C beyond their min. predicts as possible.

- **Detailed thermal vacuum test requirements are provided in the LAT Thermal Vacuum Test Plan (LAT-MD-1600)**

Thermal Vacuum Test Overview



Thermal Vacuum Test Overview

- **Goals**
  - **Hot And Cold Performance Testing**
    - **Verify that subsystems and units meet electrical functional and performance requirements under proto-qualification level temperatures in flight configuration.**
  - **Thermal Cycling**
    - **Verify the LAT's ability to survive proto-qualification temperature levels at both high and low extremes.**
    - **Workmanship test for hardware such as wiring harnesses, MLI, and cable support and strain-reliefs which have not been fully verified at the subsystem level.**

Thermal Vacuum Test Overview

- **Goals**
  - **TCS Testing**
    - **Verify that the TCS can maintain the RIT stable to within +/- 7°C (with the required control authority and without exceeding the power allocation or the reservoir not-to-exceed temperature) within the allowable RIT limits of when exposed to both steady state orbit average and transient environmental loads.**
    - ~~**Verify that the TCS can tolerate peak power loads for up to 10 minutes**~~
    - **Verify TCS correct hardware response to uploaded TCS software parameters**
    - **Verify functional performance of all heaters**

Thermal Vacuum Test Overview

- **Goals**
  - **Thermal Balances**
    - **Verify the LAT thermal control system maintains LAT temperatures within operating limits.**
    - **When the LAT is off, verify VCHP thermostatic control effectively closes the radiators to maintain LAT temperatures within survival temperature limits and heater power limits.**
    - **The LAT thermal model provides good correlation between predicted and measured temperatures**

Thermal Vacuum Test Readiness

- **Test Predicts and Margins**

Component	Cold Survival Limits	Cold Operating Limits	Hot Operating Limits	Hot Perf. (P.Q.)	Hot T.B.**	Hot Perf. Margin	Cold T.B.	Cold Perf. (P.Q.)	Cold Perf. Margin	Survival T.B.
TKR(SSD)	-15	-15	30	40	30	10	4	-1	5	-10
CAL BP	-30	-15	25	33	23	10	5	0	5	-4
EPU*	-40	-30	45	31	20	11	3	-1	4	-5
GASU*	-40	-30	45	29	18	11	5	0	5	-5
PDU*	-40	-30	45	29	15	14	5	1	4	-5
SIU*	-40	-30	45	31	20	11	4	-1	4	-5
TPS*	-40	-30	45	39	28	11	8	3	5	-5
TEM*	-40	-30	45	38	27	11	8	3	5	-5
ACD BEA	-30	-15	30	31	20	11	6	1	5	-5
ACD TDA	-40	-30	35	34	26	8	2	-2	4	-12
GRID	-40	-30	35	36	24	12	0	-5	4	-7
RIT	-6	0	15	25	14	11	0	-6	6	-6

All temperatures are in degrees C
Temperatures shown are for the hottest/coldest extremity of the subsytem, except as indicated
Hot case temperature predicts include 5 C analysis uncertainty margin
For cold and survival cases, 5 C uncertainty not used because of heater control
Based upon the Latest Power Summary of 536 Watts LAT Disipation, not including the thermal subsystem
All cases use the Spacecraft Solar Array
(*) Temperatures shown are for the box interface to its heat sink

Operations and Safety

Operations and Safety

- **Key Personnel**
  - **Test Director:**
    - Responsible for providing resources and logistics support
    - Chairs all pre-test and post-test reviews as well as regular coordination meetings and any anomaly team meetings during the thermal vacuum test.
    - Primary interface to SLAC and NASA for reporting test status.
  - **Thermal Engineer:**
    - Responsible for maintaining the LAT within temperature limits throughout the test.
    - Performs the thermal tests indicated in this procedure and evaluates the thermal response of the LAT.
  - **LAT Test Conductor:**
    - Performs the electrical functional and performance tests indicated in the LAT Performance & Operations Test Plan (LAT-MD-02730) and evaluates the performance of the LAT with respect to these tests.
    - Maintains SLAC EGSE.
    - Responsible for all commanding of the LAT

Operations and Safety

- **Key Personnel**
  - **LAT Test Operator:**
    - **Physically inputs all LAT commands under the direction of the LAT Test Conductor.**
  - **Subsystem Engineers (Tracker, Calorimeter, ACD, Electronics and FSW):**
    - **Provide expertise and evaluate data related to their subsystem.**
  - **Chamber Operator:**
    - **Responsible for maintaining the chamber equipment that sets the environment for the spacecraft.**
    - **Responsible for maintaining the chamber data acquisition system.**

Operations and Safety

- **Data recording**
  - Thermal log book
  - Heater change log book
  - Thermal data book (key print-outs)
  - Test procedure (official copy)
  - CDACS records data to MySQL database every 30 seconds
- **Communication protocol**
  - Thermal engineer informs LAT test conductor of thermal parameter changes
    - Recorded in heater change log book
  - Important LAT changes communicated to thermal engineer by LAT test conductor

Operations and Safety

Operational Alarm Limits								
Component	Unit Proto-Qual Limit	Red High	Yellow High	Min. Pred.	Max. Pred.	Yellow Low	Red Low	Unit Proto-Qual Limit
Calorimeter	-30	-25	-22	0	33	42	45	50
Tracker	-15	-10	-7	-1	40	42	45	50
TEM	-40	-35	-32	3	38	47	50	55
EPU	-40	-35	-32	-1	31	47	50	55
TPS	-40	-35	-32	3	39	47	50	55
RIT	-40	-35	-9	-6	25	32	35	40
Reservoir	-75	-70	-67	-58	3	52	55	60
GRID	-75	-70	-67	-5	34	52	55	60
ACD Shell	-25	-20	-17	-2	34	36	38	40
ACD	-25	-20	-17	1	31	32	35	40
Radiator	-75	-70	-67	-65	22	52	55	60
Reservoir	-75	-70	-67	-58	3	52	55	60
GASU	-40	-35	-32	0	29	47	50	55
PDU	-40	-35	-32	-1	29	47	50	55
SIU	-40	-35	-32	-1	31	47	50	55

Operations and Safety

Non-Operational Alarm Limits								
Component	Unit Survival Limit	Red High	Yellow High	Survival	Bake-Out	Yellow Low	Red Low	Unit Survival Limit
Calorimeter	-30	-25	-22	-4	40	42	45	50
Tracker	-15	-14	-12	-10	40	42	45	50
TEM	-40	-35	-32	-5	40	52	55	60
EPU	-40	-35	-32	-5	40	52	55	60
TPS	-40	-35	-32	-5	40	52	55	60
RIT	-75	-70	-9	-6	40	52	55	60
Reservoir	-75	-70	-67	-7	40	52	55	60
GRID	-75	-70	-67	-7	40	52	55	60
ACD Shell	-30	-25	-22	-12	40	42	44	45
ACD	-30	-25	-22	-5	40	42	44	45
Radiator	-75	-70	-67	-63	40	52	55	60
Reservoir	-75	-70	-67	-7	40	52	55	60
GASU	-40	-35	-32	-5	40	52	55	60
PDU	-40	-35	-32	-5	40	52	55	60
SIU	-40	-35	-32	-5	40	52	55	60

Operations and Safety

- **Emergency Procedures**
  - **All procedures in LAT-TD-06799 and LAT-PS-07836 and Generator Hook-up Procedure (NRL document # TBD)**
    - **Loss of building power**
    - **Loss of chamber pressure control (corona)**
    - **Building evacuations due to environment**
    - **Thermal over-temperature condition**
  - **All events require close coordination of thermal engineer and LAT test conductor**

Flight TCS Hardware

Flight TCS Hardware

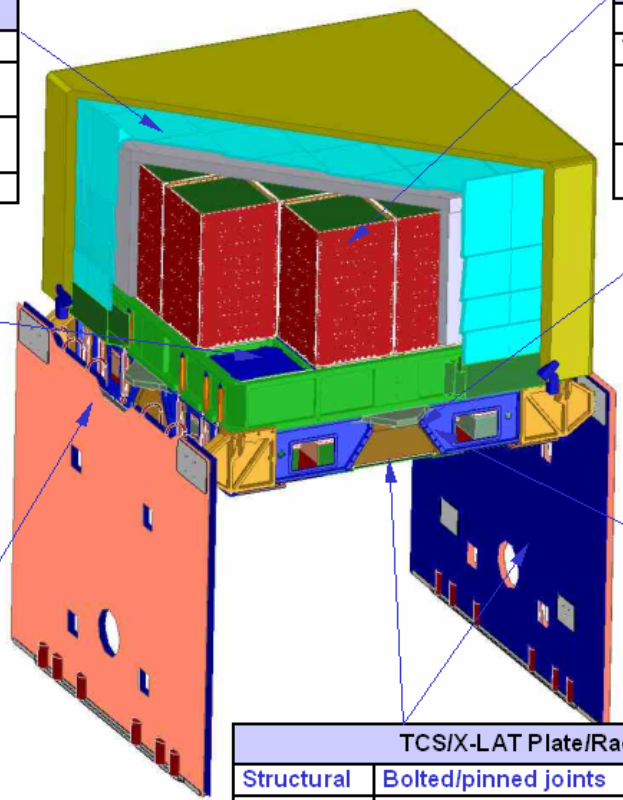
- **LAT Overview**

Anticoincidence Detector (ACD)	
Structural	Grid bolted joint, shear pins
Thermal	Conductive bolted joint; Radiative coupling w/ TKR
Electrical	3.3V, 28V; Data, Temp sensors, S/W
I&T	Lift fixture, Electrical test stand

Tracker (TKR)	
Structural	Grid Ti flexure mount
Thermal	Conductive Cu strap
Electrical	1.5V, 2.5V, 2.5VDig, 150V Bias; Data, Temp sensors, S/W
I&T	Lift fixture, Electrical test stand

Calorimeter (CAL)	
Structural	Grid pinned/bolted joint
Thermal	Conductive bolted joint
Electrical	3.3V, 3.3VDig,100V Bias; Data, Temp sensors, S/W
I&T	Alignment Tool, Lift fixture, Electrical test stand

Electronics	
Structural	Stand-off to CAL; Bolted stack; Cabling
Thermal	Thermal joint to X-LAT Plate
Electrical	27-29V Regulated, Data, S/W
I&T	Test bed



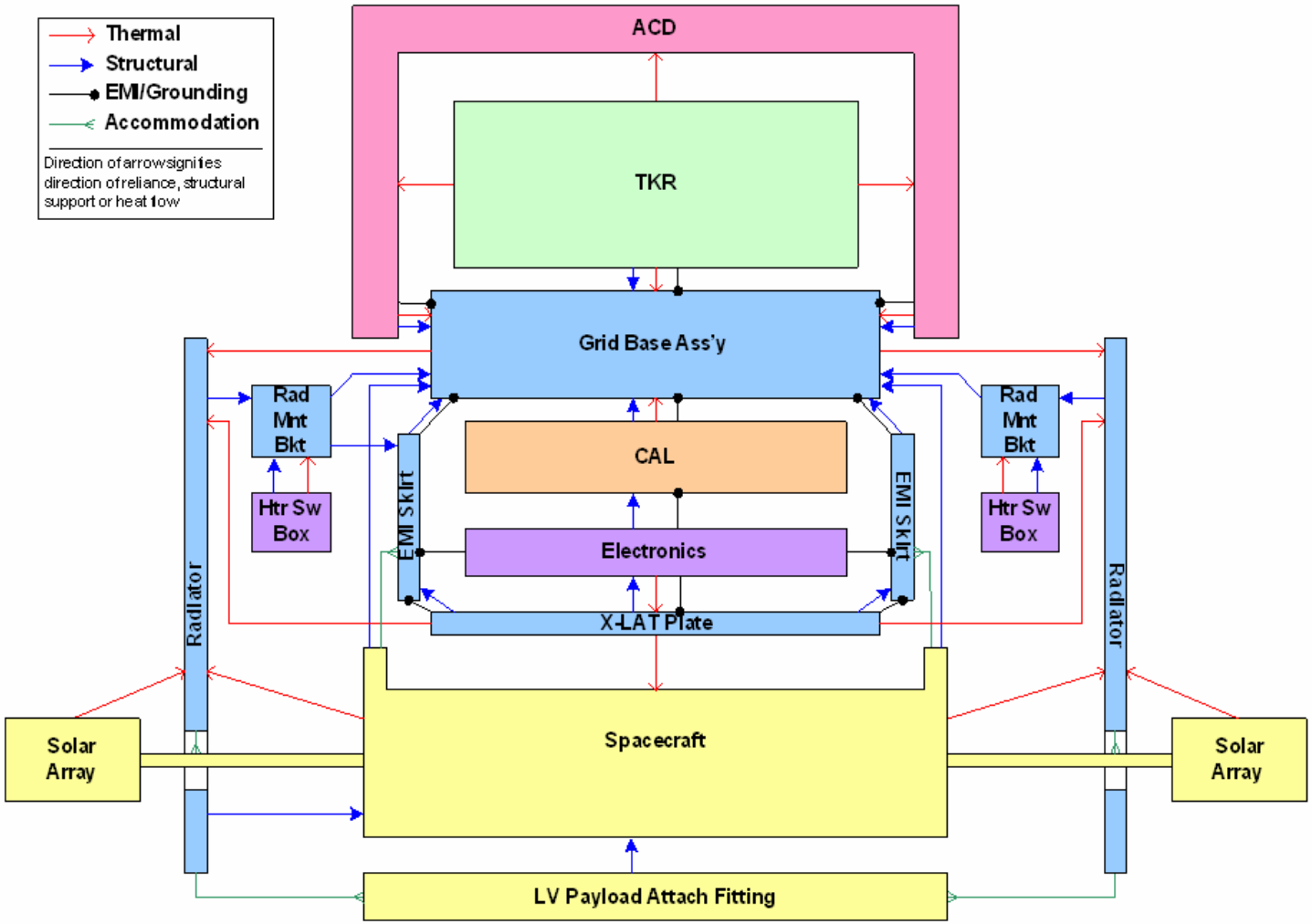
Spacecraft	
Structural	Four-point mount to SC flexures, Two-point pinned struts for each radiator
Thermal	Isolated (SC Mount, Radiator struts); Radiative (S/A)
Electrical	27-29V Regulated, 25-35V Unregulated, MIL-STD-1553B, Analog and digital sensors, LVDS, EMI/EMC, High speed serial science data
I&T	Grid perimeter ring, Radiator handling fixture, Radiator lift fixture, Purge, LAT test point

GBM	
Structural	Cabling
Thermal	None
Electrical	LVDS, 1553 Telecommands
I&T	None

TCS/X-LAT Plate/Radiators	
Structural	Bolted/pinned joints
Thermal	Heat pipes, Heaters
Electrical	27-29V Regulated, 25-35V Unregulated; Temp sensors, S/W
I&T	Radiator handling fixture, Radiator lift fixture, X LAT Plate lift fixture, Electrical test stand

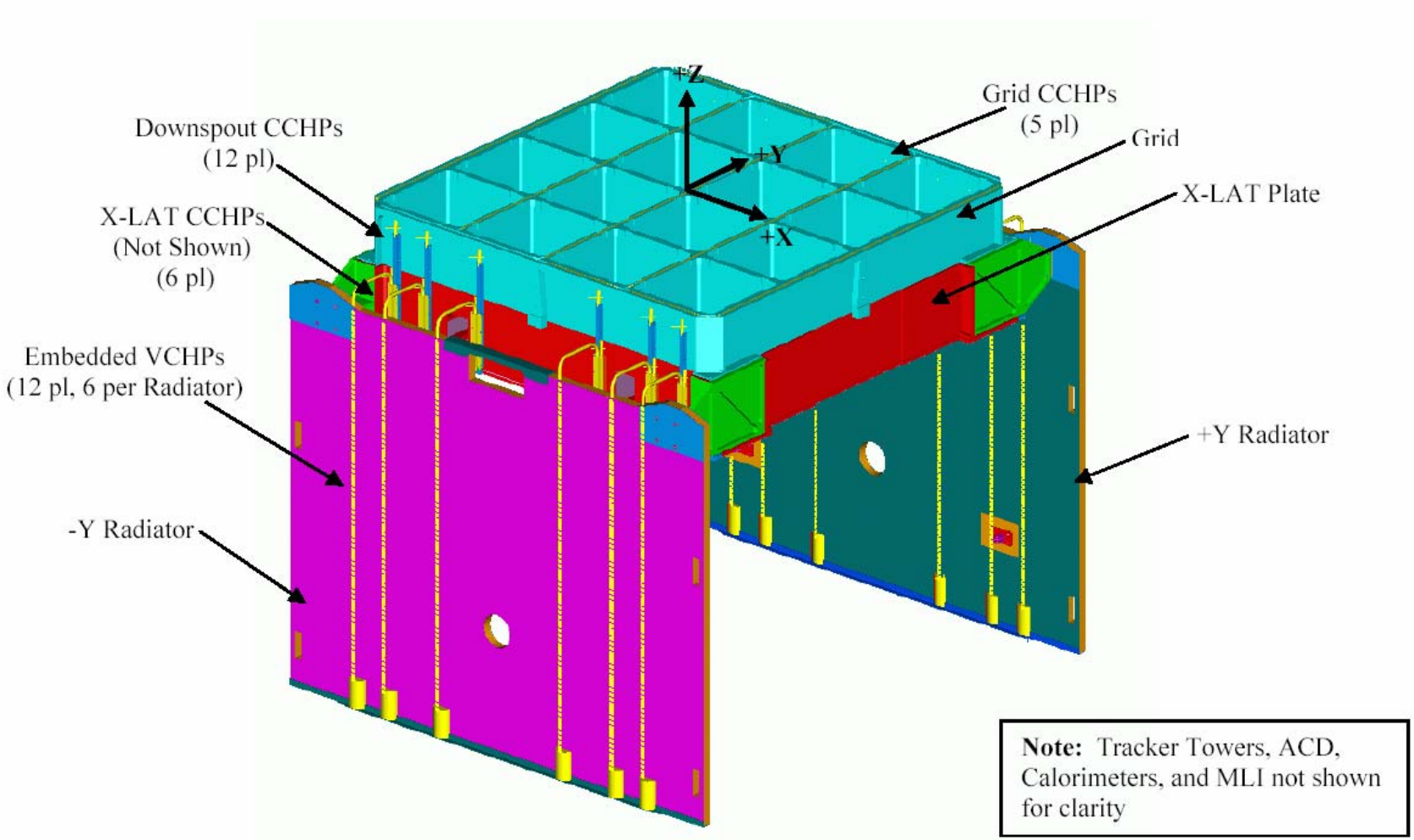
Flight TCS Hardware

- **Thermal Load Paths**



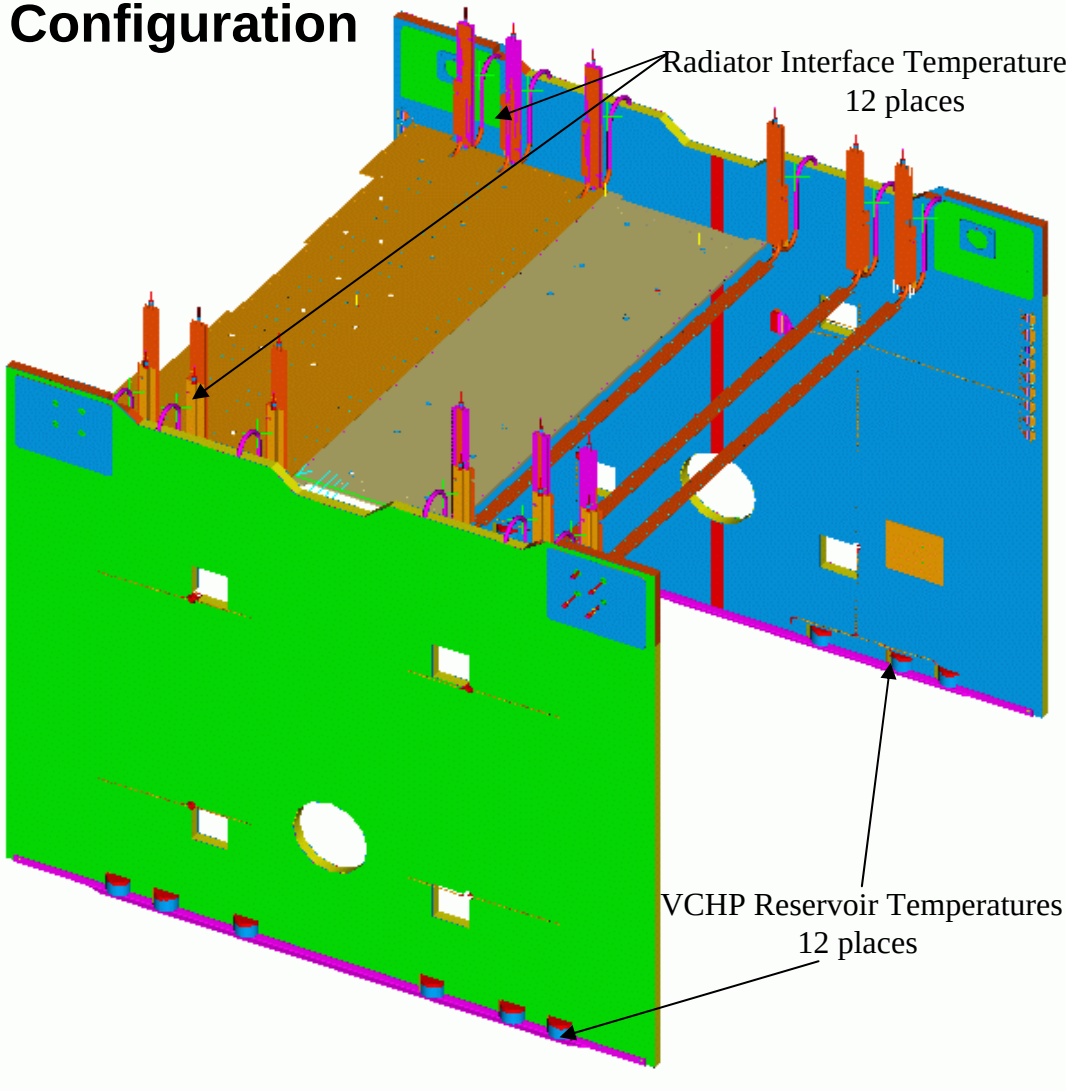
Flight TCS Hardware

- **Heat Pipe Configuration**



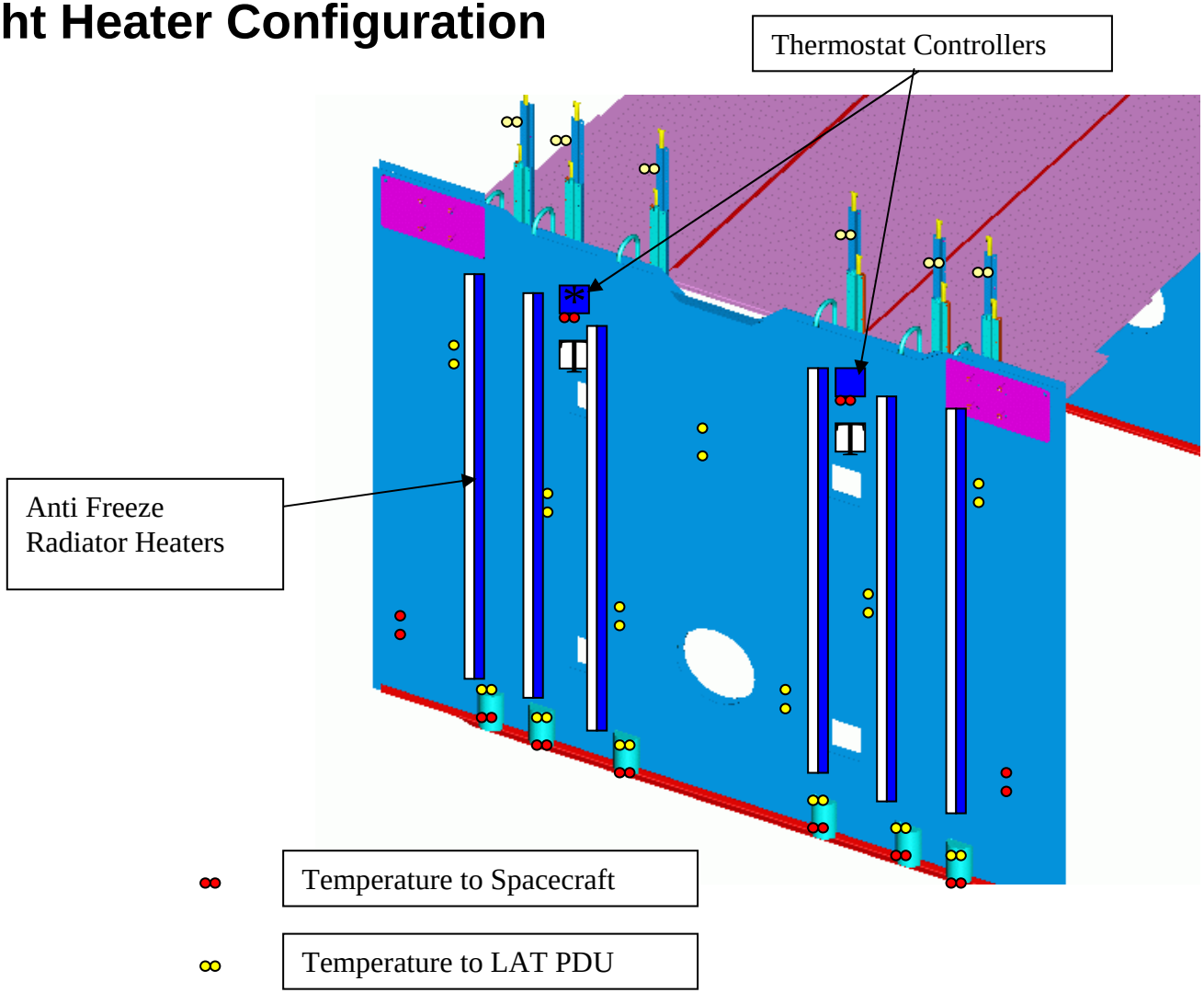
Flight TCS Hardware

- **Heat Pipe Configuration**



Flight TCS Hardware

- **Flight Heater Configuration**



Flight TCS Hardware

- **Deviations from flight configuration**

Description of Deviation from Flight Configuration	Impact on Verification Program	Assessment/Mitigation
SC Flexures: flexures are not the flight article, but are flight spares	No impact—thermally and structurally, the flexures behave identically to the flight flexures	Confirmed that flight spare design and fabrication was identical to flight article
Back-door cable into GASU	No impact—this is one additional cable connected to the LAT, and additional parasitic heating/cooling of the LAT is negligible	The total heat transfer through the EGSE cable plant will be assessed during the test. At that time, the incremental impact of this additional cable can be estimated, but is expected to be negligible
Radiator VCHP joint is flight-design joint, but will be broken after test to facilitate transport. This will be finally verified at Observatory-level thermal-vacuum testing.	No impact on LAT verification	The joint is identical to the final flight joint, so it will behave thermally the same
	Radiator thermal connection workmanship verification delayed	This will be delayed until Observatory thermal testing, but LAT thermal testing will demonstrate that the joint performs as required, so the delay is low-risk
Gravity affects the thermal performance of the VCHP's	No impact to LAT verification	LAT must be leveled to +/- 0,1 degrees to eliminate gravity effects..

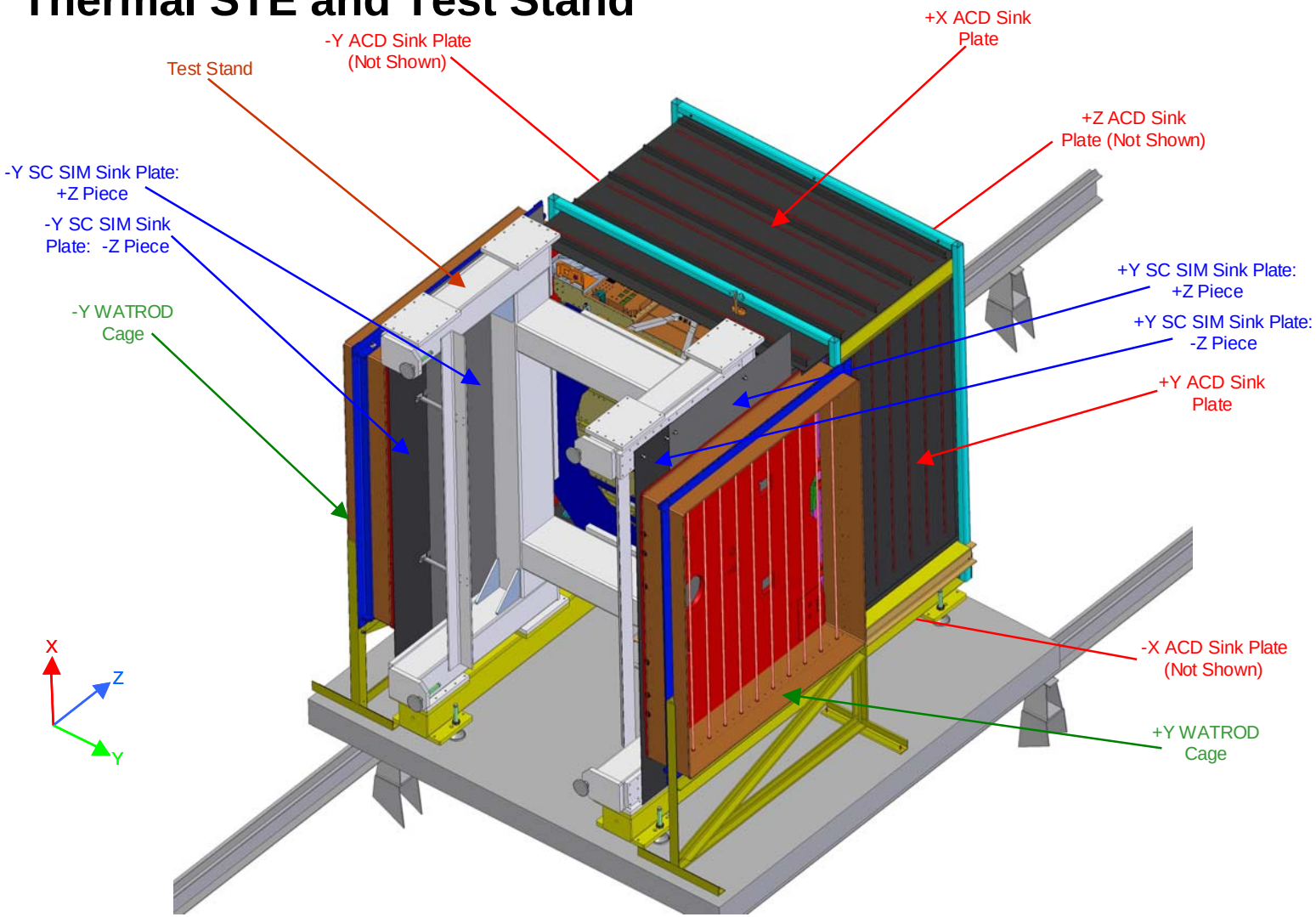
Flight TCS Hardware

- **Temperature Sensors**
  - **698 flight sensors**

Thermal GSE

Thermal GSE

- **Thermal STE and Test Stand**

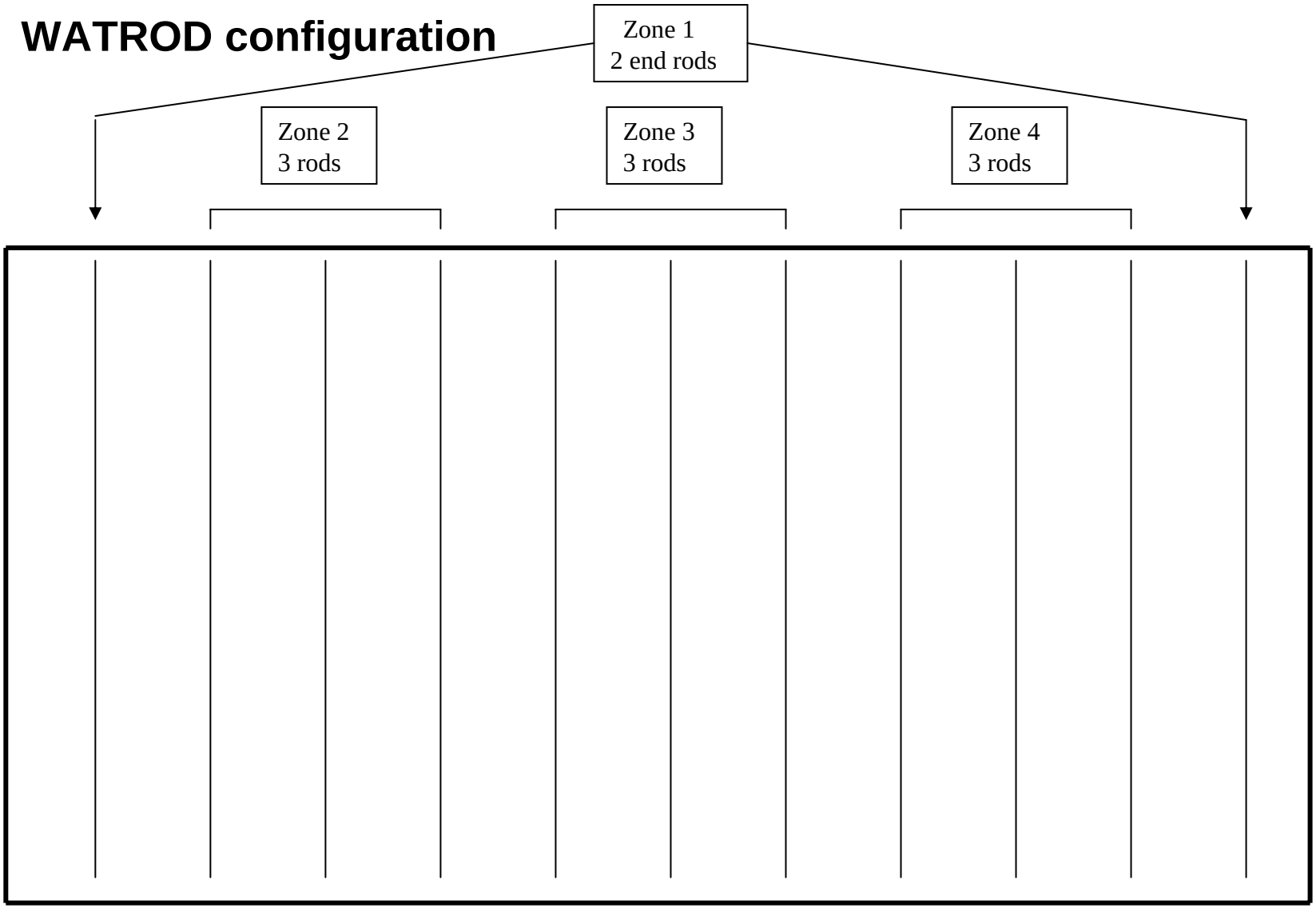


Thermal GSE

- **Radiant Tubular Heaters (Watrods)**
  - **Each array consists of 11 Watrods framed by polished aluminum baffles**
  - **The Watrods are ¼" diameter, spaced ≅ 6 inches apart and located ≅ 9 inches from the radiator surface**
  - **Each radiator Watrod array contains four separate control zones**
  - **The Watrods are controlled via CDACS and may be operated in either fixed voltage or temperature controlled modes.**
  - **Temperature control is accomplished via feedback from radiometers mounted between the Radiators and the Watrod arrays**

Thermal GSE

- **WATROD configuration**

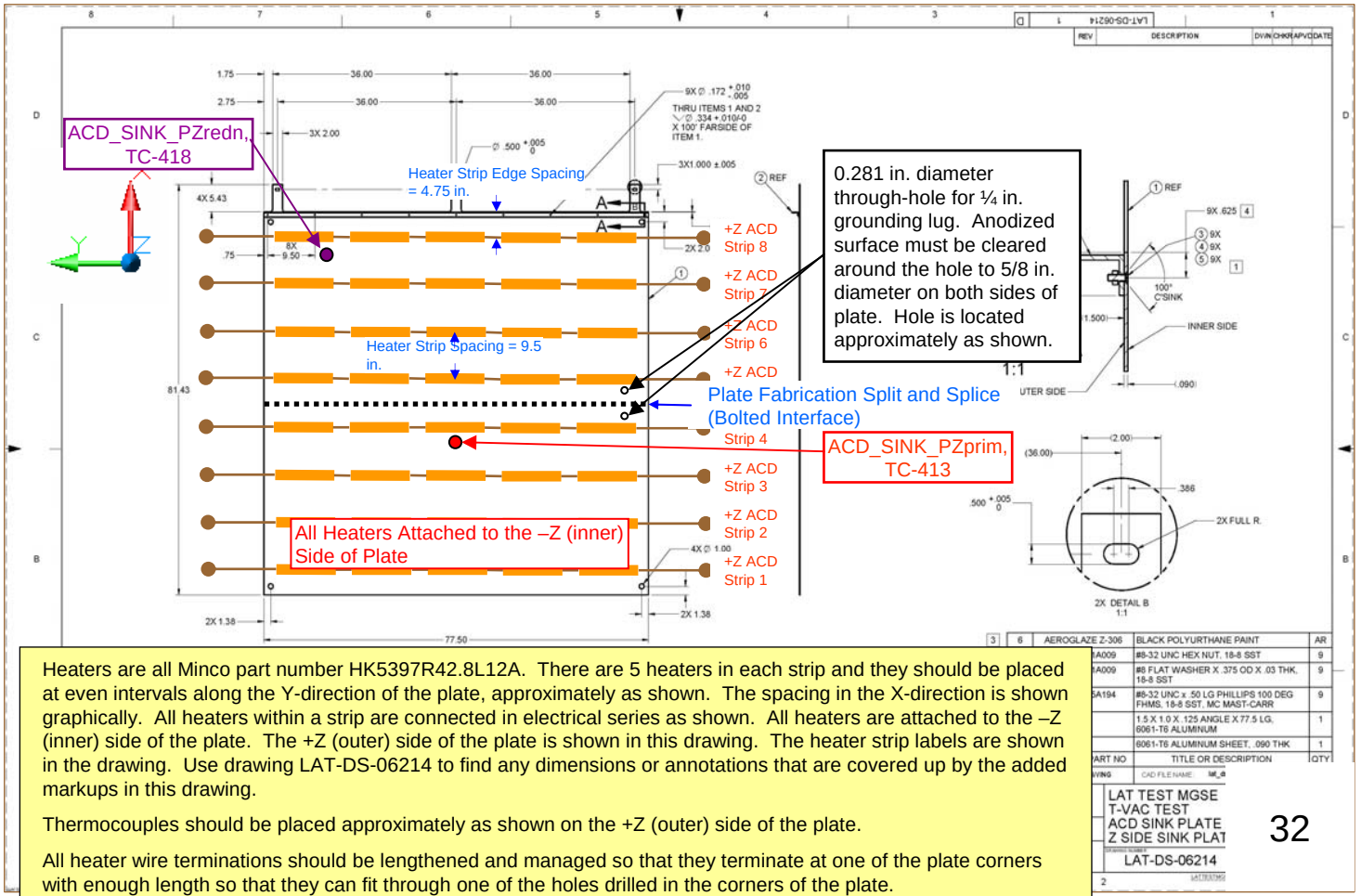


Thermal GSE

- **Heater Sink Plates**
  - **5 ACD Sink Plates: one for each of the ACD +Z, +Y, -Y, +X, and –X surfaces; The four side plates and one top plate are each individually controlled**
  - **2 SC Equivalent Sinks: two sink plates to simulate the SC bus, one inboard of each Radiator; These control the environment to the back of each Radiator Guard Heaters**
- **Guard heaters are used at LAT interfaces where test components are routed outside and provide a significant heat leak path or on any external hardware where temperature is of concern. Heaters at these locations are powered to maintain constant temperatures or small temperature gradients, thereby reducing heat leaks**

Thermal GSE

- **Sink Plate and Test Stand Heater Configurations**
  - **LAT-DS-07917, LAT-DS-07918 and heater circuit hook-up tables**



Heaters are all Minco part number HK5397R42.8L12A. There are 5 heaters in each strip and they should be placed at even intervals along the Y-direction of the plate, approximately as shown. The spacing in the X-direction is shown graphically. All heaters within a strip are connected in electrical series as shown. All heaters are attached to the –Z (inner) side of the plate. The +Z (outer) side of the plate is shown in this drawing. The heater strip labels are shown in the drawing. Use drawing LAT-DS-06214 to find any dimensions or annotations that are covered up by the added markups in this drawing.

Thermocouples should be placed approximately as shown on the +Z (outer) side of the plate.

All heater wire terminations should be lengthened and managed so that they terminate at one of the plate corners with enough length so that they can fit through one of the holes drilled in the corners of the plate.

Thermal GSE

- **Chamber Shrouds**
  - **During all phases of testing except survival heater testing, the T-Vac chamber is configured to maintain a cold wall temperature of approximately -150°C**
  - **A colder sink temperature will be necessary to expedite survival heater testing**
- **Temperature Sensors**
  - **103 fly-away test temperature sensors**
  - **194 removable test temperature sensors**

Thermal Vacuum Test Readiness

Thermal Vacuum Test Readiness

ITEM	STATUS
Test Plan	Released
Test Procedure	Released Final release prior to TVAC, review version available on LATDOCs
Test Software	Incomplete (Thermal Parameter upload scripts ready by 7/17/06)
Facilities (Chamber and CDACS)	Incomplete (CDACS and Big Blue chamber ready by 7/18/06)
Test Preps	Incomplete (All prep.'s ready by 7/18/06)
Emergency Procedures	Incomplete (Complete by 7/18/06)
Staffing Plan	Complete

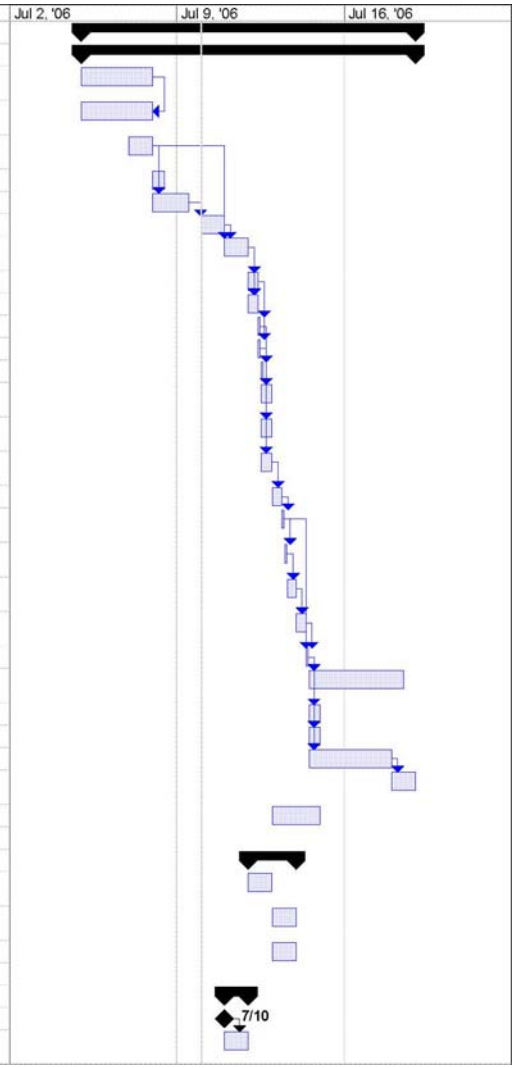
Thermal Vacuum Test Readiness

- **Facilities readiness**
  - **TVAC Chamber**
    - **Background contamination survey TBR (7/13 or 7/14)**
      - **Leak repair pending results**
  - **TVAC GSE ready by 7/18/06**
    - **Installation of TC bundles, power bundles, test MLI & STE**
  - **CDACS setup ready by 7/18/06**
  - **Backup generator currently installed**
    - **Fully tested by 7/18/06**

Thermal Vacuum Test Readiness

- **Test Preps Schedule**

ID	Task Name	People	Duration	Start	Finish
1	**TVAC Prep./Check-out**		**12 days**	**Wed 7/5/06**	**Tue 7/18/06**
2	**Hardware Prep.**		**12 days**	**Wed 7/5/06**	**Tue 7/18/06**
3	Build Remaining TC Bundles	M. Rambert, T. Wilson, G. Heruth, M. Freeman	3 days	Wed 7/5/06	Fri 7/7/06
4	Apply TCs to LAT	SLAC Techs	3 days	Wed 7/5/06	Fri 7/7/06
5	Cut Test MLI to Fit (Flexure MLI and TIP Plate Cover)	Matt Swift, Jim Mathews, SLAC Techs	1 day	Fri 7/7/06	Fri 7/7/06
6	Add Extension Beams	P. Dizon & Crew, SLAC Techs	0.5 days	Sat 7/8/06	Sat 7/8/06
7	Thermistor Touch Testing	J. Goodman	1.5 days	Sat 7/8/06	Sun 7/9/06
8	EMI Re-Test	SLAC	1 day	Mon 7/10/06	Mon 7/10/06
9	Add Remaining Test MLI and Extension Beam TCs	M. Freeman, T. Wilson, J. Mathews, G. Heruth, SLAC Techs	1 day	Tue 7/11/06	Tue 7/11/06
10	Rotate LAT	P. Dizon & Crew, SLAC Techs	0.25 days	Wed 7/12/06	Wed 7/12/06
11	Closeout Castor MLI	M. Freeman	0.25 days	Wed 7/12/06	Wed 7/12/06
12	Add ACD Cage and Plates	P. Dizon & Crew, SLAC Techs	0.25 days	Wed 7/12/06	Wed 7/12/06
13	Add SC SIM Plates	P. Dizon & Crew, SLAC Techs	0.25 days	Wed 7/12/06	Wed 7/12/06
14	Ground STE to Test Stand	M. Freeman, T. Wilson, J. Mathews,	0.25 days	Wed 7/12/06	Wed 7/12/06
15	Add TCs to STE	M. Freeman, T. Wilson, J. Mathews, G. Heruth, SLAC Techs	0.5 days	Wed 7/12/06	Wed 7/12/06
16	Add Power Bundles to STE	M. Freeman, T. Wilson, J. Mathews, G. Heruth, SLAC Techs	0.5 days	Wed 7/12/06	Wed 7/12/06
17	Shield Power Bundle Connections	T. Wilson, M. Rambert, G. Heruth, M. Freeman, SLAC Techs	0.5 days	Wed 7/12/06	Wed 7/12/06
18	Lift Test Article Onto Trolley	P. Dizon & Crew, SLAC Techs	0.25 days	Thu 7/13/06	Thu 7/13/06
19	Remove Upper Extension Beams	P. Dizon & Crew, SLAC Techs	0.25 days	Thu 7/13/06	Thu 7/13/06
20	Closeout MLI After Upper Extension beam Removal	M. Freeman, T. Wilson, J. Mathews, G. Heruth	0.25 days	Thu 7/13/06	Thu 7/13/06
21	Lift WATROD Cages Onto Trolley	P. Dizon & Crew, SLAC Techs	0.25 days	Thu 7/13/06	Thu 7/13/06
22	Attach WATROD Cages and Adjust Placement	P. Dizon & Crew, SLAC Techs	0.25 days	Fri 7/14/06	Fri 7/14/06
23	Roll Into Chamber	P. Dizon & Crew, SLAC Techs	0.25 days	Fri 7/14/06	Fri 7/14/06
24	TVAC Power and TC Hook-up and Check	M. Freeman, T. Wilson, J. Mathews, G. Heruth, V. Thai	4 days	Fri 7/14/06	Tue 7/18/06
25	Inclinometer Hook-up	M. Campell, J. Goodman	0.5 days	Fri 7/14/06	Fri 7/14/06
26	Ground LAT	M. Freeman, G. Heruth, T. Wilson	0.5 days	Fri 7/14/06	Fri 7/14/06
27	LAT CPT	B. Grist	3.5 days	Fri 7/14/06	Mon 7/17/06
28	Apply Internal EGSE Blankets w/ Heater Wire	M. Freeman, T. Wilson, J. Mathews, G. Heruth	1 day	Tue 7/18/06	Tue 7/18/06
29	LAT EGSE Check	B. Grist	2 days	Thu 7/13/06	Fri 7/14/06
30					
31	**Meetings and Training**		**2 days**	**Wed 7/12/06**	**Thu 7/13/06**
32	TVAC TRR	J. Armiger, J. Goodman, B. Pugh, N. Johnson, B. Raynor, All Interested	1 day	Wed 7/12/06	Wed 7/12/06
33	Thermal Test Conductor Training (Including CDACS)	All Thermal Test Conductors	1 day	Thu 7/13/06	Thu 7/13/06
34	Backup Generator Training	All Thermal Test Conductors	1 day	Thu 7/13/06	Thu 7/13/06
35					
36	**Software Preparations**		**1 day**	**Mon 7/10/06**	**Tue 7/11/06**
37	STPSAT Finished Testing	N/A	0 days	Mon 7/10/06	Mon 7/10/06
38	CDACS Fully Configured for Test (w/ Racks Tested)	V. Thai	1 day	Tue 7/11/06	Tue 7/11/06



Thermal Vacuum Test Readiness

- **Test Staffing**

Days in Test						1	2	3
Shift	Hours	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		07-17-2006	07-18-2006	07-19-2006	07-20-2006	07-21-2006	07-22-2006	07-23-2006
3	23:00 to 07:00					Wang	Wang	Wang
1	07:00 to 15:00					Pugh	Pugh	Pugh
2	15:00 to 23:00					Zakar	Zakar	Matonak

Days in Test		4	5	6	7	8	9	10
Shift	Hours	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		07-24-2006	07-25-2006	07-26-2006	07-27-2006	07-28-2006	07-29-2006	07-30-2006
3	23:00 to 07:00	Wang	Wang	Wang	Wang	Wang	Swales	Swales
1	07:00 to 15:00	Pugh	Pugh	Pugh	Pugh	Pugh	Pugh	Zakar
2	15:00 to 23:00	Matonak	Matonak	Matonak	Matonak	Matonak	Armiger	Armiger

Days in Test		11	12	13	14	15	16	17
Shift	Hours	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		07-31-2006	08-01-2006	08-02-2006	08-03-2006	08-04-2006	08-05-2006	08-06-2006
3	23:00 to 07:00	Matonak	Matonak	Matonak	Matonak	Matonak	Swales	Swales
1	07:00 to 15:00	Peabody	Peabody	Peabody	Peabody	Peabody	Goodman	Zakar
2	15:00 to 23:00	Wang	Wang	Wang	Wang	Wang	Armiger	Armiger

Days in Test		18	19	20	21	22	23	24
Shift	Hours	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		08-07-2006	08-08-2006	08-09-2006	08-10-2006	08-11-2006	08-12-2006	08-13-2006
3	23:00 to 07:00	Wang	Wang	Wang	Wang	Wang	Wang*	Wang*
1	07:00 to 15:00	Pugh	Pugh	Pugh	Pugh	Pugh	Pugh*	Pugh*
2	15:00 to 23:00	Goodman	Goodman	Goodman	Goodman	Ferguson	Ferguson	Ferguson

Days in Test		25	26	27	28	29	30	31
Shift	Hours	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		08-14-2006	08-15-2006	08-16-2006	08-17-2006	08-18-2006	08-19-2006	08-20-2006
3	23:00 to 07:00	Wang	Wang	Wang	Wang	Wang	Matonak	Matonak
1	07:00 to 15:00	Pugh	Pugh	Pugh	Pugh	Pugh	EWG	EWG
2	15:00 to 23:00	Matonak	Matonak	Matonak	Matonak	Goodman	Peabody	Peabody

Days in Test		32	33	34	35	36	37	38
Shift	Hours	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		08-21-2006	08-22-2006	08-23-2006	08-24-2006	08-25-2006	08-26-2006	08-27-2006
3	23:00 to 07:00	Matonak	Matonak	Matonak	Matonak	Matonak	Matonak	Matonak
1	07:00 to 15:00	EWG	EWG	EWG	EWG	EWG	EWG	EWG
2	15:00 to 23:00	Pugh	Pugh	Pugh	Pugh	Pugh	Pugh	Pugh

Days in Test		39	40	41	42	43	44	45
Shift	Hours	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		08-28-2006	08-29-2006	08-30-2006	08-31-2006	09-01-2006	09-02-2006	09-03-2006
3	23:00 to 07:00	Matonak	Matonak					
1	07:00 to 15:00	EWG	EWG					
2	15:00 to 23:00	Pugh	Pugh					

* If necessary

2nd and 3rd shift need SECRET clearance; else must be escorted from Gate to chamber.

Conclusions

- **Work still to be performed:**
  - **Complete test software to support upload of thermal parameters**
  - **Shroud leak and CDACS shake-down**
  - **Complete final test preparations at NRL**
  - **Emergency procedures**
  - **Final TVAC procedure release**
- **The Thermal Engineer and LAT Test Conductor must work closely during power cycling to insure the LAT is restarted with the correct thermal parameters**
- **Pending completion of the above items, the LAT will be ready for thermal vacuum test**