HIRDLS

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Issue A

HIGH RESOLUTION DYNAMICS LIMB SOUNDER

Originator: Richard Moss Date: 25 May 1998

Subject/Title: **HIRDLS Instrument Thermal Analysis Report**

Description/Summary/Contents:

The purpose of this document is to provide a description of the thermal model generated by MMS as a part of the Phase1B contract. Included is a set of the in-orbit flight predictions using current data from the end of the Phase1B part of the program.

Keywords: Thermal Analysis, STH, SSH, Simulation

Purpose of this Document: Thermal Analysis Report for Phase1B

Reviewed/Approved by:			
Date (yy-mm-dd):	98-6-10		10/6/98

Rutherford Appleton Laboratory
Chilton
Didcot
Oxfordshire
OX11 0QX
United Kingdom

Matra Marconi Space UK
Anchorage Road
Portsmouth
Hants PO3 5PU
United Kingdom

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HIRDLS Instrument Thermal Analysis Report

TC-MMS-381

Responsible Engineer: _____ Date: 31-05-98
Richard Moss

Quality Assurance: _____ Date: 11/6/98
Clare Burrows

Project Manager: _____ Date: 10-6-98
John Harvey

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1. Reference and Applicable Documentation

Specification for the Structure/Thermal Subsystem	SP-HIR-31D
Interface Reference Report for the HIRDLS	EOS-HIR-TRW-IS-0001
HIRDLS Preliminary Design Review	PDR Data Pack
Temperature Requirements for the Electronics Boxes	TC-LOC-310
Instrument Technical Specification (ITS)	SP-HIR-13R
General Interface Requirements Document (GIRD)	GSFC-422-11-12-01
Instrument External Interface Description (EID)	SP-HIR-014G
Unique Instrument Interface Document (UIID)	GSFC-424-28-21-06
Sun Beta Angles for HIRDLS	EOS-EDCN-0174
Sunshield Subsystem Specification	SP-HIR-50A
Thermal Subsystem - Division of UK/US Responsibilities	PM-RAL-069
System Performance Requirements and Allocation Tables (SPRAT)	TC-HIR-57H
HIRDLS Performance Verification Specification	SP-LOC-85

2. Acronyms and Abbreviations

BEU - Blackbody Electronics Unit

CCU - Cooler Electronics

CSS - Cooler Subsystem

GEU - Gyro Electronics Unit

GMU - Gyro Mechanical Unit

HIRDLS - High Resolution Dynamic Limb Sounder

IPU - Instrument Processor Unit

MLI - Multi Layer Insulation

MLS - Microwave Limb Sounder

MMS - Matra Marconi Space

OBA - Optical Bench Assembly

PCU - Power Conditioning Unit

RAL - Rutherford Appleton Laboratory

TEU - Telescope Electronics Unit

SPU - Signal Processor Unit

SSH - Sunshield SubSystem

STH - Structure Thermal Subsystem

SVA - Space View Aperture

TSS - Telescope SubSystem

3. Introduction

Presented here is a description of the thermal mathematical model generated for the Phase1B of HIRDLS project. Included are a set of the latest flight predictions and requirements as of the date of issue. The modelling is broken down into 2 parts; the in-orbit fluxes and inter-nodal radiation exchanges are calculated using the Systema/Thermica software. This data is then combined with the nodal definitions and conduction links with any additional radiation couplings to form the mathematical model which is input into Esatan to provide the temperature data (both steady state and transient around an orbit).

The HIRDLS (High Resolution Dynamic Limb Sounder) program is an Earth Observation instrument which is jointly being designed and manufactured by the US and UK. The thermal design of the instrument is a passive system of control surfaces during the nominal operational phases of the mission. The exception to this is the active cooling system used for the detector sub assembly, which is not covered in this document as this is being controlled from within the US. During the early orbit phase and during any spacecraft or instrument shutdown there is a survival circuit which will provide enough power to keep the equipment above survival temperatures. This is covered by the US prime contractor (Lockheed) and as such is not covered here, although reference should be made to the PDR and TC-LOC-312.

4. Modelling Philosophy

The model has been generated with the following error philosophy.

As the structural panels are to be manufactured from CFRP faceskins then the panels are modelled as a 2 part set of thermal nodes. Each node represents half of one panel in thickness, such that each node has the properties of a single faceskin and half the honeycomb core. This enables a conductive link to be made to the corresponding half of the panel which consists of the other half of the honeycomb and a single faceskin. In an ideal case the panels would be modelled as 3 nodes, one for each faceskin and a separate one for the core. However, as in this model we are only concerned with the unit temperatures which are mounted onto the external faceskins, a 2 node philosophy is sufficient. (An example of a case for 3 thermal nodes would be a communications payload with a heat pipe running through the honeycomb core). These structural panels are then divided up into zones, the size of which is representative of less than typical unit sizes. This enables the model to determine the temperature directly underneath an electronics unit with minimal influence from any surrounding units (with 2 units on a single thermal node there would be an error associated with an averaging of the temperature influence from each unit which could not be accurately determined). With this panel philosophy the model will give sufficiently accurate temperature data whilst minimising the computational time.

The electronics box units are represented by a 6 sided box with a separate thermal node for each face of the box. As with limiting the number of units per panel node as above, this enables an accurate model of the box interface with a panel as there will be an individual thermal node representative of the interface surface. Where there are no details available then the power distribution on the box external faces is taken as evenly spread on all 6 faces. Where more detail is available then a more realistic power load is applied. There are no internal thermal nodes representative of the internal components of the box. This leads to a significant temperature gradient between the box wall temperature and component level. Due to this lack of detail it was agreed by MMS and Lockheed at an early stage of model development to have a design margin goal of ±12°C rather than the standard ±10°C applied before correlation. When reduced thermal models are available from the subsystem designers and these are integrated into the HIRDLS model then this margin can be reduced. Following thermal balance correlation, the margin can be further reduced to ±5°C.

The inter-panel couplings are via cleats and inserts. As the cleats and inserts are designed to have a positive position tolerance only (i.e. The panels will always have a gap between them) then the conductive couplings between panels is assumed to be dependent only on the cleats and inserts and independent on the contact surface area of any 2 panels. The values for the conductance across cleats and inserts can be calculated by a study of the individual fastening design. However, an additional factor is the path of the heat from the centre of each panel node to the fastening (cleat or insert) and then to the centre of the next panel. This involves traversing the faceskin, glue, and the honeycomb in directions which do not have high thermal conductivity and has considerable build-up of error. Therefore a common value for the general link between such panels and fastenings is used in conjunction with a factor to assess the sensitivity of the instrument temperature distribution on these links.

Finally on the orbital conditions a set of worst case values is laid down in the GIRD. These are used in conjunction with the extreme Beta angles as defined in 'Sun Beta Angles for HIRDLS : EOS-EDCN-0174'. One must be wary of a build-up of worst case parameters in such a top level thermal analysis. These worst case combinations of orbital parameters is used with a model with worst case thermo-optical properties, internal dissipation, MLI effectivity, etc. These combinations can easily prevent any thermal design from having the design margin we are seeking. In addition to all this, for the test phase extra margin is applied to the qualification and acceptance at instrument and equipment and component level tests.

5. Spacecraft

HIRDLS is planned to be launched on a spacecraft manufactured by TRW Inc. named EOS-CHEMISTRY. The GIRD defines the top level requirements for the thermal system. In summary the GIRD states that the instrument is responsible for the maintenance of the operating temperatures and ability to use available survival power (defined as 66W in the UIID) to maintain switch-on temperatures. Survival is defined as any pointing orientation for a period of at least 4 orbits. The heat transfer to/from the spacecraft must be under 15.5W/m^2. As the footprint of HIRDLS is approx. 1m x 1.5m then this equates to a heat leakage of around 23W. This is via the instrument feet and through the interface MLI blanket. The environmental thermal flux parameters are also defined in the GIRD and shown in section 5. The spacecraft temperature range is defined and the operational values also shown in section 5, the survival values are -20°C to +50°C and is used by Lockheed for the survival analysis. The thermal field of view of the instrument on the spacecraft is defined in the UIID as a cone of 170° on the space facing radiator side of the instrument (+Y). However, there is an adjacent instrument (TES) which has an operational mode albedo shield which interferes with this cone. This has been taken into account during this analysis. The thermal models which are delivered to the spacecraft are all handled by Lockheed and not covered in this document.
Figures 5.1-5.6 illustrate the spacecraft thermal model used in this analysis.

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HIRDLS Project

Flight configuration

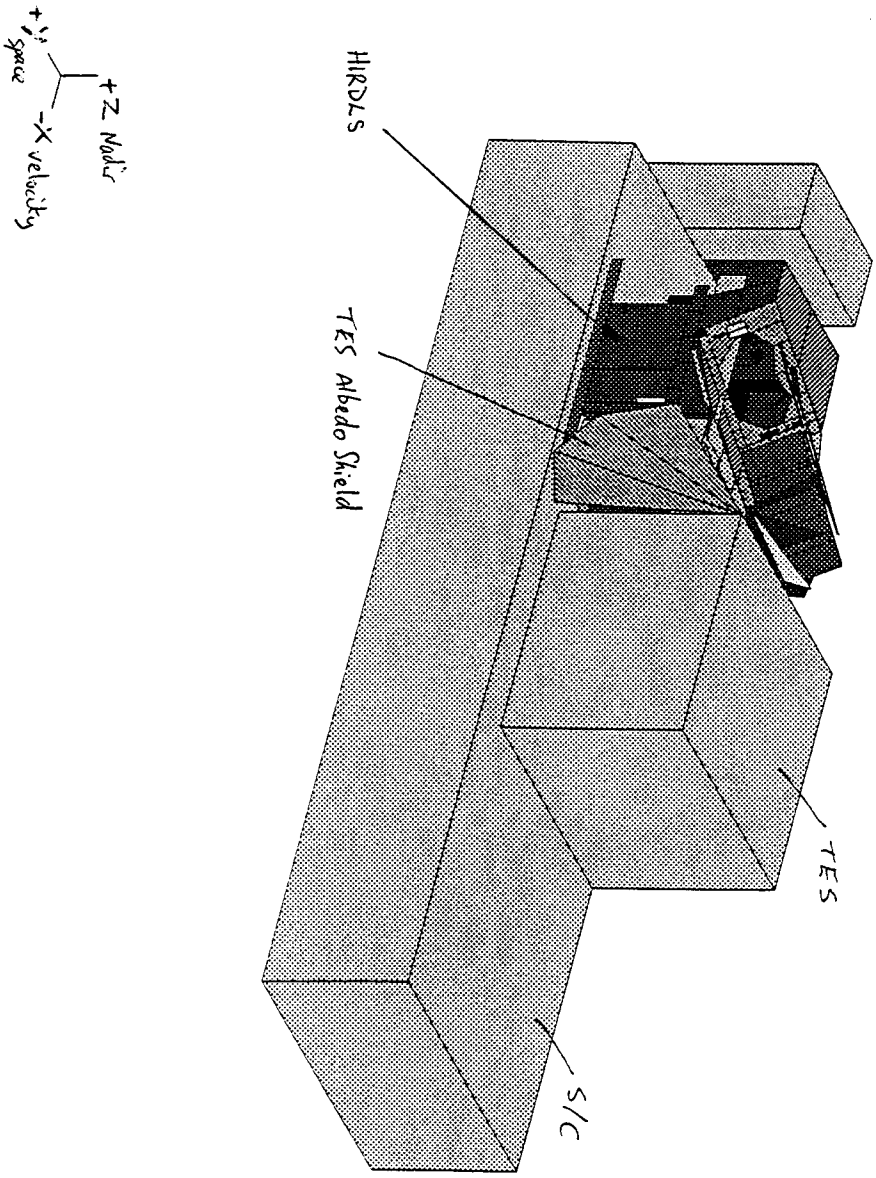

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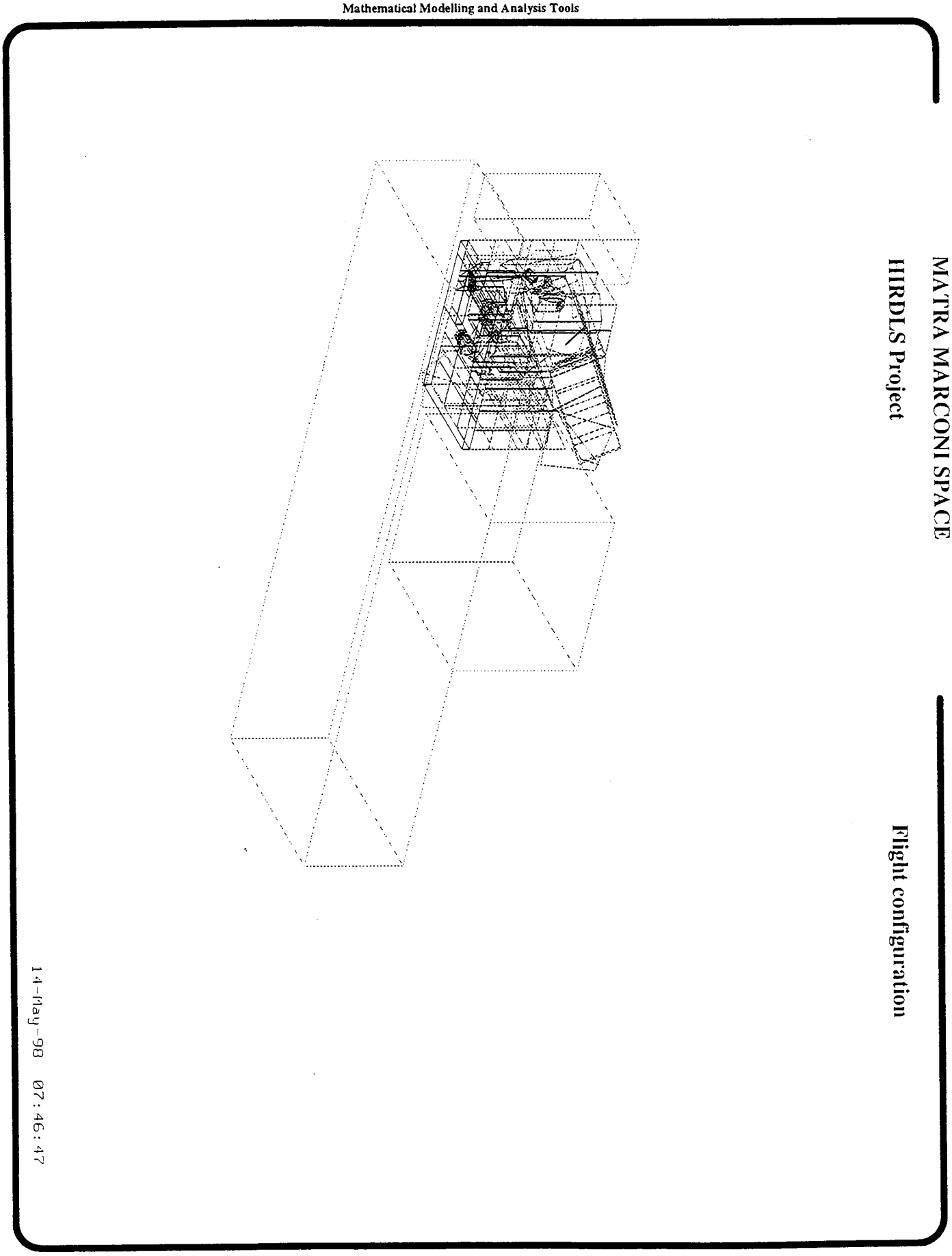
Figure 5.1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Flight configuration
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Figure 5·2

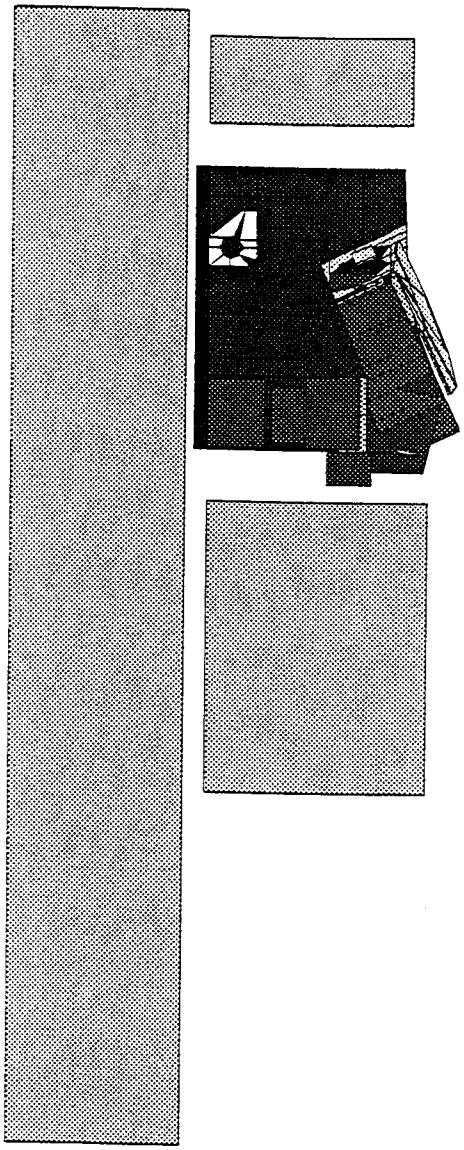

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Figure 5.3

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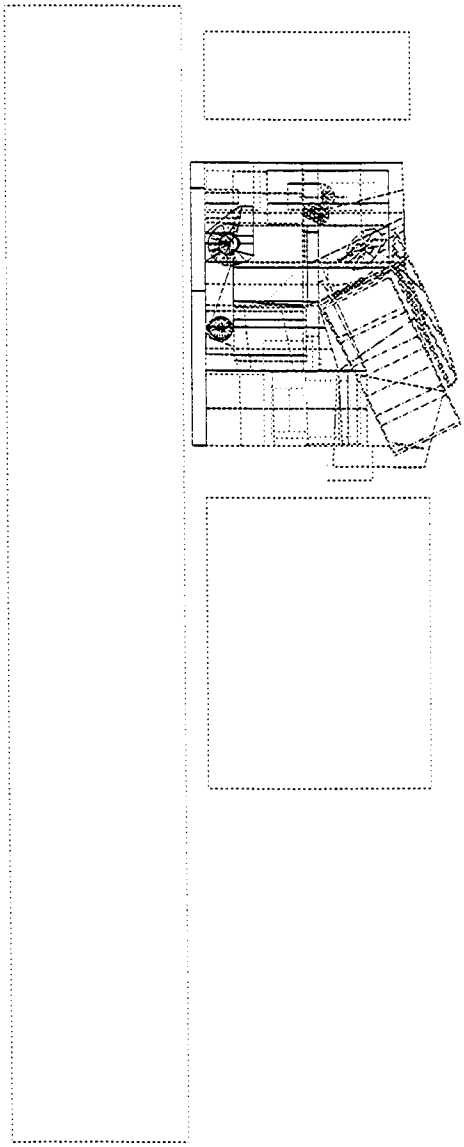

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Figure 5.4

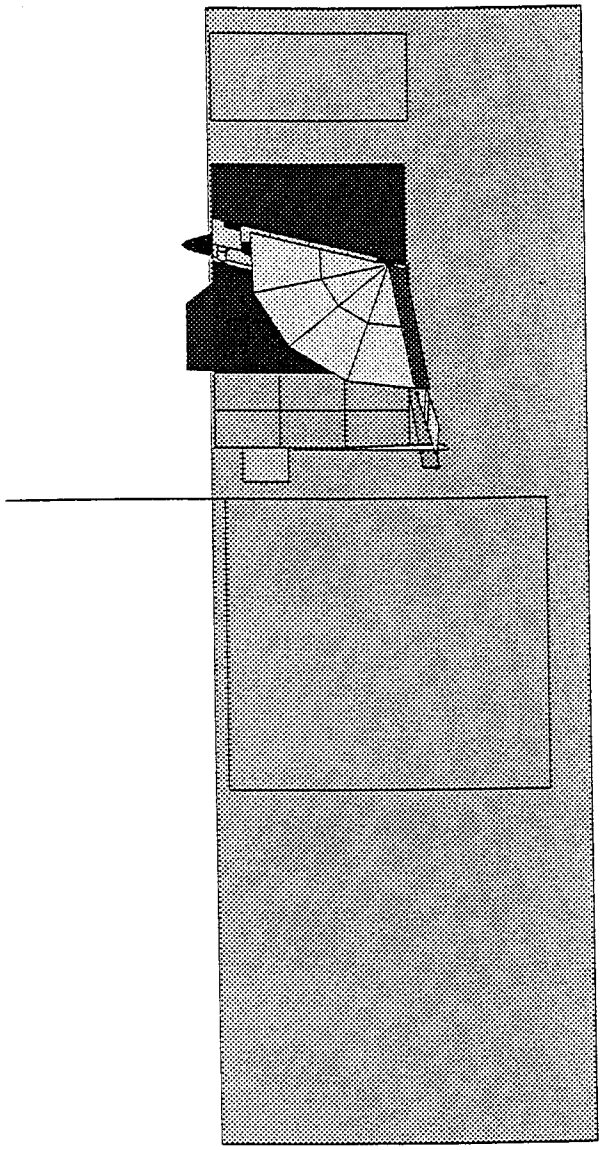

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Figure 5.5

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Flight configuration

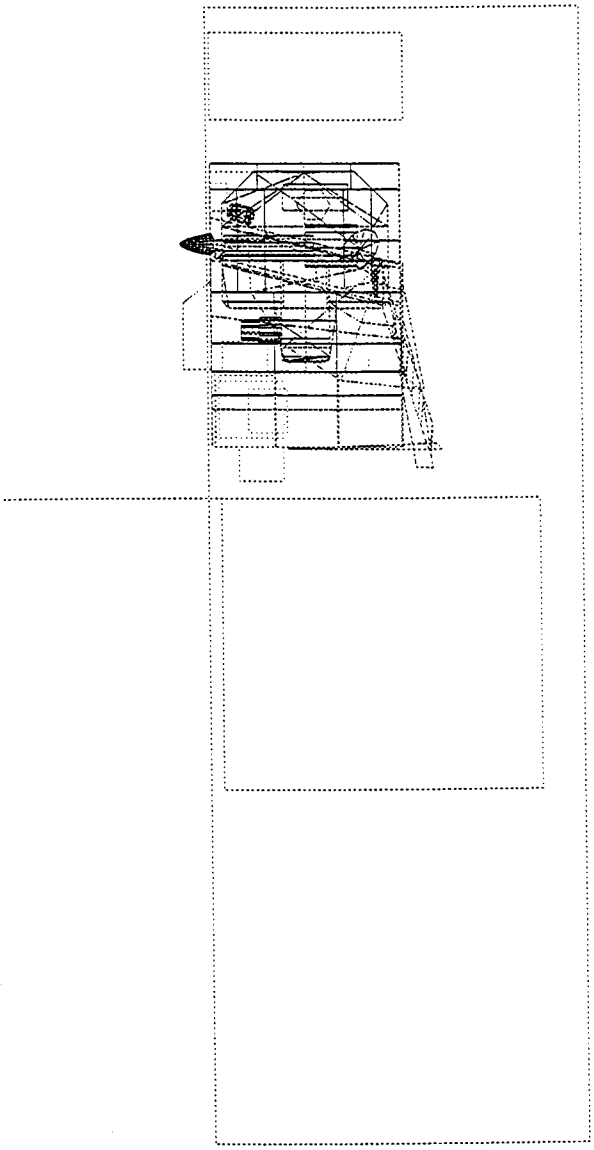

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Figure 5:6

6. Surface Geometry Model

The HIRDLS surface geometry currently consists of some 300+ thermal nodes. This is combined with 20 spacecraft and adjacent instrument thermal nodes. Many of these nodes are constructed from multiple thermal surfaces to enhance the precision of the radiative calculations. These surfaces are facing both towards the external environment (Sun, Earth, Space, Spacecraft) whilst others are more concerned with the interaction with internal surfaces. Much of the outer surfaces are representative of MLI and thus given a lower meshing of thermal node density. Of most importance for the external surface nodes is the space facing (+Y) radiator side of the instrument. This is ultimately where the majority of internally generated heat will be dissipated. Fortunately, due to the sun-synchronous orbit this face has a constant view to cold space. However, as mentioned before this view is partially obscured at the Electronics Compartment end by the presence of the TES albedo shield.

The HIRDLS model itself is broken down into the following sections; The Electronics Compartment or Cavity, the STH, the OBA, the SSH and the SVA. The spacecraft is broken down into the Bus, TES, and MLS. The Electronics Compartment is split into 2 parts; the Equipments, and the Walls. The Equipments (see Figure 6.1) contains all the electronics boxes (for historical reasons, even though many units are now located outside the EC) such as the PCU, CCU, IPU, GEU, SPU, TEU, EEA, BEU, GMU. Again for historical reasons the Walls of the Electronics Compartment are defined separately to the remainder of the STH. These are broken down into the LHwall, the posXwall, Shelf_U, Top, Rear, and SX017-14. These are in turn broken down into 2 sides as explained earlier to represent the thickness of the panels. These sides are distinguished by the co-ordinate system as used in Systema/Thermica NOT that of the IRCF, this is historical as the thermal model was generated prior to the definition of the IRCF and the co-ordinate system used in Systema correspond to a logical definition of 'Top' 'Front' etc. in the 3D display section of the software.

The STH is split into the Walls and the Baseplate (see Figures 6.2-6.4). The Walls consists of negX, teuwall, ball rad (this is only shape representative for stray radiation purposes and is not used to calculate the cooler radiator temperature), nadir, space_1, spu_1, space_2, sun_1, sun_2, sun_3, MLI, space_2, spu_2, spu_3, Mezz, +Ylip. These are again broken down into internal and external faces. As the Baseplate has a large hole in it, the Baseplate is split into Internal, External, OuterMLI, and InnerMLI shapes.

The OBA is a detailed surface model taken from Lockheed in early 1998. The model is that of the hood and a reduced model of the optical components internal. The hood (see Figure 6.5) consists of Back, Side1, Side2, Top, Aperture (removed when using model of optics), Front, Bumper, Bottom, and Base. The optics is made from Scan Mirror, CalMirror, IF_BB, and Yoke. There are other optical components but these are only represented in the mathematical model (See later section).

The SSH consists of the door in the extreme positional cases during normal operation (open and closed by angles of 60° and 119° to the aperture plate), the Top, the Sides, the Aperture, and other components. The door is split into the 2 sides of black painted inner and MLI covered outer sides. The Top is split into 2 sides, an inner and exterior surface. The Sides are now the Fin inner and outer surfaces. The aperture is the aperture plate which is broken down into the TopLeftHandSide, BaseLeftHandSide, TopRightHandSide, BaseRightHandSide, and the Edge behind the door. The Edge is important as this where the door motor is located. The other components are the HoldDownReleaseMechanism (HDRM), Motor and Actuator (see Figure 6.6).

The SVA consists of the AlbedoShieldMountingBracket, the MountingPlate, and the Shield.

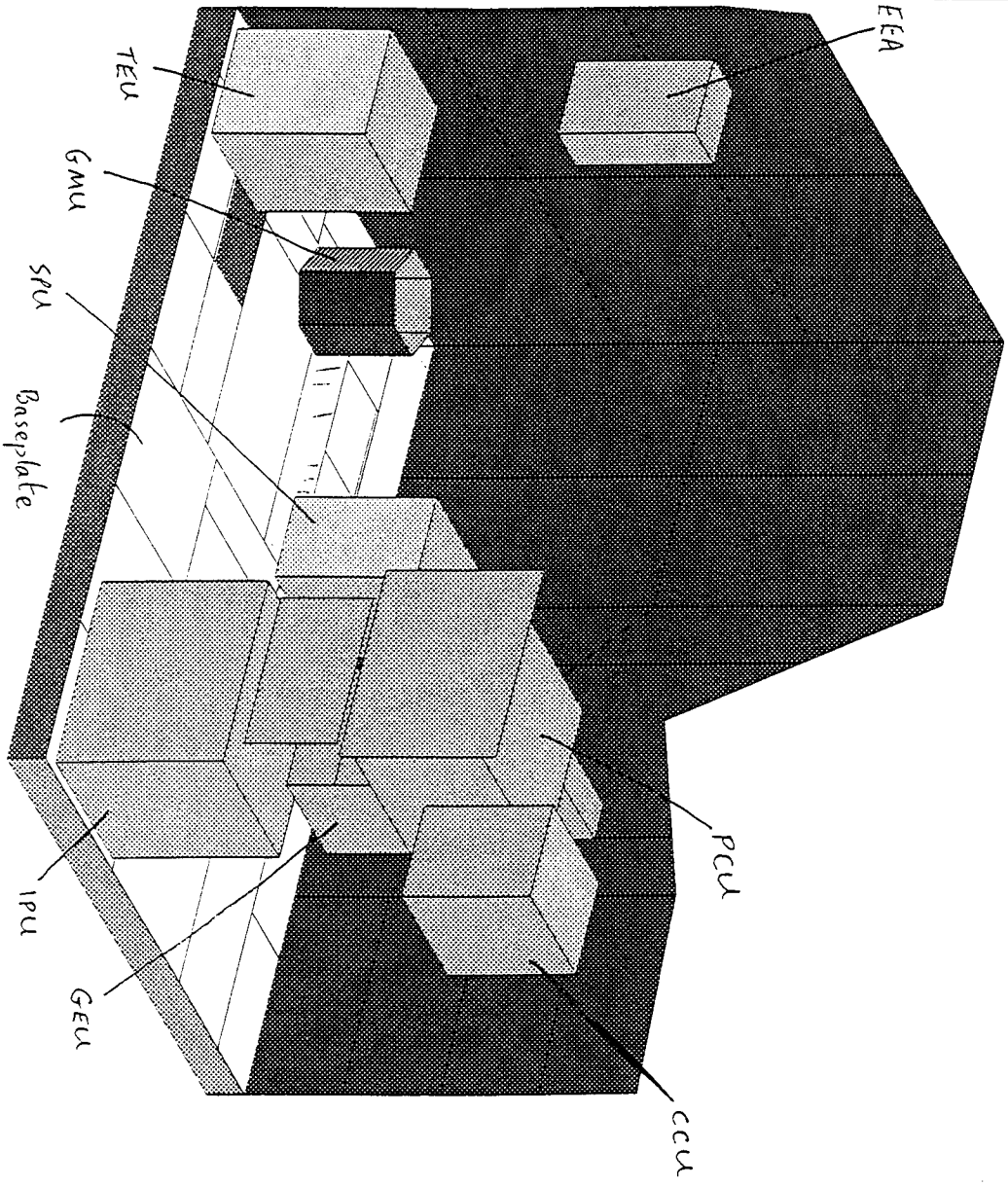

Figure 6-1

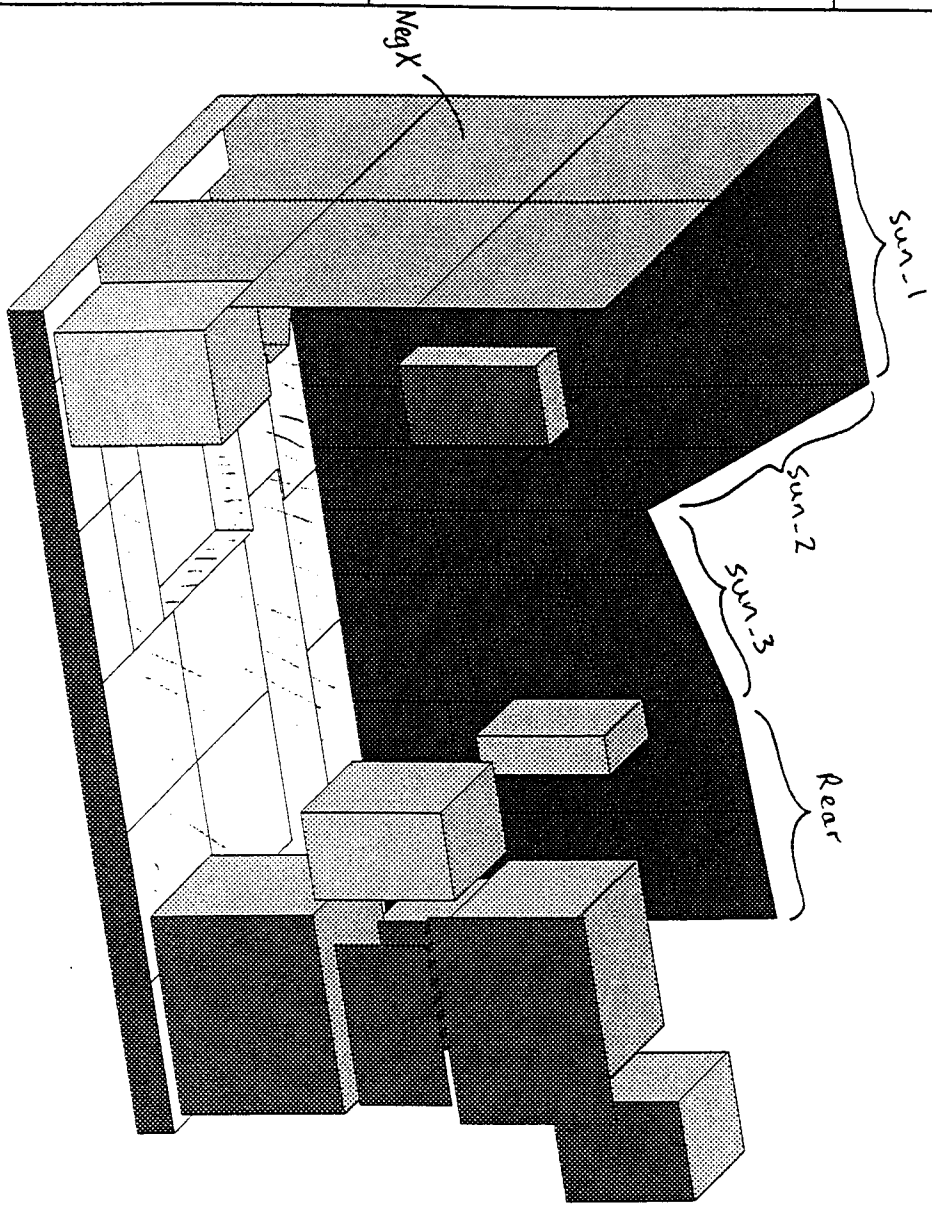

Figure 6.2

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HIRDLS Project

Model labelling

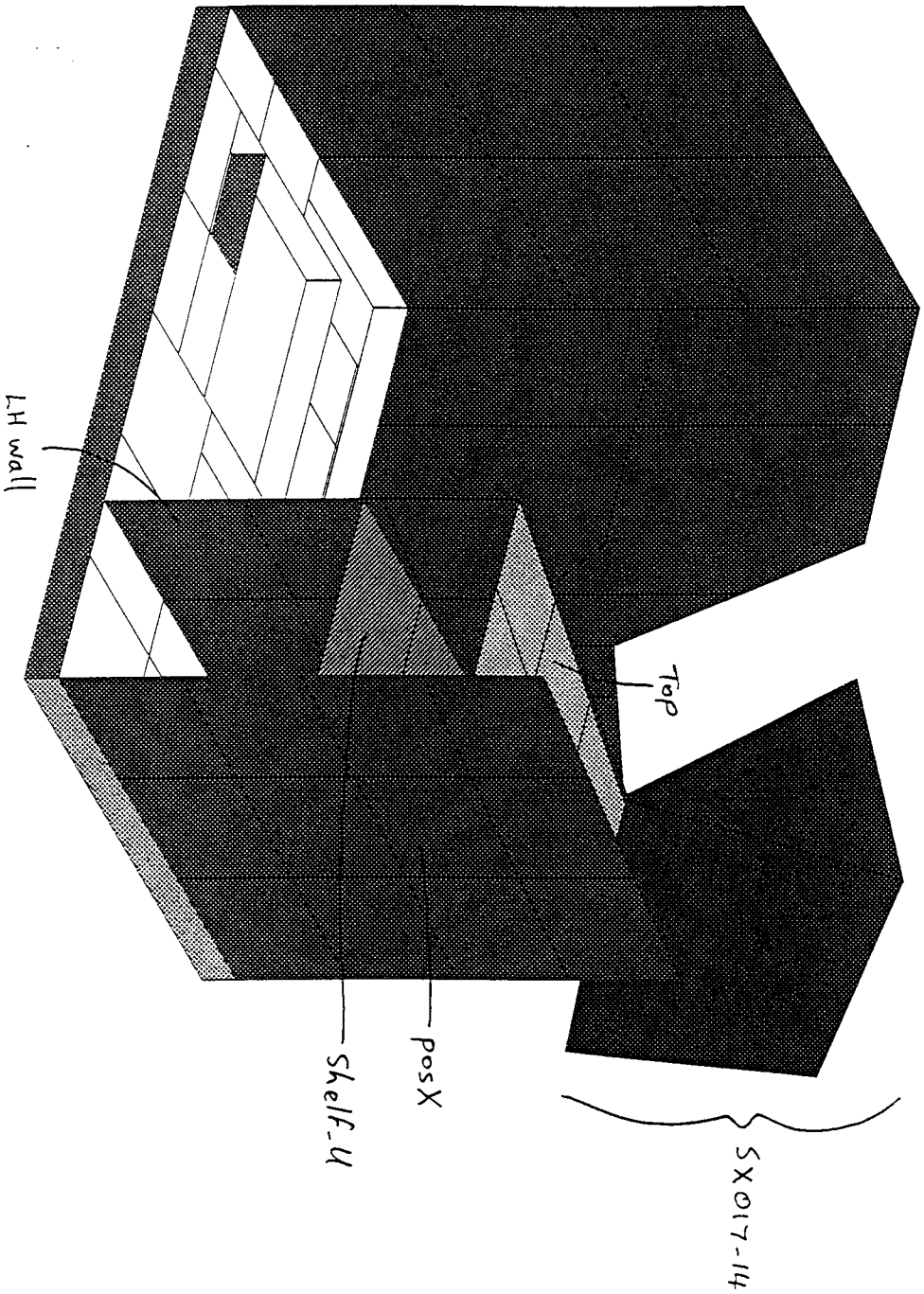

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Figure 6.3

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HIRDLS Project

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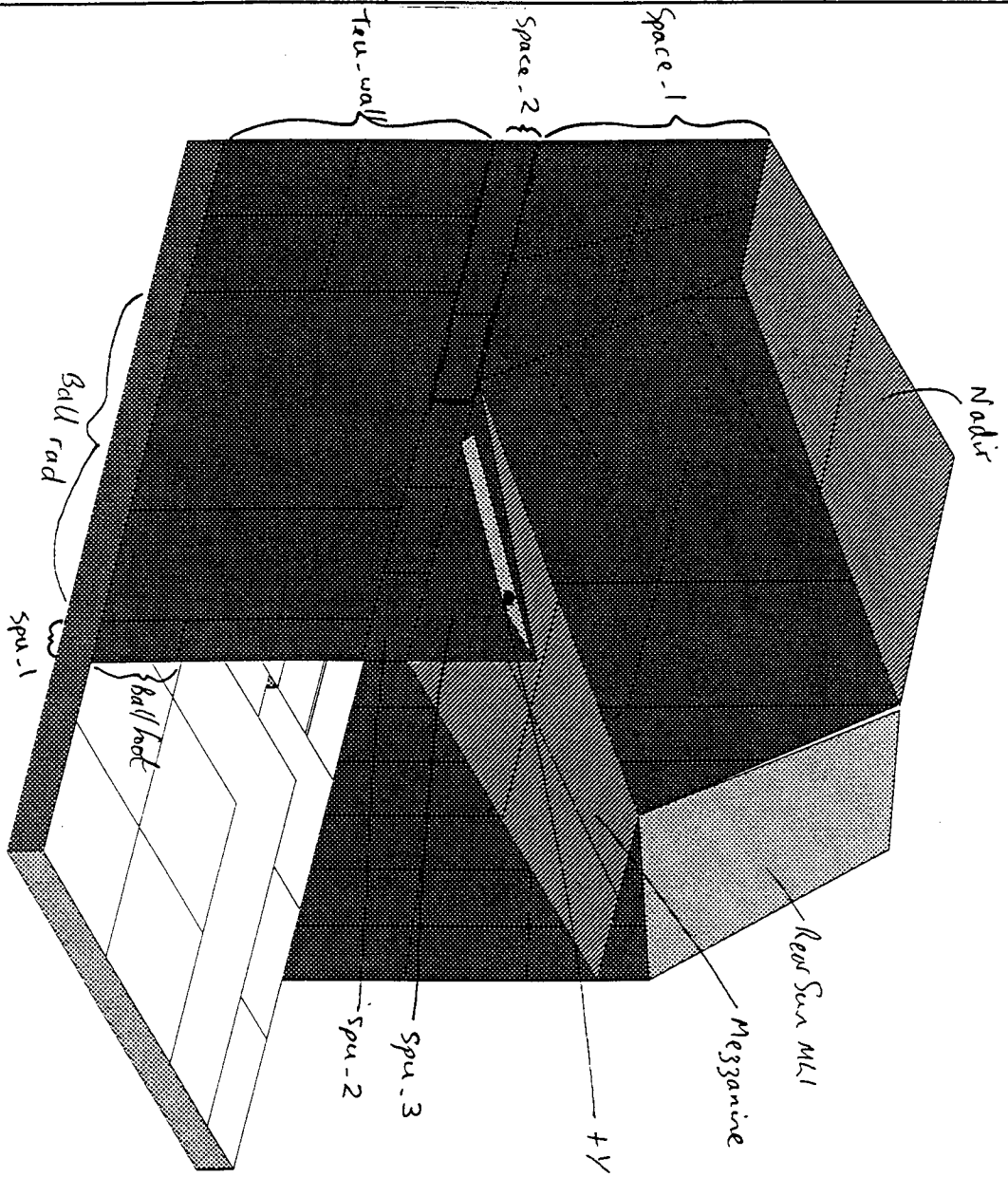

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Figure 6.4

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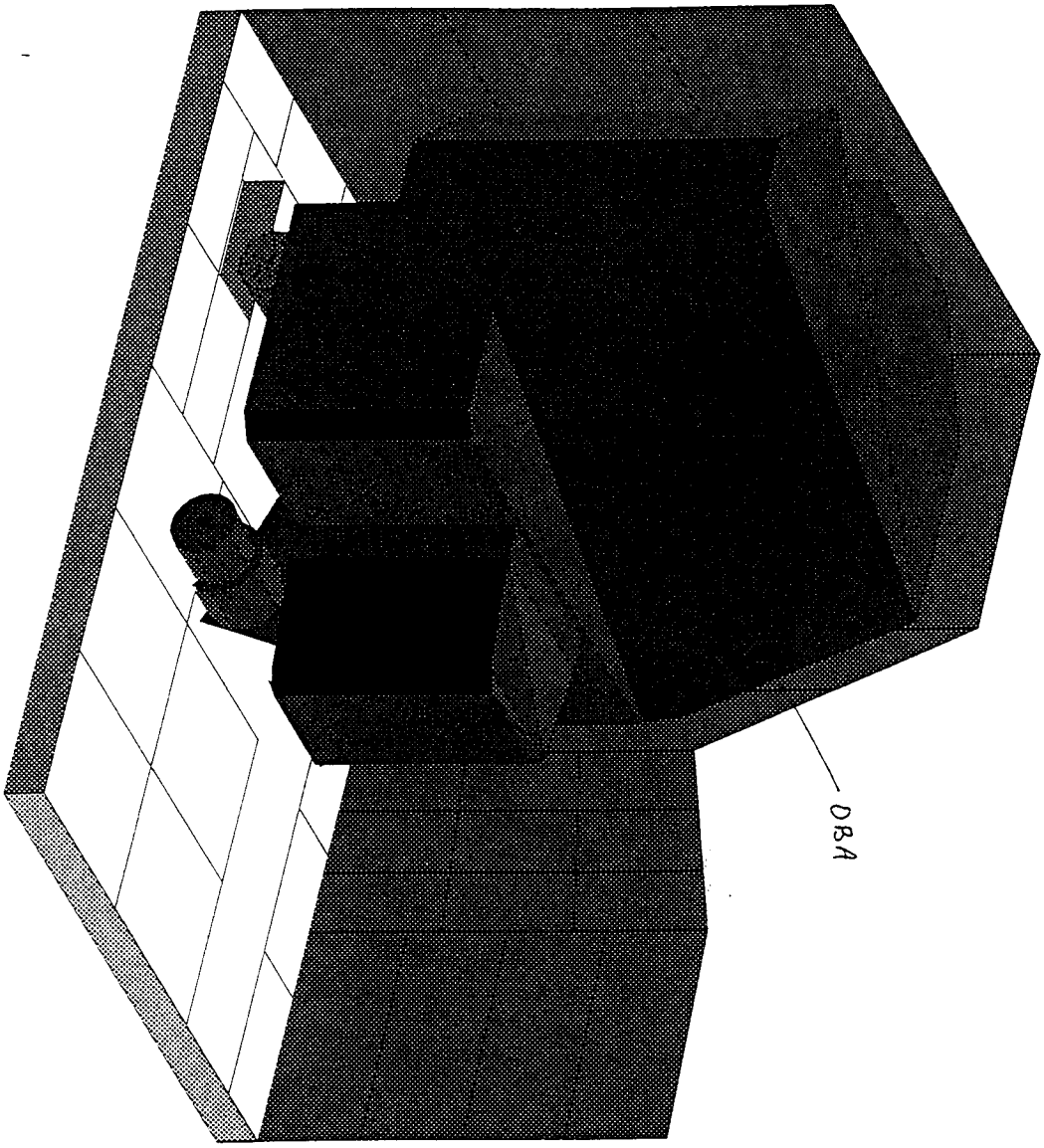
HIRDLS Project



Model labelling

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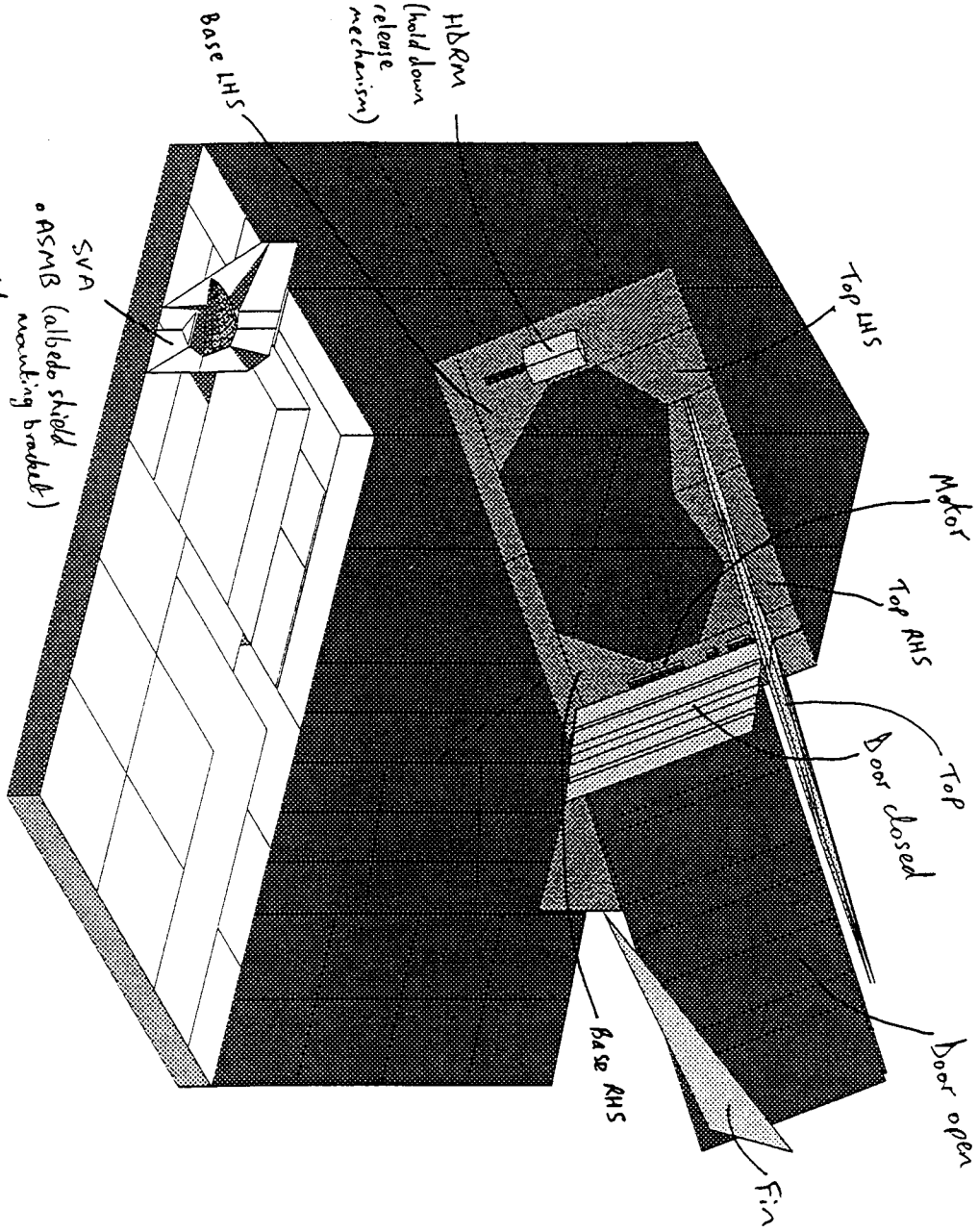

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HIRDLS Project

Model labelling

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Figure 6.6

7. Nodal Definition

The following is a listing of the thermal nodes as used in mathematical model of the instrument and spacecraft:

```
#
# Calculated the: 28-07-97 14:53
$NODES
D1101 = 'PCU', T=20.0D0, C=259.424D0, QI=37.65 * 0.8 *PA ;
D1102 = 'PCU', T=20.0D0, C=209.779D0, QI=37.65 * 0.2 *PA ;
D1103 = 'PCU', T=20.0D0, C=259.424D0, QI=0.00 / 6.0 *PA ;
D1104 = 'PCU', T=20.0D0, C=209.779D0, QI=0.00 / 6.0 *PA ;
D1105 = 'PCU', T=20.0D0, C=183.870D0, QI=0.00 / 6.0 *PA ;
D1106 = 'PCU', T=20.0D0, C=183.870D0, QI=0.00 / 6.0 *PA ;
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D1202 = 'CCU', T=25.0D0, C=195.127D0, QI=25.00 / 6.0 *PA ;
D1203 = 'CCU', T=25.0D0, C=79.998D0, QI=25.00 / 6.0 *PA ;
D1204 = 'CCU', T=25.0D0, C=80.471D0, QI=25.00 / 6.0 *PA ;
D1205 = 'CCU', T=25.0D0, C=195.127D0, QI=25.00 / 6.0 *PA ;
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D1303 = 'IPU', T=20.0D0, C=180.460D0, QI=34.73 / 6.0 *PA ;
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D1502 = 'SPU', T=20.0D0, C=96.955D0, QI=15.16 / 6.0 *PA ;
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D1956 = 'BEU', T=20.0D0, C=42.282D0, QI=2.50 / 6.0 *PA ;
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D2155 = 'LH wall -X', T=20.0D0, C=75.240D0, QI=0.00 ;
D2156 = 'LH wall -X', T=20.0D0, C=75.240D0, QI=0.00 ;
D2157 = 'LH wall -X', T=20.0D0, C=75.240D0, QI=0.00 ;
D2158 = 'LH wall -X', T=20.0D0, C=75.240D0, QI=0.00 ;
D2200 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2201 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2202 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2203 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2204 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2205 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2206 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2207 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2208 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2209 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2210 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2211 = 'posX wall -X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2250 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2251 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2252 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2253 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2254 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2255 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2256 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2257 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2258 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2259 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2260 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D2261 = 'posX wall +X', T=20.0D0, C=66.821D0, QI=0.00 ;
D22500 = 'posX wall +X MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D2300 = 'Shelf_U +Y', T=20.0D0, C=98.428D0, QI=0.00 ;
D2301 = 'Shelf_U +Y', T=20.0D0, C=98.428D0, QI=0.00 ;
D2302 = 'Shelf_U +Y', T=20.0D0, C=98.428D0, QI=0.00 ;
D2350 = 'Shelf_U -Y', T=20.0D0, C=98.428D0, QI=0.00 ;
D2351 = 'Shelf_U -Y', T=20.0D0, C=98.428D0, QI=0.00 ;
D2352 = 'Shelf_U -Y', T=20.0D0, C=98.428D0, QI=0.00 ;
D2400 = 'Top +Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2401 = 'Top +Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2402 = 'Top +Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2403 = 'Top +Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2404 = 'Top +Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2405 = 'Top +Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2450 = 'Top -Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2451 = 'Top -Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2452 = 'Top -Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2453 = 'Top -Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2454 = 'Top -Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2455 = 'Top -Y', T=20.0D0, C=53.422D0, QI=0.00 ;
D2500 = 'Rear +Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2501 = 'Rear +Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2502 = 'Rear +Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2503 = 'Rear +Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2504 = 'Rear +Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2505 = 'Rear +Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2506 = 'Rear +Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2507 = 'Rear +Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2550 = 'Rear -Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2551 = 'Rear -Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2552 = 'Rear -Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2553 = 'Rear -Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2554 = 'Rear -Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2555 = 'Rear -Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2556 = 'Rear -Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D2557 = 'Rear -Z', T=20.0D0, C=34.977D0, QI=0.00 ;
D25500 = 'Rear -Z MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D25510 = 'Rear -Z MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D25520 = 'Rear -Z MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D25530 = 'Rear -Z MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D25540 = 'Rear -Z MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D25550 = 'Rear -Z MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D25560 = 'Rear -Z MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D25570 = 'Rear -Z MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D2600 = 'SX017 inner', T=20.0D0, C=50.0D0, QI=0.00 ;
D2650 = 'SX017 outer', T=20.0D0, C=50.0D0, QI=0.00 ;
D26500 = 'SX017 outer MLI', T=20.0D0, C=0.0D0, QI=0.00 ;
D2700 = '+Y Sunshield Lip', T=20.0D0, C=50.0D0;
D6500 = 'Baseplate Top', T=20.0D0, C=113.828D0, QI=0.00 ;
D6501 = 'Baseplate Top', T=20.0D0, C=113.828D0, QI=0.00 ;
D6502 = 'Baseplate Top', T=20.0D0, C=113.828D0, QI=0.00 ;
D6503 = 'Baseplate Top', T=20.0D0, C=113.828D0, QI=0.00 ;
D6504 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6505 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6506 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6507 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6508 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6509 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6510 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6511 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6512 = 'Baseplate Top', T=20.0D0, C=262.631D0, QI=0.00 ;
D6513 = 'Baseplate Top', T=20.0D0, C=113.828D0, QI=0.00 ;
D6514 = 'Baseplate Top', T=20.0D0, C=113.828D0, QI=0.00 ;
D6515 = 'Baseplate Top', T=20.0D0, C=113.828D0, QI=0.00 ;
D6516 = 'Baseplate Top', T=20.0D0, C=113.828D0, QI=0.00 ;
D6517 = 'Baseplate Top', T=20.0D0, C=96.255D0, QI=0.00 ;
D6518 = 'Baseplate Top', T=20.0D0, C=96.255D0, QI=0.00 ;
D6519 = 'Baseplate Top', T=20.0D0, C=96.255D0, QI=0.00 ;
D6520 = 'Baseplate Top', T=20.0D0, C=96.255D0, QI=0.00 ;
D6550 = 'Baseplate Bottom', T=20.0D0, C=113.828D0, QI=0.00 ;
D6551 = 'Baseplate Bottom', T=20.0D0, C=113.828D0, QI=0.00 ;
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D6552 = 'Baseplate Bottom', T=20.0D0, C=113.828D0, QI=0.00 ;
D6553 = 'Baseplate Bottom', T=20.0D0, C=113.828D0, QI=0.00 ;
D6554 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6555 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6556 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6557 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6558 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6559 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6560 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6561 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6562 = 'Baseplate Bottom', T=20.0D0, C=262.631D0, QI=0.00 ;
D6563 = 'Baseplate Bottom', T=20.0D0, C=113.828D0, QI=0.00 ;
D6564 = 'Baseplate Bottom', T=20.0D0, C=113.828D0, QI=0.00 ;
D6565 = 'Baseplate Bottom', T=20.0D0, C=113.828D0, QI=0.00 ;
D6566 = 'Baseplate Bottom', T=20.0D0, C=113.828D0, QI=0.00 ;
D6567 = 'Baseplate Bottom', T=20.0D0, C=96.255D0, QI=0.00 ;
D6568 = 'Baseplate Bottom', T=20.0D0, C=96.255D0, QI=0.00 ;
D6569 = 'Baseplate Bottom', T=20.0D0, C=96.255D0, QI=0.00 ;
D6570 = 'Baseplate Bottom', T=20.0D0, C=96.255D0, QI=0.00 ;
D65000 = 'Baseplate MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D65010 = 'Baseplate MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D65020 = 'Baseplate MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D65030 = 'Baseplate MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D65100 = 'Baseplate Outer MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D65110 = 'Baseplate Outer MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D65120 = 'Baseplate Outer MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D65130 = 'Baseplate Outer MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D65140 = 'Baseplate Inner Kapton', T=20.0D0, C=0.000D0, QI=0.00 ;
D65150 = 'Baseplate Inner Kapton', T=20.0D0, C=0.000D0, QI=0.00 ;
D65160 = 'Baseplate Inner Kapton', T=20.0D0, C=0.000D0, QI=0.00 ;
D65170 = 'Baseplate Inner Kapton', T=20.0D0, C=0.000D0, QI=0.00 ;
D3010 = 'NegX int', T=20.0D0, C=64.657D0, QI=0.00 ;
D3011 = 'NegX int', T=20.0D0, C=64.657D0, QI=0.00 ;
D3012 = 'NegX int', T=20.0D0, C=64.657D0, QI=0.00 ;
D3013 = 'NegX int', T=20.0D0, C=64.657D0, QI=0.00 ;
D3014 = 'NegX int', T=20.0D0, C=64.657D0, QI=0.00 ;
D3015 = 'NegX int', T=20.0D0, C=64.657D0, QI=0.00 ;
D3510 = 'NegX ext', T=20.0D0, C=64.657D0, QI=0.00 ;
D3511 = 'NegX ext', T=20.0D0, C=64.657D0, QI=0.00 ;
D3512 = 'NegX ext', T=20.0D0, C=64.657D0, QI=0.00 ;
D3513 = 'NegX ext', T=20.0D0, C=64.657D0, QI=0.00 ;
D3514 = 'NegX ext', T=20.0D0, C=64.657D0, QI=0.00 ;
D3515 = 'NegX ext', T=20.0D0, C=64.657D0, QI=0.00 ;
D9010 = 'NegX ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9011 = 'NegX ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9012 = 'NegX ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9013 = 'NegX ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9014 = 'NegX ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9015 = 'NegX ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D3020 = 'teu wall int', T=20.0D0, C=15.090D0, QI=0.00 ;
D3021 = 'teu wall int', T=20.0D0, C=15.090D0, QI=0.00 ;
D3022 = 'teu wall int', T=20.0D0, C=15.090D0, QI=0.00 ;
D3023 = 'teu wall int', T=20.0D0, C=15.090D0, QI=0.00 ;
D3520 = 'teu wall ext', T=20.0D0, C=15.090D0, QI=0.00 ;
D3521 = 'teu wall ext', T=20.0D0, C=15.090D0, QI=0.00 ;
D3522 = 'teu wall ext', T=20.0D0, C=15.090D0, QI=0.00 ;
D3523 = 'teu wall ext', T=20.0D0, C=15.090D0, QI=0.00 ;
B3030 = 'ball_rad', T=-10.0D0, C=0.000D0, QI=0.00 ;
B3031 = 'ball_rad', T=-10.0D0, C=0.000D0, QI=0.00 ;
D3040 = 'nadir int', T=20.0D0, C=76.094D0, QI=0.00 ;
D3041 = 'nadir int', T=20.0D0, C=76.094D0, QI=0.00 ;
D3540 = 'nadir ext', T=20.0D0, C=76.094D0, QI=0.00 ;
D3541 = 'nadir ext', T=20.0D0, C=76.094D0, QI=0.00 ;
D3549 = 'nadir MLI', T=20.0D0, C=0.0D0, QI=0.0D0 ;
D3050 = 'space_1 int', T=20.0D0, C=15.559D0, QI=0.00 ;
D3051 = 'space_1 int', T=20.0D0, C=15.559D0, QI=0.00 ;
D3052 = 'space_1 int', T=20.0D0, C=15.559D0, QI=0.00 ;
D3053 = 'space_1 int', T=20.0D0, C=15.559D0, QI=0.00 ;
D3550 = 'space_1 ext', T=20.0D0, C=15.559D0, QI=0.00 ;
D3551 = 'space_1 ext', T=20.0D0, C=15.559D0, QI=0.00 ;
D3552 = 'space_1 ext', T=20.0D0, C=15.559D0, QI=0.00 ;
D3553 = 'space_1 ext', T=20.0D0, C=15.559D0, QI=0.00 ;
D3070 = 'space_2 int', T=20.0D0, C=5.792D0, QI=0.00 ;
D3071 = 'space_2 int', T=20.0D0, C=11.584D0, QI=0.00 ;
D3072 = 'space_2 int', T=20.0D0, C=11.584D0, QI=0.00 ;
D3570 = 'space_2 ext', T=20.0D0, C=11.584D0, QI=0.00 ;
D3571 = 'space_2 ext', T=20.0D0, C=11.584D0, QI=0.00 ;
D3572 = 'space_2 ext', T=20.0D0, C=11.584D0, QI=0.00 ;
D3060 = 'spu_1int', T=20.0D0, C=16.732D0, QI=0.00 ;
D3061 = 'spu_2int', T=20.0D0, C=11.584D0, QI=0.00 ;
D3062 = 'spu_2int', T=20.0D0, C=11.584D0, QI=0.00 ;
D3063 = 'spu_2int', T=20.0D0, C=11.584D0, QI=0.00 ;
D3064 = 'spu_3int', T=20.0D0, C=63.002D0, QI=0.00 ;
D3560 = 'spu_1ext', T=20.0D0, C=16.732D0, QI=0.00 ;
D3561 = 'spu_2ext', T=20.0D0, C=11.584D0, QI=0.00 ;
D3562 = 'spu_2ext', T=20.0D0, C=11.584D0, QI=0.00 ;
D3563 = 'spu_2ext', T=20.0D0, C=11.584D0, QI=0.00 ;
D3564 = 'spu_3ext', T=20.0D0, C=63.002D0, QI=0.00 ;
D3110 = 'sun_1 int', T=20.0D0, C=91.888D0, QI=0.00 ;
D3111 = 'sun_1 int', T=20.0D0, C=91.888D0, QI=0.00 ;
D3112 = 'sun_1 int', T=20.0D0, C=91.888D0, QI=0.00 ;
D3113 = 'sun_1 int', T=20.0D0, C=91.888D0, QI=0.00 ;
D3610 = 'sun_1 ext', T=20.0D0, C=91.888D0, QI=0.00 ;
D3611 = 'sun_1 ext', T=20.0D0, C=91.888D0, QI=0.00 ;
D3612 = 'sun_1 ext', T=20.0D0, C=91.888D0, QI=0.00 ;
D3613 = 'sun_1 ext', T=20.0D0, C=91.888D0, QI=0.00 ;
D9110 = 'sun_1 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9111 = 'sun_1 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9112 = 'sun_1 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9113 = 'sun_1 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D3120 = 'sun_2 int', T=20.0D0, C=34.201D0, QI=0.00 ;
D3121 = 'sun_2 int', T=20.0D0, C=34.201D0, QI=0.00 ;
D3122 = 'sun_2 int', T=20.0D0, C=34.201D0, QI=0.00 ;
D3123 = 'sun_2 int', T=20.0D0, C=34.201D0, QI=0.00 ;
D3620 = 'sun_2 ext', T=20.0D0, C=34.201D0, QI=0.00 ;
D3621 = 'sun_2 ext', T=20.0D0, C=34.201D0, QI=0.00 ;
D3622 = 'sun_2 ext', T=20.0D0, C=34.201D0, QI=0.00 ;
D3623 = 'sun_2 ext', T=20.0D0, C=34.201D0, QI=0.00 ;
D9120 = 'sun_2 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9121 = 'sun_2 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9122 = 'sun_2 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9123 = 'sun_2 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D3130 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3131 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3132 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3133 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3134 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3135 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3136 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3137 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3138 = 'sun_3 int', T=20.0D0, C=17.038D0, QI=0.00 ;
D3630 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D3631 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D3632 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D3633 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D3634 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D3635 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D3636 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D3637 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D3638 = 'sun_3 ext', T=20.0D0, C=17.038D0, QI=0.00 ;
D9130 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9131 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9132 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9133 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9134 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9135 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9136 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9137 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9138 = 'sun_3 ext MLI', T=20.0D0, C=0.000D0, QI=0.00 ;
D9900 = 'RearSunMLI', T=20.0D0, C=0.0D0 ;
#for cold case oba=0 for hot case oba =5.5;
B5010 = 'oba', T=0.0D0, C=0.000D0, QI=0.00 ;
#B5010 = 'oba', T=5.5D0, C=0.000D0, QI=0.00 ;
B10000 = 'bus', T=0.0D0, C=0.000D0, QI=0.00 ;
B10001 = 'bus', T=0.0D0, C=0.000D0, QI=0.00 ;
B10002 = 'bus', T=0.0D0, C=0.000D0, QI=0.00 ;
B10003 = 'bus', T=0.0D0, C=0.000D0, QI=0.00 ;
B10004 = 'bus', T=0.0D0, C=0.000D0, QI=0.00 ;
B10005 = 'bus', T=0.0D0, C=0.000D0, QI=0.00 ;
B10010 = 'tes', T=20.0D0, C=0.000D0, QI=0.00 ;
B10011 = 'tes', T=20.0D0, C=0.000D0, QI=0.00 ;
B10012 = 'tes', T=20.0D0, C=0.000D0, QI=0.00 ;
B10013 = 'tes', T=20.0D0, C=0.000D0, QI=0.00 ;
B10014 = 'tes', T=20.0D0, C=0.000D0, QI=0.00 ;
B10015 = 'tes', T=20.0D0, C=0.000D0, QI=0.00 ;
B10016 = 'tes', T=20.0D0, C=0.000D0, QI=0.00 ;
B10020 = 'tes shield', T=-3.0D0, C=0.000D0, QI=0.00 ;
B10030 = 'mls', T=20.0D0, C=0.000D0, QI=0.00 ;
B10031 = 'mls', T=20.0D0, C=0.000D0, QI=0.00 ;
B10032 = 'mls', T=20.0D0, C=0.000D0, QI=0.00 ;
B10033 = 'mls', T=20.0D0, C=0.000D0, QI=0.00 ;
B10034 = 'mls', T=20.0D0, C=0.000D0, QI=0.00 ;
B10035 = 'mls', T=20.0D0, C=0.000D0, QI=0.00 ;
#
#Sunshield Model
#
D3310 = 'Door ', T=20.0D0, C=38.165D0 * 2.0, QI=0.00 ;
D3311 = 'Door ', T=20.0D0, C=38.165D0 * 2.0, QI=0.00 ;
D3312 = 'Door ', T=20.0D0, C=38.165D0 * 2.0, QI=0.00 ;
D3313 = 'Door ', T=20.0D0, C=38.165D0 * 2.0, QI=0.00 ;
D3314 = 'Door ', T=20.0D0, C=38.165D0 * 2.0, QI=0.00 ;
D33100 = 'Door MLI ', T=20.0D0, C=0.0D0, QI=0.00 ;
D3320 = 'Lower Side Structure', T=20.0D0, C=14.598D0, QI=0.00 ;
D3325 = 'HDRM Housing', T=20.0D0, C=130.50D0, QI=0.00;
D3326 = 'HDRM Actuator', T=20.0D0, C=43.500D0, QI=0.00;
D33260= 'HDRM ActuatorMLI', T=20.0D0, C=0.0D0, QI=0.0D0;
D3327 = 'HDRM Microswitch plate', T=20.0D0, C=34.80D0, QI=0.00;
D3330 = 'Hinge Bracket Pot', T=20.0D0, C=29.800D0, QI=0.00;
D3331 = 'Structure at Pot', T=20.0D0, C=17.400D0, QI=0.00;
D3332 = 'Potentiometer', T=20.0D0, C=34.80D0, QI=0.00;
D3333 = 'Hinge Bracket Motor', T=20.0D0, C=28.80D0, QI=0.00;
D3334 = 'Structure at Motor', T=20.0D0, C=67.00D0, QI=0.00;
D3335 = 'Motor', T=20.0D0, C=128.80D0, QI=0.00;
D3350 = 'Sunshield Top Inner', T=20.0D0, C=54.634D0, QI=0.00 ;
D3351 = 'Sunshield  Top Outer', T=20.0D0, C=163.901D0, QI=0.00 ;
D3352 = 'Sunshield Top Inner N. Hinge', T=20.0D0, C=54.634D0,
QI=0.00 ;
D3353 = 'Sunshield Top Outer N. Hinge', T=20.0D0, C=163.901D0,
QI=0.00 ;
D3354 = 'Sunshield  Top Edge', T=20.0D0, C=50.810D0, QI=0.00 ;
```

```
D3360 = 'Sunshield Base Behind Hinge', T=20.0D0, C=20.360D0,
Ql=0.00 ;
D3361 = 'Sunshield Base By Aperture', T=20.0D0, C=53.477D0,
Ql=0.00 ;
D3362 = 'Sunshield Base N. Hinge & Aperture', T=20.0D0,
C=160.430D0;
D3363 = 'Sunshield Base ', T=20.0D0, C=130.156D0, Ql=0.00 ;
D3364 = 'Sunshield Base', T=20.0D0, C=125.181D0, Ql=0.00 ;
D3365 = 'Sunshield Base Cut-off Corner', T=20.0D0, C=31.836D0,
Ql=0.00 ;
D3370 = 'Sunshield Side N. Hinge', T=20.0D0, C=71.934D0, Ql=0.00 ;
D3371 = 'Sunshield Side', T=20.0D0, C=85.377D0, Ql=0.00 ;
D3372 = 'Sunshield Side', T=20.0D0, C=85.416D0, Ql=0.00 ;
D3373 = 'Sunshield Side', T=20.0D0, C=71.346D0, Ql=0.00 ;
D3374 = 'Side Fin', T=20.0D0, C=61.353D0, Ql=0.00 ;
D3375 = 'Front Fin', T=20.0D0, C=103.234D0, Ql=0.00 ;
D3400 = 'Aperture Top LH', T=20.0D0, C=31.835D0, Ql=0.00 ;
D3401 = 'Aperture Base LH', T=20.0D0, C=20.242D0, Ql=0.00 ;
D3402 = 'Aperture Top RH', T=20.0D0, C=31.654D0, Ql=0.00 ;
D3403 = 'Aperture Base RH', T=20.0D0, C=20.287D0, Ql=0.00 ;
D3404 = 'Aperture Top Behind Door', T=20.0D0, C=15.000D0, Ql=0.00
;
D3405 = 'Aperture Base Behind Door', T=20.0D0, C=15.000D0;
D3420 = 'Lower Side Structure MLI', T=20.0D0, C=0.000D0;
X3425 = 'Door Motor MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3450 = 'Sunshield Top Inner MLI', T=20.0D0, C=0.000D0 ;
D3451 = 'Sunshield Top Outer MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3452 = 'Sunshield Top Inner N. Hinge MLI', T=20.0D0, C=0.000D0 ;
D3453 = 'Sunshield Top Outer N. Hinge MLI', T=20.0D0, C=0.000D0;
D3454 = 'Sunshield Top Edge MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3460 = 'Sunshield Base Behind Hinge MLI', T=20.0D0, C=0.000D0;
D3461 = 'Sunshield Base By Aperture MLI', T=20.0D0, C=0.000D0;
D3462 = 'Sunshield Base N. Hinge & Aperture MLI', T=20.0D0,
C=0.000D0;
D3463 = 'Sunshield Base MLI ', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3464 = 'Sunshield Base MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3465 = 'Sunshield Base Cut-off Corner MLI', T=20.0D0, C=0.000D0,
Ql=0.00 ;
D3470 = 'Sunshield Side N. Hinge MLI', T=20.0D0, C=0.000D0,
Ql=0.00 ;
D3471 = 'Sunshield Side MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3472 = 'Sunshield Side MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3473 = 'Sunshield Side MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3474 = 'Side Fin MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
D3475 = 'Front Fin MLI', T=20.0D0, C=0.000D0, Ql=0.00 ;
#Albedo Shield added 30March98
D33261 = 'ASMB', T=20.0D0, C=100.0D0;
D33262 = 'Mountplate', T=20.0D0, C=270.0D0;
D33263 = 'Shield', T=20.0D0, C=50.0D0;
#
D40060 = 'WSEA',T=20.0D0, C=63.0D0;
D40500 = 'SCANMIRROR',T=20.0D0,C=686.1D0;
D40505 = 'SCANMIRROR YOKE',T=20.0D0,C=6.56D+03,Ql=2.1;
D40510 = 'PRIMARYMIRROR',T=20.0D0,C=1.74D+03;
D40520 = 'SECONDARYMIRROR',T=20.0D0,C=1.17D+02;
D40530 = 'CHOPPER',T=20.0D0,C=4.32D+02,Ql=0.6;
D40540 = 'SPACEVIEWMIRROR',T=20.0D0,C=4.01D+02;
D40550 = 'CALIBRATIONMIRROR',T=28.0D0,C=1.53D+02,Ql=0.5;
D40560 = 'FOLDMIRROR',T=20.0D0,C=9.06D+01;
D40570 = 'WARMFILTER',T=28.0D0,C=2.36D+02;
D40580 = 'SAS',T=20.0D0,C=29.4954;
D40590 = 'GERMANIUMLENS',T=28.0D0,C=1.07D+01;
D40595 = 'GERMANIUMLENS',T=28.0D0,C=3.43D+01;
D40600 = 'TRUSS',T=20.0D0,C=1.89D+00,Ql=2.4;
D40610 = 'OPTICALTUBE',T=20.0D0,C=2.71D+03;
D40620 = 'SPACEVIEW TUBE',T=20.0D0,C=3.00D+02;
D40632 = 'DOGLEG',T=20.0D0,C=1.48D+03;
D40640 = 'HOOD',T=20.0D0,C=2.01D+03;
B40645 = 'OBA MLI',T=20.0D0;
D40710 = 'IFC BLACKBODY',T=20.0D0,C=5.10D+01;
B40711 = 'BBSOURCE',T=28.0D0,Ql=0.7;
#SINKNODES
B40400 = 'Aperture to OBA',T=20.0D0;
B40700 = 'GMU',T=70.0D0;
B40705 = 'GMUCABLE',T=7.0D0;
B40630 = 'Gelenszone1',T=28.0D0;
B40631 = 'Gelenszone2',T=28.0D0;
#
#
#
B999 = 'SPACE', T=-269.0D0 ;
```

The nodal definition within Esatan consists of the following syntax:

The node is defined as either a diffusion node (D) or a boundary node (B) or an unused node (X). An unused node is one which was originally present in the model but has now been removed. If the node is simply removed from the input deck then any future references to it must also be found and removed, however, if the node is converted to an (X) type node then Esatan ignores any future reference to it automatically. The node is then given a label, an initial temperature (T), thermal capacitance (C), and the option for an internal dissipation (Ql). All nodes must be defined in order to be used, and any reference in the flux or conduction data blocks without definition will result in the model not solving.

8. Conductive and Radiative Couplings

The conductive couplings are generally calculated by hand and input into the model. Also some radiative couplings are calculated by hand, such as those between MLI and underlying nodes. The following is a listing of these couplings:

```
# Conductances in the EU CAVITY
(transverse)
#
# LH wall
GL( 2100 , 2150 )= 8.5274 ;
GL( 2101 , 2151 )= 8.5274 ;
GL( 2102 , 2152 )= 8.5274 ;
GL( 2103 , 2153 )= 8.5274 ;
GL( 2104 , 2154 )= 8.5274 ;
GL( 2105 , 2155 )= 8.5274 ;
GL( 2106 , 2156 )= 8.5274 ;
GL( 2107 , 2157 )= 8.5274 ;
GL( 2108 , 2158 )= 8.5274 ;
# posX wall
GL( 2200 , 2250 )= 7.5978 ;
GL( 2201 , 2251 )= 7.5978 ;
GL( 2202 , 2252 )= 7.5978 ;
GL( 2203 , 2253 )= 7.5978 ;
GL( 2204 , 2254 )= 7.5978 ;
GL( 2205 , 2255 )= 7.5978 ;
GL( 2206 , 2256 )= 7.5978 ;
GL( 2207 , 2257 )= 7.5978 ;
GL( 2208 , 2258 )= 7.5978 ;
GL( 2209 , 2259 )= 7.5978 ;
GL( 2210 , 2260 )= 7.5978 ;
GL( 2211 , 2261 )= 7.5978 ;
# Shelf_U wall
GL( 2300 , 2350 )= 11.1554 ;
GL( 2301 , 2351 )= 11.1554 ;
GL( 2302 , 2352 )= 11.1554 ;
# Top wall
GL( 2400 , 2450 )= 5.5777 ;
GL( 2401 , 2451 )= 5.5777 ;
GL( 2402 , 2452 )= 5.5777 ;
GL( 2403 , 2453 )= 5.5777 ;
GL( 2404 , 2454 )= 5.5777 ;
GL( 2405 , 2455 )= 5.5777 ;
#Rear
GL( 2500 , 2550 )= 5.2383 ;
GL( 2501 , 2551 )= 5.2383 ;
GL( 2502 , 2552 )= 5.2383 ;
GL( 2503 , 2553 )= 5.2383 ;
GL( 2504 , 2554 )= 5.2383 ;
GL( 2505 , 2555 )= 5.2383 ;
GL( 2506 , 2556 )= 5.2383 ;
GL( 2507 , 2557 )= 5.2383 ;
# Conductances in the EU CAVITY (longi)
#
# LH wall
GL( 2100 , 2101 )= 0.0215 ;
GL( 2101 , 2102 )= 0.0215 ;
GL( 2103 , 2104 )= 0.0215 ;
GL( 2104 , 2105 )= 0.0215 ;
GL( 2106 , 2107 )= 0.0215 ;
GL( 2107 , 2108 )= 0.0215 ;
GL( 2100 , 2103 )= 0.0262 ;
GL( 2103 , 2106 )= 0.0262 ;
GL( 2101 , 2104 )= 0.0262 ;
GL( 2104 , 2107 )= 0.0262 ;
GL( 2102 , 2105 )= 0.0262 ;
GL( 2105 , 2108 )= 0.0262 ;
GL( 2150 , 2151 )= 0.0215 ;
GL( 2151 , 2152 )= 0.0215 ;
GL( 2153 , 2154 )= 0.0215 ;
GL( 2154 , 2155 )= 0.0215 ;
GL( 2156 , 2157 )= 0.0215 ;
GL( 2157 , 2158 )= 0.0215 ;
GL( 2150 , 2153 )= 0.0262 ;
GL( 2153 , 2156 )= 0.0262 ;
GL( 2151 , 2154 )= 0.0262 ;
GL( 2154 , 2157 )= 0.0262 ;
GL( 2152 , 2155 )= 0.0262 ;
GL( 2155 , 2158 )= 0.0262 ;
# posX wall
GL( 2250 , 2251 )= 0.0255 ;
GL( 2251 , 2252 )= 0.0255 ;
GL( 2253 , 2254 )= 0.0255 ;
GL( 2254 , 2255 )= 0.0255 ;
GL( 2256 , 2257 )= 0.0255 ;
GL( 2257 , 2258 )= 0.0255 ;
GL( 2259 , 2260 )= 0.0255 ;
GL( 2260 , 2261 )= 0.0255 ;
GL( 2250 , 2253 )= 0.0700 ;
GL( 2253 , 2256 )= 0.0700 ;
GL( 2256 , 2259 )= 0.0700 ;
GL( 2251 , 2254 )= 0.0700 ;
GL( 2254 , 2257 )= 0.0700 ;
GL( 2257 , 2260 )= 0.0700 ;
GL( 2252 , 2255 )= 0.0700 ;
GL( 2255 , 2258 )= 0.0700 ;
GL( 2258 , 2261 )= 0.0700 ;
GL( 2200 , 2201 )= 0.0255 ;
GL( 2201 , 2202 )= 0.0255 ;
GL( 2203 , 2204 )= 0.0255 ;
GL( 2204 , 2205 )= 0.0255 ;
GL( 2206 , 2207 )= 0.0255 ;
GL( 2207 , 2208 )= 0.0255 ;
GL( 2209 , 2210 )= 0.0255 ;
GL( 2210 , 2211 )= 0.0255 ;
GL( 2200 , 2203 )= 0.0700 ;
GL( 2203 , 2206 )= 0.0700 ;
GL( 2206 , 2209 )= 0.0700 ;
GL( 2201 , 2204 )= 0.0700 ;
GL( 2204 , 2207 )= 0.0700 ;
GL( 2207 , 2210 )= 0.0700 ;
GL( 2202 , 2205 )= 0.0700 ;
GL( 2205 , 2208 )= 0.0700 ;
GL( 2208 , 2211 )= 0.0700 ;
# Shelf_U
GL( 2300 , 2301 )= 0.0281 ;
GL( 2301 , 2302 )= 0.0281 ;
GL( 2350 , 2351 )= 0.0281 ;
GL( 2351 , 2352 )= 0.0281 ;
#Top
GL( 2400 , 2401 )= 0.0316 ;
GL( 2402 , 2403 )= 0.0316 ;
GL( 2404 , 2405 )= 0.0316 ;
GL( 2400 , 2402 )= 0.0178 ;
GL( 2402 , 2404 )= 0.0178 ;
GL( 2401 , 2403 )= 0.0178 ;
GL( 2403 , 2405 )= 0.0178 ;
GL( 2450 , 2451 )= 0.0316 ;
GL( 2452 , 2453 )= 0.0316 ;
GL( 2454 , 2455 )= 0.0316 ;
GL( 2450 , 2452 )= 0.0178 ;
GL( 2452 , 2454 )= 0.0178 ;
GL( 2451 , 2453 )= 0.0178 ;
GL( 2453 , 2455 )= 0.0178 ;
#Rear
GL( 2500 , 2501 )= 0.0117 ;
GL( 2502 , 2503 )= 0.0117 ;
GL( 2504 , 2505 )= 0.0117 ;
GL( 2506 , 2507 )= 0.0117 ;
GL( 2500 , 2502 )= 0.0478 ;
GL( 2502 , 2504 )= 0.0478 ;
GL( 2504 , 2506 )= 0.0478 ;
GL( 2501 , 2503 )= 0.0478 ;
GL( 2503 , 2505 )= 0.0478 ;
GL( 2505 , 2507 )= 0.0478 ;
GL( 2550 , 2551 )= 0.0117 ;
GL( 2552 , 2553 )= 0.0117 ;
GL( 2554 , 2555 )= 0.0117 ;
GL( 2556 , 2557 )= 0.0117 ;
GL( 2550 , 2552 )= 0.0478 ;
GL( 2552 , 2554 )= 0.0478 ;
GL( 2554 , 2556 )= 0.0478 ;
GL( 2551 , 2553 )= 0.0478 ;
GL( 2553 , 2555 )= 0.0478 ;
GL( 2555 , 2557 )= 0.0478 ;
# Conductances in the STH (longi)
#
# Baseplate
GL( 6504 , 6507 )= 0.0482 ;
GL( 6507 , 6510 )= 0.0482 ;
GL( 6505 , 6508 )= 0.0482 ;
GL( 6508 , 6511 )= 0.0482 ;
GL( 6506 , 6509 )= 0.0482 ;
GL( 6509 , 6512 )= 0.0482 ;
GL( 6513 , 6515 )= 0.1108 ;
GL( 6500 , 6502 )= 0.1108 ;
GL( 6514 , 6516 )= 0.1108 ;
GL( 6501 , 6503 )= 0.1108 ;
GL( 6517 , 6518 )= 0.0314 ;
GL( 6518 , 6519 )= 0.0314 ;
GL( 6519 , 6520 )= 0.0314 ;
GL( 6504 , 6505 )= 0.0721 ;
GL( 6505 , 6506 )= 0.0721 ;
GL( 6506 , 6513 )= 0.0313 ;
GL( 6506 , 6515 )= 0.0313 ;
GL( 6513 , 6514 )= 0.0313 ;
GL( 6515 , 6516 )= 0.0313 ;
GL( 6514 , 6517 )= 0.1365 ;
GL( 6516 , 6517 )= 0.1708 ;
GL( 6516 , 6518 )= 0.3416 ;
GL( 6507 , 6508 )= 0.0721 ;
GL( 6508 , 6509 )= 0.0721 ;
GL( 6510 , 6511 )= 0.0721 ;
GL( 6511 , 6512 )= 0.0721 ;
GL( 6512 , 6500 )= 0.0313 ;
GL( 6512 , 6502 )= 0.0313 ;
GL( 6500 , 6501 )= 0.0313 ;
GL( 6502 , 6503 )= 0.0313 ;
GL( 6501 , 6520 )= 0.1281 ;
GL( 6503 , 6520 )= 0.1281 ;
# negX int
GL( 3010 , 3011 )= 0.0146 ;
GL( 3012 , 3013 )= 0.0146 ;
GL( 3014 , 3015 )= 0.0146 ;
GL( 3010 , 3012 )= 0.0363 ;
GL( 3012 , 3014 )= 0.0363 ;
GL( 3011 , 3013 )= 0.0363 ;
GL( 3013 , 3015 )= 0.0363 ;
# negX ext
GL( 3510 , 3511 )= 0.0146 ;
GL( 3512 , 3513 )= 0.0146 ;
GL( 3514 , 3515 )= 0.0146 ;
GL( 3510 , 3512 )= 0.0363 ;
GL( 3512 , 3514 )= 0.0363 ;
GL( 3511 , 3513 )= 0.0363 ;
GL( 3513 , 3515 )= 0.0363 ;
# teu wall int
GL( 3020 , 3021 )= 0.0417 ;
GL( 3022 , 3023 )= 0.0417 ;
GL( 3020 , 3022 )= 0.0127 ;
GL( 3021 , 3023 )= 0.0127 ;
# teu wall ext
GL( 3520 , 3521 )= 0.0417 ;
GL( 3522 , 3523 )= 0.0417 ;
GL( 3520 , 3522 )= 0.0127 ;
GL( 3521 , 3523 )= 0.0127 ;
# ball rad
# not modelled
# nadir int
GL( 3040 , 3041 )= 0.0243 ;
# nadir ext
GL( 3540 , 3541 )= 0.0243 ;
# space_1 int
GL( 3050 , 3051 )= 0.0201 ;
GL( 3052 , 3053 )= 0.0358 ;
GL( 3050 , 3052 )= 0.0412 ;
GL( 3051 , 3053 )= 0.0412 ;
# space_1 ext
GL( 3550 , 3551 )= 0.0201 ;
GL( 3552 , 3553 )= 0.0358 ;
GL( 3550 , 3552 )= 0.0412 ;
GL( 3551 , 3553 )= 0.0412 ;
# spu wall int
#GL( 3060 , 3063 )= 0.0112 ;
#GL( 3063 , 3062 )= 0.0054 ;
#GL( 3062 , 3061 )= 0.0054 ;
GL( 3060 , 3063 )= 0.112 ;
GL( 3063 , 3062 )= 0.054 ;
GL( 3062 , 3061 )= 0.054 ;
GL( 3064 , 3061 )= 0.0454 ;
GL( 3064 , 3062 )= 0.0454 ;
GL( 3064 , 3063 )= 0.0454 ;
# spu wall ext
GL( 3560 , 3563 )= 0.0112 ;
GL( 3563 , 3562 )= 0.0054 ;
GL( 3562 , 3561 )= 0.0054 ;
GL( 3564 , 3561 )= 0.0454 ;
GL( 3564 , 3562 )= 0.0454 ;
GL( 3564 , 3563 )= 0.0454 ;
# space_2 int
GL( 3070 , 3071 )= 0.0053 ;
```

```
GL( 3071 , 3072 )= 0.0053 ;
# space_2 ext
GL( 3570 , 3571 )= 0.0053 ;
GL( 3571 , 3572 )= 0.0053 ;
# sun_1 int
GL( 3110 , 3111 )= 0.0454 ;
GL( 3112 , 3113 )= 0.0454 ;
GL( 3110 , 3112 )= 0.0117 ;
GL( 3111 , 3113 )= 0.0117 ;
# sun_1 ext
GL( 3610 , 3611 )= 0.0454 ;
GL( 3612 , 3613 )= 0.0454 ;
GL( 3610 , 3612 )= 0.0117 ;
GL( 3611 , 3613 )= 0.0117 ;
# sun_2 int
GL( 3120 , 3121 )= 0.0831 ;
GL( 3122 , 3123 )= 0.0831 ;
GL( 3120 , 3122 )= 0.0064 ;
GL( 3121 , 3123 )= 0.0064 ;
# sun_2 ext
GL( 3620 , 3621 )= 0.0831 ;
GL( 3622 , 3623 )= 0.0831 ;
GL( 3620 , 3622 )= 0.0064 ;
GL( 3621 , 3623 )= 0.0064 ;
# sun_3 int
GL( 3130 , 3131 )= 0.0391 ;
GL( 3131 , 3132 )= 0.0391 ;
GL( 3133 , 3134 )= 0.0391 ;
GL( 3134 , 3135 )= 0.0391 ;
GL( 3136 , 3137 )= 0.0391 ;
GL( 3137 , 3138 )= 0.0391 ;
GL( 3130 , 3133 )= 0.0135 ;
GL( 3133 , 3136 )= 0.0135 ;
GL( 3131 , 3134 )= 0.0135 ;
GL( 3134 , 3137 )= 0.0135 ;
GL( 3132 , 3135 )= 0.0135 ;
GL( 3135 , 3138 )= 0.0135 ;
# sun_3 ext
GL( 3630 , 3631 )= 0.0391 ;
GL( 3631 , 3632 )= 0.0391 ;
GL( 3633 , 3634 )= 0.0391 ;
GL( 3634 , 3635 )= 0.0391 ;
GL( 3636 , 3637 )= 0.0391 ;
GL( 3637 , 3638 )= 0.0391 ;
GL( 3630 , 3633 )= 0.0135 ;
GL( 3633 , 3636 )= 0.0135 ;
GL( 3631 , 3634 )= 0.0135 ;
GL( 3634 , 3637 )= 0.0135 ;
GL( 3632 , 3635 )= 0.0135 ;
GL( 3635 , 3638 )= 0.0135 ;
# Conductances in the STH (transverse)
#
# Baseplate
GL( 6500 , 6550 )= 2.0181 ;
GL( 6501 , 6551 )= 2.0181 ;
GL( 6502 , 6552 )= 2.0181 ;
GL( 6503 , 6553 )= 2.0181 ;
GL( 6504 , 6554 )= 4.6564 ;
GL( 6505 , 6555 )= 4.6564 ;
GL( 6506 , 6556 )= 4.6564 ;
GL( 6507 , 6557 )= 4.6564 ;
GL( 6508 , 6558 )= 4.6564 ;
GL( 6509 , 6559 )= 4.6564 ;
GL( 6510 , 6560 )= 4.6564 ;
GL( 6511 , 6561 )= 4.6564 ;
GL( 6512 , 6562 )= 4.6564 ;
GL( 6513 , 6563 )= 2.0181 ;
GL( 6514 , 6564 )= 2.0181 ;
GL( 6515 , 6565 )= 2.0181 ;
GL( 6516 , 6566 )= 2.0181 ;
GL( 6517 , 6567 )= 1.7066 ;
GL( 6518 , 6568 )= 1.7066 ;
GL( 6519 , 6569 )= 1.7066 ;
GL( 6520 , 6570 )= 1.7066 ;
#Baseplate to Spacecraft
#Through KMs
GL( 6567 , 10003 )= 0.0246 ;
GL( 6570 , 10003 )= 0.0246 ;
GL( 6568 , 10003 )= 0.0369 ;
GL( 6569 , 10003 )= 0.0369 ;
GL( 6563 , 10003 )= 0.0492 ;
GL( 6552 , 10003 )= 0.0492 ;
GL( 6554 , 10003 )= 0.0246 ;
GL( 6560 , 10003 )= 0.0246 ;
#negX
GL( 3010 , 3510 )= 15.0990 ;
GL( 3011 , 3511 )= 15.0990 ;
GL( 3012 , 3512 )= 15.0990 ;
GL( 3013 , 3513 )= 15.0990 ;
GL( 3014 , 3514 )= 15.0990 ;
GL( 3015 , 3515 )= 15.0990 ;
#teu wall
GL( 3020 , 3520 )= 3.5239 ;
GL( 3021 , 3521 )= 3.5239 ;
GL( 3022 , 3522 )= 3.5239 ;
GL( 3023 , 3523 )= 3.5239 ;
#nadir
GL( 3040 , 3540 )= 17.7700 ;
GL( 3041 , 3541 )= 17.7700 ;
#space_1
GL( 3050 , 3550 )= 3.6334 ;
GL( 3051 , 3551 )= 3.6334 ;
GL( 3052 , 3552 )= 3.6334 ;
GL( 3053 , 3553 )= 3.6334 ;
#spu wall
GL( 3060 , 3560 )= 1.9537 ;
GL( 3061 , 3561 )= 1.3526 ;
GL( 3062 , 3562 )= 1.3526 ;
GL( 3063 , 3563 )= 1.3526 ;
GL( 3064 , 3564 )= 7.3564 ;
#space_2
GL( 3070 , 3570 )= 1.3526 ;
GL( 3071 , 3571 )= 1.3526 ;
GL( 3072 , 3572 )= 1.3526 ;
#sun_1
GL( 3110 , 3610 )= 10.7292 ;
GL( 3111 , 3611 )= 10.7292 ;
GL( 3112 , 3612 )= 10.7292 ;
GL( 3113 , 3613 )= 10.7292 ;
#sun_2
GL( 3120 , 3620 )= 3.9935 ;
GL( 3121 , 3621 )= 3.9935 ;
GL( 3122 , 3622 )= 3.9935 ;
GL( 3123 , 3623 )= 3.9935 ;
#sun_3
GL( 3130 , 3630 )= 1.9894 ;
GL( 3131 , 3631 )= 1.9894 ;
GL( 3132 , 3632 )= 1.9894 ;
GL( 3133 , 3633 )= 1.9894 ;
GL( 3134 , 3634 )= 1.9894 ;
GL( 3135 , 3635 )= 1.9894 ;
GL( 3136 , 3636 )= 1.9894 ;
GL( 3137 , 3637 )= 1.9894 ;
GL( 3138 , 3638 )= 1.9894 ;
# Inter panel couplings
# spu to space_2
GL( 3060 , 3072 )= 0.5923 ;
# teu wall to space_2
GL( 3022 , 3070 )= 1.3181 ;
GL( 3023 , 3070 )= 1.3181 ;
# space_2 to space_1
GL( 3070 , 3050 )= 2.8384 ;
GL( 3070 , 3051 )= 1.4192 ;
GL( 3071 , 3051 )= 1.4192 ;
# space_1 to nadir
#Added16Apr98
#posXwall to Baseplate
GL( 6504 , 2200 )= 0.3 * INSERTFA ;
GL( 6504 , 2250 )= 0.3 * INSERTFA ;
GL( 6507 , 2201 )= 0.3 * INSERTFA ;
GL( 6507 , 2251 )= 0.3 * INSERTFA ;
GL( 6510 , 2202 )= 0.3 * INSERTFA ;
GL( 6510 , 2252 )= 0.3 * INSERTFA ;
#posXwall to Rear (EUcav)
GL( 2501 , 2202 )= 0.3/2.0 * INSERTFA ;
GL( 2503 , 2205 )= 0.3/2.0 * INSERTFA ;
GL( 2505 , 2208 )= 0.3/2.0 * INSERTFA ;
GL( 2507 , 2208 )= 0.3/2.0 * INSERTFA ;
GL( 2551 , 2252 )= 0.3/2.0 * INSERTFA ;
GL( 2553 , 2255 )= 0.3/2.0 * INSERTFA ;
GL( 2555 , 2258 )= 0.3/2.0 * INSERTFA ;
GL( 2557 , 2258 )= 0.3/2.0 * INSERTFA ;
#Baseplate to -Youter panel (sun1,2,3)
GL( 3110 , 6520 )= 0.3/2.0 * INSERTFA ;
GL( 3111 , 6503 )= 0.3/2.0 * INSERTFA ;
GL( 3120 , 6502 )= 0.3/2.0 * INSERTFA ;
GL( 3121 , 6512 )= 0.3/2.0 * INSERTFA ;
GL( 3130 , 6512 )= 0.3/2.0 * INSERTFA ;
GL( 3131 , 6512 )= 0.3/2.0 * INSERTFA ;
GL( 3132 , 6511 )= 0.3/2.0 * INSERTFA ;
GL( 3610 , 6520 )= 0.3/2.0 * INSERTFA ;
GL( 3611 , 6503 )= 0.3/2.0 * INSERTFA ;
GL( 3620 , 6502 )= 0.3/2.0 * INSERTFA ;
GL( 3621 , 6512 )= 0.3/2.0 * INSERTFA ;
GL( 3630 , 6512 )= 0.3/2.0 * INSERTFA ;
GL( 3631 , 6512 )= 0.3/2.0 * INSERTFA ;
GL( 3632 , 6511 )= 0.3/2.0 * INSERTFA ;
#Baseplate to Rear (EUcav)
GL( 6510 , 2501 )= 0.3 * INSERTFA ;
GL( 6511 , 2502 )= 0.3 * INSERTFA ;
GL( 6510 , 2551 )= 0.3 * INSERTFA ;
GL( 6511 , 2552 )= 0.3 * INSERTFA ;
#EU top panel to sunshield support (sx017-
14) - cleats
GL( 2600 , 2454 )= 0.2 * CLEATFA ;
GL( 2600 , 2455 )= 0.2 * CLEATFA ;
GL( 2600 , 2404 )= 0.2 * CLEATFA ;
GL( 2600 , 2405 )= 0.2 * CLEATFA ;
#Rear to Top (EUcav)
GL( 2507 , 2404 )= 0.3 * 2.0 * INSERTFA ;
GL( 2506 , 2405 )= 0.3 * 2.0 * INSERTFA ;
#Top to posXwall (EUcav)
GL( 2450 , 2209 )= 0.3 * INSERTFA ;
GL( 2452 , 2210 )= 0.3 * INSERTFA ;
GL( 2454 , 2211 )= 0.3 * INSERTFA ;
GL( 2400 , 2209 )= 0.3 * INSERTFA ;
GL( 2402 , 2210 )= 0.3 * INSERTFA ;
GL( 2404 , 2211 )= 0.3 * INSERTFA ;
#Shelf to posXwall (EUcav)
GL( 2300 , 2206 )= 0.3 * INSERTFA ;
GL( 2301 , 2207 )= 0.3 * INSERTFA ;
GL( 2302 , 2208 )= 0.3 * INSERTFA ;
GL( 2350 , 2206 )= 0.3 * INSERTFA ;
GL( 2351 , 2207 )= 0.3 * INSERTFA ;
GL( 2352 , 2208 )= 0.3 * INSERTFA ;
#Shelf to Rear (EUcav)
GL( 2302 , 2506 )= 0.3 * INSERTFA ;
GL( 2302 , 2507 )= 0.3 * INSERTFA ;
GL( 2352 , 2504 )= 0.3 * INSERTFA ;
GL( 2352 , 2505 )= 0.3 * INSERTFA ;
#Baseplate to midpanel(LHwall)
GL( 2100 , 6505 )= 0.3 * INSERTFA ;
GL( 2101 , 6508 )= 0.3 * INSERTFA ;
GL( 2102 , 6511 )= 0.3 * INSERTFA ;
GL( 2150 , 6505 )= 0.3 * INSERTFA ;
GL( 2151 , 6508 )= 0.3 * INSERTFA ;
GL( 2152 , 6511 )= 0.3 * INSERTFA ;
#Midpanel(LHwall) to Shelf
GL( 2103 , 2300 )= 0.3 * INSERTFA ;
GL( 2104 , 2301 )= 0.3 * INSERTFA ;
GL( 2105 , 2302 )= 0.3 * INSERTFA ;
GL( 2103 , 2350 )= 0.3 * INSERTFA ;
GL( 2104 , 2351 )= 0.3 * INSERTFA ;
GL( 2105 , 2352 )= 0.3 * INSERTFA ;
#Midpanel(LHwall) to Top
GL( 2106 , 2401 )= 0.3 * INSERTFA ;
GL( 2107 , 2403 )= 0.3 * INSERTFA ;
GL( 2108 , 2405 )= 0.3 * INSERTFA ;
GL( 2106 , 2401 )= 0.3 * INSERTFA ;
GL( 2107 , 2403 )= 0.3 * INSERTFA ;
GL( 2108 , 2405 )= 0.3 * INSERTFA ;
#Midpanel(LHwall) to Rear
GL( 2102 , 2500 )= 0.2 * INSERTFA ;
GL( 2105 , 2502 )= 0.2 * INSERTFA ;
GL( 2108 , 2506 )= 0.2 * INSERTFA ;
GL( 2152 , 2500 )= 0.2 * INSERTFA ;
GL( 2155 , 2502 )= 0.2 * INSERTFA ;
GL( 2158 , 2506 )= 0.2 * INSERTFA ;
#Mezzanine to Sun
GL( 3462 , 3136 )= 0.3/2.0 * INSERTFA ;
GL( 3463 , 3138 )= 0.3/2.0 * INSERTFA ;
GL( 3362 , 3136 )= 0.3/2.0 * INSERTFA ;
GL( 3363 , 3138 )= 0.3/2.0 * INSERTFA ;
#Aperture plate to Sun
GL( 3404 , 9122 )= 0.4 * INSERTFA ;
GL( 3405 , 9123 )= 0.4 * INSERTFA ;
GL( 3404 , 3122 )= 0.4 * INSERTFA ;
GL( 3405 , 3123 )= 0.4 * INSERTFA ;
#Aperture plate to Nadir
GL( 3400 , 3040 )= 0.2 * 2.0 * CLEATFA ;
GL( 3402 , 3040 )= 0.2 * 2.0 * CLEATFA ;
#negXwall to Sun
GL( 9110 , 9011 )= 0.3 * 2.0 * INSERTFA ;
GL( 9112 , 9015 )= 0.3 * 2.0 * INSERTFA ;
GL( 3110 , 3011 )= 0.3 * 2.0 * INSERTFA ;
GL( 3112 , 3015 )= 0.3 * 2.0 * INSERTFA ;
#negXwall to Baseplate
GL( 9011 , 6519 )= 0.3 * 2.0 * INSERTFA ;
GL( 9010 , 6518 )= 0.3 * 2.0 * INSERTFA ;
GL( 3011 , 6519 )= 0.3 * 2.0 * INSERTFA ;
GL( 3010 , 6518 )= 0.3 * 2.0 * INSERTFA ;
#negXwall to nadir
GL( 3040 , 9015 )= 0.4 * INSERTFA ;
GL( 3041 , 9014 )= 0.4 * INSERTFA ;
GL( 3540 , 3015 )= 0.4 * INSERTFA ;
GL( 3541 , 3014 )= 0.4 * INSERTFA ;
#negXwall to teu wall
GL( 3520 , 3510 )= 0.3 * INSERTFA ;
GL( 3522 , 3510 )= 0.3 * INSERTFA ;
GL( 3020 , 3010 )= 0.3 * INSERTFA ;
GL( 3022 , 3010 )= 0.3 * INSERTFA ;
#negXwall to space_1
GL( 3512 , 3550 )= 0.3 * INSERTFA ;
GL( 3514 , 3552 )= 0.3 * INSERTFA ;
GL( 3012 , 3050 )= 0.3 * INSERTFA ;
GL( 3014 , 3052 )= 0.3 * INSERTFA ;
#teu wall to baseplate
GL( 3520 , 6517 )= 0.3 * INSERTFA ;
GL( 3521 , 6514 )= 0.3 * INSERTFA ;
GL( 3020 , 6517 )= 0.3 * INSERTFA ;
GL( 3021 , 6514 )= 0.3 * INSERTFA ;
#Mezzanine to spu_2
GL( 3460 , 3561 )= 0.3/2.0 * INSERTFA ;
GL( 3461 , 3563 )= 0.3/2.0 * INSERTFA ;
GL( 3360 , 3061 )= 0.3/2.0 * INSERTFA ;
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GL( 3361 , 3063 )= 0.3/2.0 * INSERTFA ;
#Mezzanine to aperture plate
GL( 3401 , 3460 )= 0.2 * 1.5 * CLEATFA ;
GL( 3403 , 3462 )= 0.2 * 1.5 * CLEATFA ;
GL( 3401 , 3060 )= 0.2 * 1.5 * CLEATFA ;
GL( 3403 , 3062 )= 0.2 * 1.5 * CLEATFA ;
#+Y to aperture plate
GL( 3400 , 3553 )= 0.3 * INSERTFA ;
GL( 3401 , 3551 )= 0.3 * INSERTFA ;
GL( 3400 , 3053 )= 0.3 * INSERTFA ;
GL( 3401 , 3051 )= 0.3 * INSERTFA ;
#+Y to nadir
GL( 3549 , 3552 )= 0.3/2.0 * INSERTFA ;
GL( 3549 , 3553 )= 0.3/2.0 * INSERTFA ;
GL( 3549 , 3052 )= 0.3/2.0 * INSERTFA ;
GL( 3549 , 3053 )= 0.3/2.0 * INSERTFA ;
#Sun to nadir
GL( 3549 , 3112 )= 0.3 * INSERTFA ;
GL( 3549 , 3113 )= 0.3 * INSERTFA ;
GL( 3549 , 3612 )= 0.3 * INSERTFA ;
GL( 3549 , 3613 )= 0.3 * INSERTFA ;
#SX017 to sunshield
GL( 3454 , 2650 )=0.3 * 1.5 * INSERTFA ;
GL( 3354 , 2600 )=0.3 * 1.5 * INSERTFA ;
#
#space_1 to nadir
# see cleat section
# nadir to negX wall
# see cleat section
# sun_1 to sun_2
# mli
#
# Cleats/inserts between panels
#
# Contact conductance between equipments
and structure
#
#
#
#
GL( 1102 , 2300 )= 6.2410D+00 ;
GL( 1202 , 2256 )= 8.8405D+00 ;
#GL( 1902 , 2258 )= 8.8405D+00 ;
GL( 1302 , 6504 )= 15.1784D+00 ;
GL( 1404 , 2350 )= 4.6459D+00 ;
GL( 1501 , 2153 )= 3.2941D+00 ;
#Add thermal link to spu
GL( 1502 , 3060 )= 0.4000D+00 ;
GL( 1502 , 3063 )= 0.2000D+00 ;
GL( 1951 , 2155 )= 4.8937D+00 ;
#
GL( 1606 , 3020 )= 8.2202D+00 / 30.0 ;
GL( 1606 , 3021 )= 8.2202D+00 / 30.0 ;
GL( 1606 , 3022 )= 8.2202D+00 / 30.0 ;
GL( 1606 , 3023 )= 8.2202D+00 / 30.0 ;
GL( 1701 , 3050 )= 5.4006D+00 / 50.0 ;
GL( 1701 , 3052 )= 5.4006D+00 / 50.0 ;
#
#GL( 1606 , 3020 )= 8.2202D+00 ;
#GL( 1606 , 3021 )= 8.2202D+00 ;
#GL( 1606 , 3022 )= 8.2202D+00 ;
#GL( 1606 , 3023 )= 8.2202D+00 ;
#GL( 1701 , 3050 )= 5.4006D+00 ;
#GL( 1701 , 3052 )= 5.4006D+00 ;
#GL( 1801 , 3051 )= 1.1811D+00 ;
#
# Contact conductance between PCU faces
#
GL( 1101 , 1102 )= 5.1306D+00 ;
GL( 1101 , 1104 )= 5.1306D+00 ;
GL( 1101 , 1105 )= 3.9415D+00 ;
GL( 1101 , 1106 )= 3.9415D+00 ;
GL( 1103 , 1102 )= 5.1306D+00 ;
GL( 1103 , 1104 )= 5.1306D+00 ;
GL( 1103 , 1105 )= 3.9415D+00 ;
GL( 1103 , 1106 )= 3.9415D+00 ;
GL( 1104 , 1105 )= 0.3022D+00 ;
GL( 1104 , 1106 )= 0.3022D+00 ;
GL( 1102 , 1105 )= 0.3022D+00 ;
GL( 1102 , 1106 )= 0.3022D+00 ;
#GL( 1101 , 1199 )= 11.2872D+00 ;
# Contact conductance between PCU faces
and power dissipators
# Contact conductance between GEU faces
#
GL( 1401 , 1402 )= 6.0952D+00 ;
GL( 1401 , 1404 )= 6.0952D+00 ;
GL( 1401 , 1405 )= 3.4286D+00 ;
GL( 1401 , 1406 )= 3.4286D+00 ;
GL( 1403 , 1402 )= 6.0952D+00 ;
GL( 1403 , 1404 )= 6.0952D+00 ;
GL( 1403 , 1405 )= 3.4286D+00 ;
GL( 1403 , 1406 )= 3.4286D+00 ;
GL( 1404 , 1405 )= 0.4000D+00 ;
GL( 1404 , 1406 )= 0.4000D+00 ;
GL( 1402 , 1405 )= 0.4000D+00 ;
GL( 1402 , 1406 )= 0.4000D+00 ;
GL( 1404 , 1498 )= 0.2000D+00 ;
# Contact conductance between GEU faces
and power dissipators
# Contact conductance between CCU faces
#
GL( 1201 , 1202 )= 0.5698D+00 ;
GL( 1201 , 1205 )= 0.5698D+00 ;
GL( 1201 , 1203 )= 0.1645D+00 ;
GL( 1201 , 1206 )= 0.1645D+00 ;
GL( 1204 , 1202 )= 0.5698D+00 ;
GL( 1204 , 1205 )= 0.5698D+00 ;
GL( 1204 , 1203 )= 0.1645D+00 ;
GL( 1204 , 1206 )= 0.1645D+00 ;
GL( 1205 , 1206 )= 0.5641D+00 ;
GL( 1205 , 1203 )= 0.5641D+00 ;
GL( 1202 , 1206 )= 0.5641D+00 ;
GL( 1202 , 1203 )= 0.5641D+00 ;
#GL( 1201 , 1210 )= 6.7060D+00 ;
# Contact conductance between CCU faces
and power dissipators
# Contact conductance between IPU faces
#
GL( 1301 , 1302 )= 3.7340D+00 ;
GL( 1301 , 1304 )= 3.7340D+00 ;
GL( 1301 , 1305 )= 2.6567D+00 ;
GL( 1301 , 1306 )= 2.6567D+00 ;
GL( 1303 , 1302 )= 3.7340D+00 ;
GL( 1303 , 1304 )= 3.7340D+00 ;
GL( 1303 , 1305 )= 2.6567D+00 ;
GL( 1303 , 1306 )= 2.6567D+00 ;
GL( 1304 , 1305 )= 0.5165D+00 ;
GL( 1304 , 1306 )= 0.5165D+00 ;
GL( 1302 , 1305 )= 0.5165D+00 ;
GL( 1302 , 1306 )= 0.5165D+00 ;
#GL( 1301 , 1397 )= 1.3000D+00 ;
#GL( 1301 , 1398 )= 1.3000D+00 ;
#GL( 1301 , 1399 )= 1.3000D+00 ;
# Contact conductance between IPU faces
and power dissipators
# Contact conductance between SPU faces
#
GL( 1501 , 1502 )= 5.2000D+00 ;
GL( 1501 , 1504 )= 5.2000D+00 ;
GL( 1501 , 1505 )= 7.8769D+00 ;
GL( 1501 , 1506 )= 7.8769D+00 ;
GL( 1503 , 1502 )= 5.2000D+00 ;
GL( 1503 , 1504 )= 5.2000D+00 ;
GL( 1503 , 1505 )= 7.8769D+00 ;
GL( 1503 , 1506 )= 7.8769D+00 ;
GL( 1504 , 1505 )= 0.2715D+00 ;
GL( 1504 , 1506 )= 0.2715D+00 ;
GL( 1502 , 1505 )= 0.2715D+00 ;
GL( 1502 , 1506 )= 0.2715D+00 ;
# Contact conductance between SPU faces
and power dissipators
# Contact conductance between TEU faces
#
GL( 1601 , 1602 )= 0.8810D+00 ;
GL( 1601 , 1604 )= 0.8810D+00 ;
GL( 1601 , 1605 )= 9.3057D+00 ;
GL( 1601 , 1606 )= 9.3057D+00 ;
GL( 1603 , 1602 )= 0.8810D+00 ;
GL( 1603 , 1604 )= 0.8810D+00 ;
GL( 1603 , 1605 )= 9.3057D+00 ;
GL( 1603 , 1606 )= 9.3057D+00 ;
GL( 1604 , 1605 )= 0.5176D+00 ;
GL( 1604 , 1606 )= 0.5176D+00 ;
GL( 1602 , 1605 )= 0.5176D+00 ;
GL( 1602 , 1606 )= 0.5176D+00 ;
# Contact conductance between TEU faces
and power dissipators
# Contact conductance between EEA faces
#
GL( 1701 , 1702 )= 5.1839D+00 ;
GL( 1701 , 1704 )= 5.1839D+00 ;
GL( 1701 , 1705 )= 11.4144D+00 ;
GL( 1701 , 1706 )= 11.4144D+00 ;
GL( 1703 , 1702 )= 5.1839D+00 ;
GL( 1703 , 1704 )= 5.1839D+00 ;
GL( 1703 , 1705 )= 11.4144D+00 ;
GL( 1703 , 1706 )= 11.4144D+00 ;
GL( 1704 , 1705 )= 0.2161D+00 ;
GL( 1704 , 1706 )= 0.2161D+00 ;
GL( 1702 , 1705 )= 0.2161D+00 ;
GL( 1702 , 1706 )= 0.2161D+00 ;
# Contact conductance between EEA faces
and power dissipators
# Contact conductance between WSEA
faces
#
#GL( 1801 , 1802 )= 21.3333D+00 ;
#GL( 1801 , 1804 )= 21.3333D+00 ;
#GL( 1801 , 1805 )= 48.0000D+00 ;
#GL( 1801 , 1806 )= 48.0000D+00 ;
#GL( 1803 , 1802 )= 21.3333D+00 ;
#GL( 1803 , 1804 )= 21.3333D+00 ;
#GL( 1803 , 1805 )= 48.0000D+00 ;
#GL( 1803 , 1806 )= 48.0000D+00 ;
#GL( 1804 , 1805 )= 0.1538D+00 ;
#GL( 1804 , 1806 )= 0.1538D+00 ;
#GL( 1802 , 1805 )= 0.1538D+00 ;
#GL( 1802 , 1806 )= 0.1538D+00 ;
# Contact conductance between WSEA
faces and power dissipators
# Contact conductance between BEU faces
#
GL( 1951 , 1952 )= 17.7778D+00 ;
GL( 1951 , 1955 )= 17.7778D+00 ;
GL( 1951 , 1953 )= 10.0000D+00 ;
GL( 1951 , 1956 )= 10.0000D+00 ;
GL( 1954 , 1952 )= 17.7778D+00 ;
GL( 1954 , 1953 )= 10.0000D+00 ;
GL( 1954 , 1955 )= 17.7778D+00 ;
GL( 1954 , 1956 )= 10.0000D+00 ;
GL( 1956 , 1952 )= 0.1371D+00 ;
GL( 1956 , 1955 )= 0.1371D+00 ;
GL( 1953 , 1952 )= 0.1371D+00 ;
GL( 1953 , 1955 )= 0.1371D+00 ;
# Contact conductance between BEU faces
and power dissipators
# Conductive couplings between MLI and
structure
#
#SX017 from mli to outer panel
GL( 2650 , 26500 )= 0.0049D+00 * MLIFA ;
#posX
GL( 2250 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2251 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2252 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2253 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2254 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2255 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2256 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2257 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2258 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2259 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2260 , 22500 )= 0.0013D+00 * MLIFA ;
GL( 2261 , 22500 )= 0.0013D+00 * MLIFA ;
#Rear
GL( 2550 , 25500 )= 0.0018D+00 * MLIFA ;
GL( 2551 , 25500 )= 0.0018D+00 * MLIFA ;
GL( 2552 , 25500 )= 0.0018D+00 * MLIFA ;
GL( 2553 , 25500 )= 0.0018D+00 * MLIFA ;
GL( 2554 , 25500 )= 0.0018D+00 * MLIFA ;
GL( 2555 , 25500 )= 0.0018D+00 * MLIFA ;
GL( 2556 , 25500 )= 0.0018D+00 * MLIFA ;
GL( 2557 , 25500 )= 0.0018D+00 * MLIFA ;
#Nadir
GL( 3540 , 3549 )= 0.00251D+00 ;
GL( 3541 , 3549 )= 0.00338D+00 ;
#Baseplate
GL( 6550 , 65020 )= 0.0011D+00 * MLIFA ;
GL( 6551 , 65020 )= 0.0011D+00 * MLIFA ;
GL( 6552 , 65020 )= 0.0011D+00 * MLIFA ;
GL( 6553 , 65020 )= 0.0011D+00 * MLIFA ;
GL( 6554 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6555 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6556 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6557 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6558 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6559 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6560 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6561 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6562 , 65010 )= 0.0013D+00 * MLIFA ;
GL( 6563 , 65000 )= 0.0011D+00 * MLIFA ;
GL( 6564 , 65000 )= 0.0011D+00 * MLIFA ;
GL( 6565 , 65000 )= 0.0011D+00 * MLIFA ;
GL( 6566 , 65000 )= 0.0011D+00 * MLIFA ;
GL( 6567 , 65030 )= 0.0009D+00 * MLIFA ;
GL( 6568 , 65030 )= 0.0009D+00 * MLIFA ;
GL( 6569 , 65030 )= 0.0009D+00 * MLIFA ;
GL( 6570 , 65030 )= 0.0009D+00 * MLIFA ;
# sun_1
GL( 9110 , 3110 )= 0.0018D+00 * MLIFA ;
GL( 9111 , 3111 )= 0.0018D+00 * MLIFA ;
GL( 9112 , 3112 )= 0.0018D+00 * MLIFA ;
GL( 9113 , 3113 )= 0.0018D+00 * MLIFA ;
# sun_2
GL( 9120 , 3120 )= 0.0012D+00 * MLIFA ;
GL( 9121 , 3121 )= 0.0012D+00 * MLIFA ;
GL( 9122 , 3122 )= 0.0012D+00 * MLIFA ;
GL( 9123 , 3123 )= 0.0012D+00 * MLIFA ;
# sun_3
GL( 9130 , 3130 )= 0.0006D+00 * MLIFA ;
GL( 9131 , 3131 )= 0.0006D+00 * MLIFA ;
GL( 9132 , 3132 )= 0.0006D+00 * MLIFA ;
GL( 9133 , 3133 )= 0.0006D+00 * MLIFA ;
GL( 9134 , 3134 )= 0.0006D+00 * MLIFA ;
```

```
GL( 9135 , 3135 )= 0.0006D+00 * MLIFA ;
GL( 9136 , 3136 )= 0.0006D+00 * MLIFA ;
GL( 9137 , 3137 )= 0.0006D+00 * MLIFA ;
GL( 9138 , 3138 )= 0.0006D+00 * MLIFA ;
# negX
GL( 9010 , 3510 )= 0.0025D+00 * MLIFA ;
GL( 9011 , 3511 )= 0.0025D+00 * MLIFA ;
GL( 9012 , 3512 )= 0.0025D+00 * MLIFA ;
GL( 9013 , 3513 )= 0.0025D+00 * MLIFA ;
GL( 9014 , 3514 )= 0.0025D+00 * MLIFA ;
GL( 9015 , 3515 )= 0.0025D+00 * MLIFA ;
#ccu
#GL( 1205 , 1299 )= 0.0008D+00 ;
#ccu 2
#GL( 1905 , 1999 )= 0.0008D+00 ;
#
# Radiative couplings between MLI and
structure
#
#SX017 from mli to outer panel
GR( 2650 , 26500 )= 0.0036D+00 * MLIFA ;
#posX
GR( 2250 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2251 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2252 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2253 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2254 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2255 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2256 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2257 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2258 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2259 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2260 , 22500 )= 0.0009D+00 * MLIFA ;
GR( 2261 , 22500 )= 0.0009D+00 * MLIFA ;
#Rear
GR( 2550 , 25500 )= 0.0013D+00 * MLIFA ;
GR( 2551 , 25500 )= 0.0014D+00 * MLIFA ;
GR( 2552 , 25500 )= 0.0014D+00 * MLIFA ;
GR( 2553 , 25500 )= 0.0000D+00 * MLIFA ;
GR( 2554 , 25500 )= 0.0007D+00 * MLIFA ;
GR( 2555 , 25500 )= 0.0007D+00 * MLIFA ;
GR( 2556 , 25500 )= 0.0007D+00 * MLIFA ;
GR( 2557 , 25500 )= 0.0007D+00 * MLIFA ;
#Nadir
GR( 3540 , 3549 )= 0.00185D+00 * MLIFA ;
GR( 3541 , 3549 )= 0.00249D+00 * MLIFA ;
#Baseplate
GR( 6550 , 65020 )= 0.0009D+00 * MLIFA ;
GR( 6551 , 65020 )= 0.0009D+00 * MLIFA ;
GR( 6552 , 65020 )= 0.0009D+00 * MLIFA ;
GR( 6553 , 65020 )= 0.0009D+00 * MLIFA ;
GR( 6554 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6555 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6556 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6557 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6558 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6559 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6560 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6561 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6562 , 65010 )= 0.0009D+00 * MLIFA ;
GR( 6563 , 65000 )= 0.0009D+00 * MLIFA ;
GR( 6564 , 65000 )= 0.0009D+00 * MLIFA ;
GR( 6565 , 65000 )= 0.0009D+00 * MLIFA ;
GR( 6566 , 65000 )= 0.0009D+00 * MLIFA ;
GR( 6567 , 65030 )= 0.0008D+00 * MLIFA ;
GR( 6568 , 65030 )= 0.0008D+00 * MLIFA ;
GR( 6569 , 65030 )= 0.0008D+00 * MLIFA ;
GR( 6570 , 65030 )= 0.0008D+00 * MLIFA ;
#Baseplate sides MLI
GL( 65100 , 6514 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6513 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6506 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6505 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6504 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6564 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6563 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6556 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6555 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65100 , 6554 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GR( 65100 , 6514 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6513 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6506 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6505 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6504 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6564 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6563 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6556 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6555 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65100 , 6554 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
#
GL( 65110 , 6504 )= 5.18D-02 / 3.0 / 2.0 *
0.036 * MLIFA ;
GL( 65110 , 6507 )= 5.18D-02 / 3.0 / 2.0 *
0.036 * MLIFA ;
GL( 65110 , 6510 )= 5.18D-02 / 3.0 / 2.0 *
0.036 * MLIFA ;
GL( 65110 , 6554 )= 5.18D-02 / 3.0 / 2.0 *
0.036 * MLIFA ;
GL( 65110 , 6557 )= 5.18D-02 / 3.0 / 2.0 *
0.036 * MLIFA ;
GL( 65110 , 6560 )= 5.18D-02 / 3.0 / 2.0 *
0.036 * MLIFA ;
GR( 65110 , 6504 )= 5.18D-02 / 3.0 / 2.0 *
0.032 * MLIFA ;
GR( 65110 , 6507 )= 5.18D-02 / 3.0 / 2.0 *
0.032 * MLIFA ;
GR( 65110 , 6510 )= 5.18D-02 / 3.0 / 2.0 *
0.032 * MLIFA ;
GR( 65110 , 6554 )= 5.18D-02 / 3.0 / 2.0 *
0.032 * MLIFA ;
GR( 65110 , 6557 )= 5.18D-02 / 3.0 / 2.0 *
0.032 * MLIFA ;
GR( 65110 , 6560 )= 5.18D-02 / 3.0 / 2.0 *
0.032 * MLIFA ;
#
GL( 65120 , 6510 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6511 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6512 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6502 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6503 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6560 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6561 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6562 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6552 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GL( 65120 , 6553 )= 7.75D-02 / 5.0 / 2.0 *
0.036 * MLIFA ;
GR( 65120 , 6510 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6511 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6512 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6502 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6503 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6560 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6561 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6562 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6552 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
GR( 65120 , 6553 )= 7.75D-02 / 5.0 / 2.0 *
0.032 * MLIFA ;
#
GL( 65130 , 6520 )= 5.18D-02 / 4.0 / 2.0 *
0.036 * MLIFA ;
GL( 65130 , 6519 )= 5.18D-02 / 4.0 / 2.0 *
0.036 * MLIFA ;
GL( 65130 , 6518 )= 5.18D-02 / 4.0 / 2.0 *
0.036 * MLIFA ;
GL( 65130 , 6517 )= 5.18D-02 / 4.0 / 2.0 *
0.036 * MLIFA ;
GL( 65130 , 6570 )= 5.18D-02 / 4.0 / 2.0 *
0.036 * MLIFA ;
GL( 65130 , 6569 )= 5.18D-02 / 4.0 / 2.0 *
0.036 * MLIFA ;
GL( 65130 , 6568 )= 5.18D-02 / 4.0 / 2.0 *
0.036 * MLIFA ;
GL( 65130 , 6567 )= 5.18D-02 / 4.0 / 2.0 *
0.036 * MLIFA ;
GR( 65130 , 6520 )= 5.18D-02 / 4.0 / 2.0 *
0.032 * MLIFA ;
GR( 65130 , 6519 )= 5.18D-02 / 4.0 / 2.0 *
0.032 * MLIFA ;
GR( 65130 , 6518 )= 5.18D-02 / 4.0 / 2.0 *
0.032 * MLIFA ;
GR( 65130 , 6517 )= 5.18D-02 / 4.0 / 2.0 *
0.032 * MLIFA ;
GR( 65130 , 6570 )= 5.18D-02 / 4.0 / 2.0 *
0.032 * MLIFA ;
GR( 65130 , 6569 )= 5.18D-02 / 4.0 / 2.0 *
0.032 * MLIFA ;
GR( 65130 , 6568 )= 5.18D-02 / 4.0 / 2.0 *
0.032 * MLIFA ;
GR( 65130 , 6567 )= 5.18D-02 / 4.0 / 2.0 *
0.032 * MLIFA ;
#Baseplate inner hole Kapton
GL( 65140 , 6515 )= 2.82D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65140 , 6516 )= 2.82D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65140 , 6565 )= 2.82D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65140 , 6566 )= 2.82D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GR( 65140 , 6515 )= 2.82D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65140 , 6516 )= 2.82D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65140 , 6565 )= 2.82D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65140 , 6566 )= 2.82D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
#
GL( 65150 , 6509 )= 2.18D-02 /2.0 * 0.036 *
MLIFA ;
GL( 65150 , 6559 )= 2.18D-02 /2.0 * 0.036 *
MLIFA ;
GR( 65150 , 6509 )= 2.18D-02 /2.0 * 0.032 *
MLIFA ;
GR( 65150 , 6559 )= 2.18D-02 /2.0 * 0.032 *
MLIFA ;
#
GL( 65160 , 6500 )= 2.82D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65160 , 6501 )= 2.82D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65160 , 6550 )= 2.82D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65160 , 6551 )= 2.82D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GR( 65160 , 6500 )= 2.82D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65160 , 6501 )= 2.82D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65160 , 6550 )= 2.82D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65160 , 6551 )= 2.82D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
#
GL( 65170 , 6519 )= 2.18D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65170 , 6518 )= 2.18D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65170 , 6569 )= 2.18D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GL( 65170 , 6568 )= 2.18D-02 / 2.0 / 2.0 *
0.036 * MLIFA ;
GR( 65170 , 6519 )= 2.18D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65170 , 6518 )= 2.18D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65170 , 6569 )= 2.18D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
GR( 65170 , 6568 )= 2.18D-02 / 2.0 / 2.0 *
0.032 * MLIFA ;
# negX
GR( 9010 , 3510 )= 0.0018D+00 * MLIFA ;
GR( 9011 , 3511 )= 0.0018D+00 * MLIFA ;
GR( 9012 , 3512 )= 0.0018D+00 * MLIFA ;
GR( 9013 , 3513 )= 0.0018D+00 * MLIFA ;
GR( 9014 , 3514 )= 0.0018D+00 * MLIFA ;
GR( 9015 , 3515 )= 0.0018D+00 * MLIFA ;
#sun_1
GR( 3610 , 9110 )= 0.0013D+00 * MLIFA ;
GR( 3611 , 9111 )= 0.0013D+00 * MLIFA ;
GR( 3612 , 9112 )= 0.0013D+00 * MLIFA ;
GR( 3613 , 9113 )= 0.0013D+00 * MLIFA ;
#sun_2
GR( 3620 , 9120 )= 0.0011D+00 * MLIFA ;
GR( 3621 , 9121 )= 0.0011D+00 * MLIFA ;
GR( 3622 , 9122 )= 0.0011D+00 * MLIFA ;
GR( 3623 , 9123 )= 0.0011D+00 * MLIFA ;
```

```
#sun_3
GR( 3630 , 9130 )= 0.0005D+00 * MLIFA ;
GR( 3631 , 9131 )= 0.0005D+00 * MLIFA ;
GR( 3632 , 9132 )= 0.0005D+00 * MLIFA ;
GR( 3633 , 9133 )= 0.0005D+00 * MLIFA ;
GR( 3634 , 9134 )= 0.0005D+00 * MLIFA ;
GR( 3635 , 9135 )= 0.0005D+00 * MLIFA ;
GR( 3636 , 9136 )= 0.0005D+00 * MLIFA ;
GR( 3637 , 9137 )= 0.0005D+00 * MLIFA ;
GR( 3638 , 9138 )= 0.0005D+00 * MLIFA ;
#ccu
#GR( 1205 , 1299 )= 0.0006D+00 ;
#ccu2
#GR( 1905 , 1999 )= 0.0006D+00 ;
#
#Sunshield model
#
# ----------------------------------------------------------
------------------
# Conduction Links
# ----------------------------------------------------------
------------------
# Through Aperture Links
GL( 3400 , 3401 )= 9.676D-4;
GL( 3400 , 3402 )= 4.848D-4;
GL( 3401 , 3403 )= 9.676D-4;
GL( 3402 , 3403 )= 4.848D-4;
GL( 3402 , 3404 )= 8.000D-4;
GL( 3403 , 3405 )= 8.000D-4;
# Through Door Links
GL( 3310 , 3311 )= 2.112D-3;
GL( 3311 , 3312 )= 2.112D-3;
GL( 3312 , 3313 )= 2.112D-3;
GL( 3313 , 3314 )= 2.112D-3;
# Through Sunshield Top Links
GL( 3350 , 3351 )= 3.291D-4;
GL( 3352 , 3353 )= 3.291D-4;
GL( 3350 , 3352 )= 6.655D-4;
GL( 3352 , 3354 )= 8.795D-4;
GL( 3351 , 3353 )= 2.223D-4;
GL( 3353 , 3354 )= 3.793D-4;
# Through Sunshield Base Links
GL( 3360 , 3362 )= 1.178D-3;
GL( 3361 , 3362 )= 3.349D-4;
GL( 3361 , 3363 )= 6.041D-4;
GL( 3362 , 3364 )= 5.370D-4;
GL( 3363 , 3364 )= 3.650D-4;
GL( 3363 , 3365 )= 1.643D-4;
GL( 3364 , 3365 )= 1.825D-4;
# Through Sunshield Side
GL( 3370 , 3371 )= 6.054D-4;
GL( 3371 , 3372 )= 1.883D-4;
GL( 3372 , 3373 )= 6.054D-4;
#Through Sunshield 'Fins'
GL( 3374 , 3375 )= 7.708D-4;
#----------------------------------------------------------
-----------------------------------
# Item to item Links
#----------------------------------------------------------
-----------------------------------
GL( 3400 , 3351 )= 0.1000;  # Aperture to
Top
GL( 3402 , 3350 )= 0.1000;  #Aperture to
Top
GL( 3401 , 3361 )= 0.1000;  #Aperture to
Base
GL( 3403 , 3362 )= 0.1000;  #Aperture to
Base
GL( 3364 , 3375 )= 0.1000;  # Base to Fin
GL( 3373 , 3374 )= 0.0100;  # Side to Fin
#GL( 3325 , 3302 )= 0.1750;  #Motor to
Aperture Plate
#GL( 3325 , 3303 )= 0.1750;  #Motor to
Aperture Plate
#GL( 3325 , 3310 )= 0.0430;  # Motor to
Door
GL( 3354 , 3370 )= 0.8290;  # Top to Side
GL( 3354 , 3373 )= 0.8290;  # Top to Side
GL( 3325 , 3400 )= 0.25/2.0; #HDRM to
Aperture Plate
GL( 3325 , 3401 )= 0.25/2.0; #HDRM to
Aperture Plate
GL( 33260, 3326 )= 0.00011; #HDRM
ActuatorMLI to Actuator
GR( 33260, 3326 )= 0.00010; #HDRM
ActuatorMLI to Actuator
GL( 3326 , 3325 )=0.01;     #HDRM
Actuator to Housing
GL( 3327 , 3325 )=0.5;      #HDRM
Microswitch Plate to Housing
GL( 3331 , 3330 )=0.05;     #Hinge Pot
Struct to Pot Bracket
GL( 3332 , 3330 )=0.04;     #Hinge Pot to
Pot Struct
GL( 3332 , 3331 )=0.08;     #Pot to Pot
Struct
GL( 3330 , 3402 )=0.037;    #Hinge Bracket
Pot to Aperture Plate
GL( 3334 , 3333 )=0.05;     #Struct Motor to
Hinge Bracket Motor
GL( 3335 , 3333 )=0.04;     #Motor to Hinge
Bracket Motor
GL( 3335 , 3334 )=0.08;     #Motor to Struct
Motor
GL( 3333 , 3403 )=0.037;    #Hinge Bracket
Motor to Aperture Plate
GL( 33100, 3310 )=0.001 * MLIFA;    #Door
MLI to Door
GL( 33100, 3311 )=0.001 * MLIFA;    #Door
MLI to Door
GL( 33100, 3312 )=0.001 * MLIFA;    #Door
MLI to Door
GL( 33100, 3313 )=0.001 * MLIFA;    #Door
MLI to Door
GL( 33100, 3314 )=0.001 * MLIFA;    #Door
MLI to Door
GR( 33100, 3310 )=0.0007 * MLIFA;
#Door MLI to Door
GR( 33100, 3311 )=0.0007 * MLIFA;
#Door MLI to Door
GR( 33100, 3312 )=0.0007 * MLIFA;
#Door MLI to Door
GR( 33100, 3313 )=0.0007 * MLIFA;
#Door MLI to Door
GR( 33100, 3314 )=0.0007 * MLIFA;
#Door MLI to Door
#albedo shield
GL( 33261 , 33262 )=0.2;  #8M4 bolts
GL( 33262 , 33261 )=0.15;  #5M4 bolts
GL( 33262 , 3521 )=0.2;
GL( 33262 , 3031 )=0.2;
# ----------------------------------------------------------
------------------
#Radiation Links
# ----------------------------------------------------------
------------------
# Blanket Radiation Links
# Sunshield Top to MLI
GR( 3350 , 3450 )= 1.940D-3 * MLIFA;
GR( 3351 , 3451 )= 5.800D-3 * MLIFA;
GR( 3352 , 3452 )= 1.940D-3 * MLIFA;
GR( 3353 , 3453 )= 5.800D-3 * MLIFA;
GR( 3354 , 3454 )= 1.804D-3 * MLIFA;
#  Sunshield Base to MLI
GR( 3360 , 3460 )= 2.358D-4 * MLIFA;
GR( 3361 , 3461 )= 1.659D-3 * MLIFA;
GR( 3362 , 3462 )= 4.978D-3 * MLIFA;
GR( 3363 , 3463 )= 5.852D-3 * MLIFA;
GR( 3364 , 3464 )= 5.899D-3 * MLIFA;
GR( 3365 , 3465 )= 1.974D-3 * MLIFA;
# Sunshield Side to MLI
GR( 3370 , 3470 )= 1.839D-3 * MLIFA;
GR( 3371 , 3471 )= 1.491D-3 * MLIFA;
GR( 3372 , 3472 )= 3.582D-3 * MLIFA;
GR( 3373 , 3473 )= 2.805D-3 * MLIFA;
# Lower Side Structure to MLI
GR( 3320 , 3420 )= 5.500D-4 * MLIFA;
# 'Fins' to MLI
GR( 3374 , 3474 )= 6.232D-4 * MLIFA;
GR( 3375 , 3475 )= 4.021D-3 * MLIFA;
#
#
#
#optics from LMMS
#incorporated 8th April 98
#
GL(40550,40640)=0.0090;
GL(40500,40505)=0.0440;
GL(40505,40600)=0.1780;
GL(40520,40610)=1.1900;
GL(40510,40610)=2.2560;
GL(40590,40630)=0.3360;
GL(40595,40631)=0.2200;
GL(40710,40600)=0.0700;
GL(40710,40711)=0.0400;
GL(40700,40600)=0.0080;
GL(40700,40705)=0.0400;
GL(40530,40610)=0.1340;
GL(40580,40632)=0.3320;
GL(40560,40632)=1.9800;
GL(40570,40630)=0.3680;
GL(40632,40610)=0.7200;
GL(40600,40610)=23.0000;
#change sth baseplate to node 6509
#GL(40600,40330)=0.207*3.0D-06;
GL(40600,6509)=0.207*3.0;
GL(40600,40640)=0.2490;
GL(40620,40610)=31.8000;
GL(40630,40632)=0.0040;
GL(40631,40632)=0.0040;
GR(40640,40645)=126500.0000D-06;
GR(40060,40400)=55.1640D-06;
GR(40060,3400)=12.0540D-06;
GR(40060,40505)=131.6900D-06;
GR(40060,40600)=120.1800D-06;
GR(40060,40620)=30.3280D-06;
GR(40060,40640)=7736.3000D-06;
GR(40060,40710)=18.7370D-06;
GR(40400,3400)=6129.5000D-06;
GR(40400,40500)=473.1100D-06;
GR(40400,40505)=8055.3000D-06;
GR(40400,40510)=29.6620D-06;
GR(40400,40530)=296.4100D-06;
GR(40400,40550)=94.4680D-06;
GR(40400,40600)=2188.3000D-06;
GR(40400,40610)=1565.3000D-06;
GR(40400,40620)=51.2570D-06;
GR(40400,40640)=49674.0000D-06;
GR(40400,40640)=100.0800D-06;
GR(40400,40710)=854.6500D-06;
GR(3400,40500)=106.5200D-06;
GR(3400,40505)=2407.5000D-06;
GR(3400,40530)=219.5600D-06;
GR(3400,40550)=24.4570D-06;
GR(3400,40600)=1161.3000D-06;
GR(3400,40610)=668.3900D-06;
GR(3400,40620)=202.4800D-06;
GR(3400,40640)=15015.0000D-06;
GR(3400,40640)=31.5820D-06;
GR(3400,40710)=416.9500D-06;
GR(40500,40505)=1675.7000D-06;
GR(40500,40600)=21.3890D-06;
GR(40500,40610)=142.6300D-06;
GR(40500,40640)=7147.4000D-06;
GR(40500,40710)=36.2900D-06;
GR(40505,40510)=26.6890D-06;
GR(40505,40530)=190.2600D-06;
GR(40505,40550)=122.1700D-06;
GR(40505,40600)=5982.0000D-06;
GR(40505,40610)=3068.5000D-06;
GR(40505,40620)=90.2560D-06;
GR(40505,40640)=97312.0000D-06;
GR(40505,40640)=98.5510D-06;
GR(40505,40710)=2174.5000D-06;
GR(40510,40530)=10.0130D-06;
GR(40510,40610)=2448.5000D-06;
GR(40510,40640)=698.8700D-06;
GR(40520,40600)=279.1400D-06;
GR(40520,40610)=54.7270D-06;
GR(40520,40620)=35.3720D-06;
GR(40520,40640)=29.0600D-06;
GR(40530,40570)=40.4570D-06;
GR(40530,40600)=545.7800D-06;
GR(40530,40610)=7278.3000D-06;
GR(40530,40620)=256.8900D-06;
GR(40530,40640)=5077.8000D-06;
GR(40530,40710)=415.4000D-06;
GR(40540,40600)=60.1910D-06;
GR(40540,40610)=266.8500D-06;
GR(40540,40640)=570.9400D-06;
GR(40550,40600)=54.9460D-06;
GR(40550,40610)=61.6470D-06;
GR(40550,40640)=2536.7000D-06;
GR(40550,40710)=22.9620D-06;
GR(40560,40632)=131.8600D-06;
GR(40570,40600)=105.9100D-06;
GR(40570,40610)=3337.6000D-06;
GR(40570,40620)=273.3200D-06;
GR(40570,40632)=2772.7000D-06;
GR(40570,40640)=1356.6000D-06;
GR(40580,40595)=11.4250D-06;
GR(40580,40610)=54.6130D-06;
GR(40580,40632)=2078.9000D-06;
GR(40590,40610)=381.6200D-06;
GR(40590,40632)=1351.3000D-06;
GR(40590,40640)=117.5400D-06;
GR(40595,40632)=389.8600D-06;
GR(40595,40640)=15.7120D-06;
GR(40600,40610)=13752.0000D-06;
GR(40600,40620)=11924.0000D-06;
GR(40600,40640)=90491.0000D-06;
GR(40600,40640)=28.6770D-06;
GR(40600,40710)=1930.9000D-06;
GR(40610,40620)=26473.0000D-06;
GR(40610,40632)=7529.4000D-06;
GR(40610,40640)=363000.0000D-06;
GR(40610,40640)=38.8870D-06;
GR(40610,40710)=2466.7000D-06;
GR(40620,40640)=57281.0000D-06;
GR(40620,40710)=46.7010D-06;
GR(40632,40640)=7704.0000D-06;
GR(40640,40640)=492.0400D-06;
GR(40640,40710)=25197.0000D-06;
GR(40640,40710)=10.4960D-06;
```

The units are those of W/K. The designation GL refers to a linear conductive coupling whereas the GR refers to a non-linear radiative coupling. These are treated differently in the mathematical model solution process.

9. Additional Radiative Couplings

There are also many radiative couplings which take into account the internal and external instrument view factors between surfaces. These are calculated using the Systema/Thermica software. The listing of couplings is exhautive and only a selection is reproduced here to demonstrate the similarity with the above section output:

```
GR ( 1101, 1104) =1.2843D-05;
GR ( 1101, 1105) =3.6807D-07;
GR ( 1101, 1401) =2.7462D-06;
GR ( 1101, 1405) =2.7473D-07;
GR ( 1101, 1601) =3.3160D-07;
GR ( 1101, 2012) =2.8902D-06;
GR ( 1101, 2026) =7.8163D-06;
GR ( 1101, 2030) =2.2210D-06;
GR ( 1101, 2032) =5.5701D-07;
```

10. Orbital Fluxes

The orbital fluxes are calculated using the Systema/Thermica software (version 3.2.14). The following are examples of the output of the flux data as used on HIRDLS. The data is available as time dependant arrays and in an average form for use on transient and steady state analyses respectively.

```
$ARRAYS
$REAL
# (ABSORBED)
Y01101 (2,  13) =   .000000D+00, 1.0697D+00, # SOLAR+ALBEDO      ABSORBED
                7.415830D+02, 9.0994D-01,
                1.483166D+03, 4.0256D-01,
                2.224749D+03, 9.3404D-04,
                2.366708D+03, 1.5084D-03,
                2.386708D+03,  .0000D+00,
                2.966332D+03,  .0000D+00,
                3.707915D+03,  .0000D+00,
                4.446465D+03,  .0000D+00,
                4.449498D+03,  .0000D+00,
                4.466465D+03, 1.5909D+00,
                5.191081D+03, 5.5081D-01,
                5.932664D+03, 1.0697D+00;
E01101 (2,  13) =   .000000D+00, 2.6361D+00, # PLANET          ABSORBED
                7.415830D+02, 2.6361D+00,
                1.483166D+03, 2.6361D+00,
                2.224749D+03, 2.6361D+00,
                2.366708D+03, 2.6361D+00,
                2.386708D+03, 2.6361D+00,
                2.966332D+03, 2.6361D+00,
                3.707915D+03, 2.6361D+00,
                4.446465D+03, 2.6361D+00,
                4.449498D+03, 2.6361D+00,
                4.466465D+03, 2.6361D+00,
                5.191081D+03, 2.6361D+00,
                5.932664D+03, 2.6361D+00;

#
#     THIS IS THE AVERAGE HEAT FLUX OVER THE ORBIT
#
      QS01101 = 4.6536D-01
      QS01103 = 6.2264D-03
      QS01104 = 1.2190D-01
      QS01105 = 1.1281D-02
      QE01101 = 2.6361D+00
      QE01103 = 4.5797D-03
      QE01104 = 1.4669D-01
      QE01105 = 2.2167D-02
```

The data is available in single arrays of solar, albedo, and earthshine data or as a combination of some or all contributions.

11. Mathematical Model

The mathematical model is written in Fortran for the Esatan thermal analysis programme. A Skeleton is formed within Systema which is used to control the mathematical model. This skeleton contains the information as to the file locations of the nodal definition, radiative exchanges, conductive couplings, and external environmental fluxes. Also are the definitions of many of the parameters used in the model which can be varied to see the effect, such as varying the effective emissivity factor of the MLI, or changing the power margin factor.

The model produces the temperature data around the HIRDLS model in terms of transient and steady state analysis. Also there are options to calculate the heat flow between nodes and detailed energy balance information which can be used for debugging.

FOR ATTENTION OF
LIZ OSBORNE
TC-MMS-381

12. Flight Predictions

The following tables show the flight predictions for the in-orbit hot and cold cases.

The following parameters (Tables 12.1-12.2 and Figure 12.1) are used for the flight predictions of hot and cold cases.

For cold case -

ORBIT AND KINEMATICS PARAMETERS		
Semi major axis (km)	:	7083.14014
Eccentricity	:	.00000
Inclination (deg)	:	98.20803
Right ascension of the ascend. node (deg)	:	108.57767
Argument of perigee (deg)	:	.00057
True anomaly of 1st position (deg)	:	.00057
Planet equatorial radius (km)	:	6378.14014
Planet gravitational constant (km3/s2)	:	398600.40625
Planet angle / ecliptic plane (deg)	:	23.44151
Epoch of the 1st orbital point		
Year, Month, Day	:	1999-06-19
Hours, Minutes, Seconds	:	1-22-22.00000
Sun Data		
Right ascension of the Sun (deg)	:	5.80847
Sun declination (deg)	:	23.41522
Sun Beta angle (deg)	:	15.98648
Sun line proj. on orbit / Asc. node (deg)	:	27.32142

Table 12.1 Cold case orbital parameters

For the hot case -

ORBIT AND KINEMATICS PARAMETERS		
Semi major axis (km)	:	7083.14014
Eccentricity	:	.00000
Inclination (deg)	:	98.20803
Right ascension of the ascend. node (deg)	:	300.98004
Argument of perigee (deg)	:	.00057
True anomaly of 1st position (deg)	:	.00057
Planet equatorial radius (km)	:	6378.14014
Planet gravitational constant (km3/s2)	:	398600.40625
Planet angle / ecliptic plane (deg)	:	23.44151
Epoch of the 1st orbital point		
Year, Month, Day	:	1999-12-18
Hours, Minutes, Seconds	:	1-22-22.00000
Sun Data		
Right ascension of the Sun (deg)	:	17.68530
Sun declination (deg)	:	-23.37054
Sun Beta angle (deg)	:	35.93163
Sun line proj. on orbit / Asc. node (deg)	:	337.01895

Table 12.2 Hot case orbital parameters

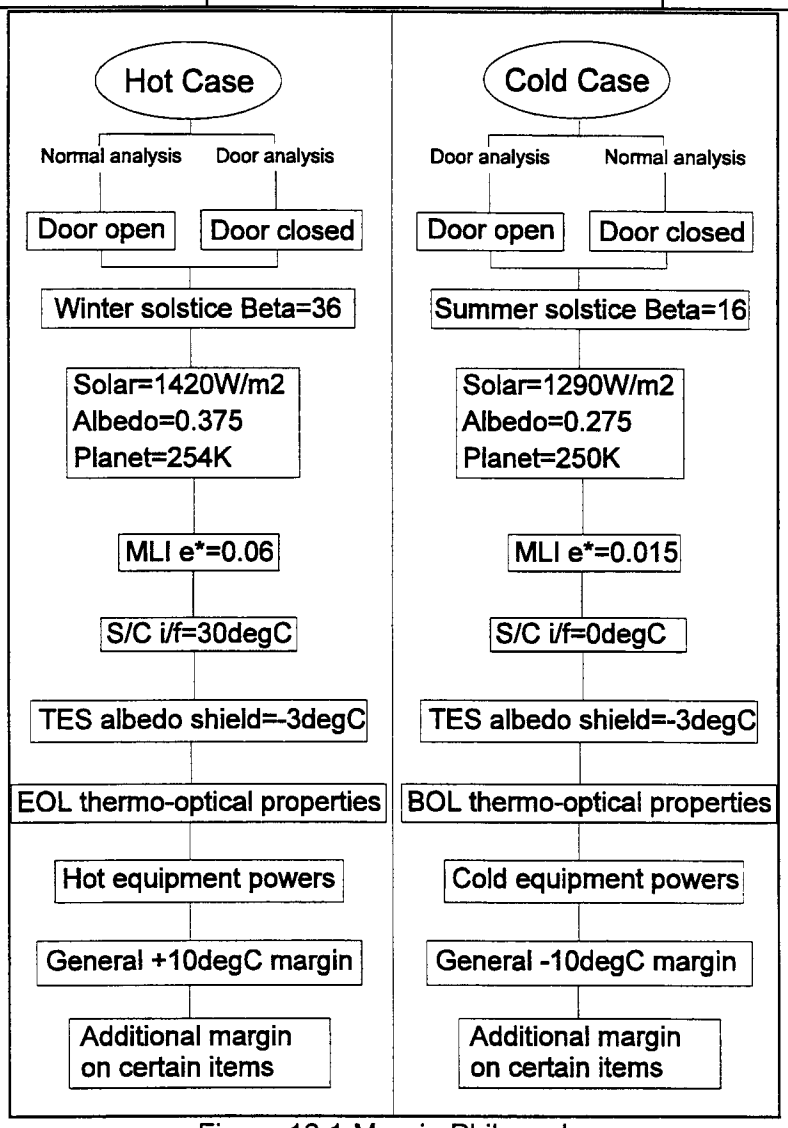
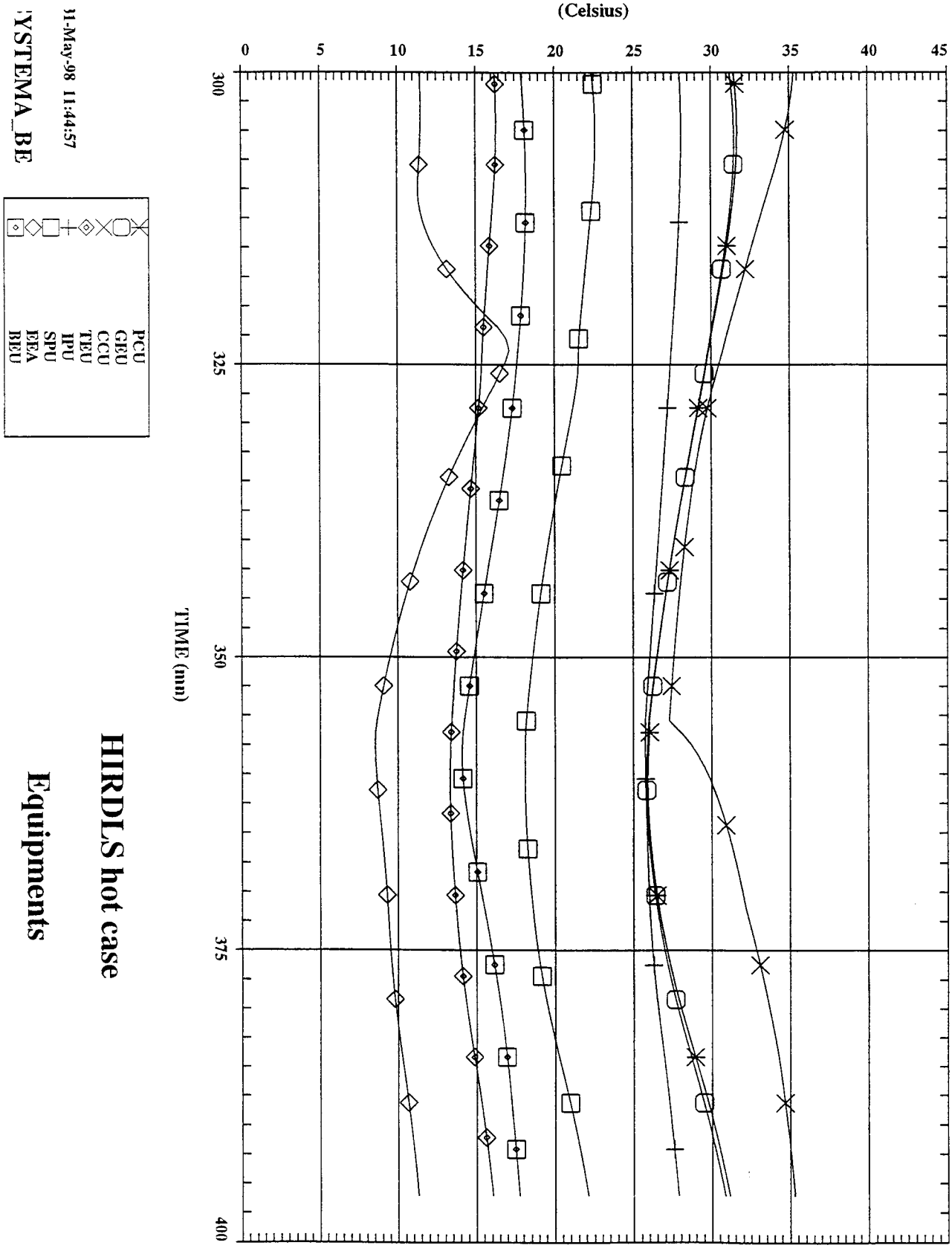
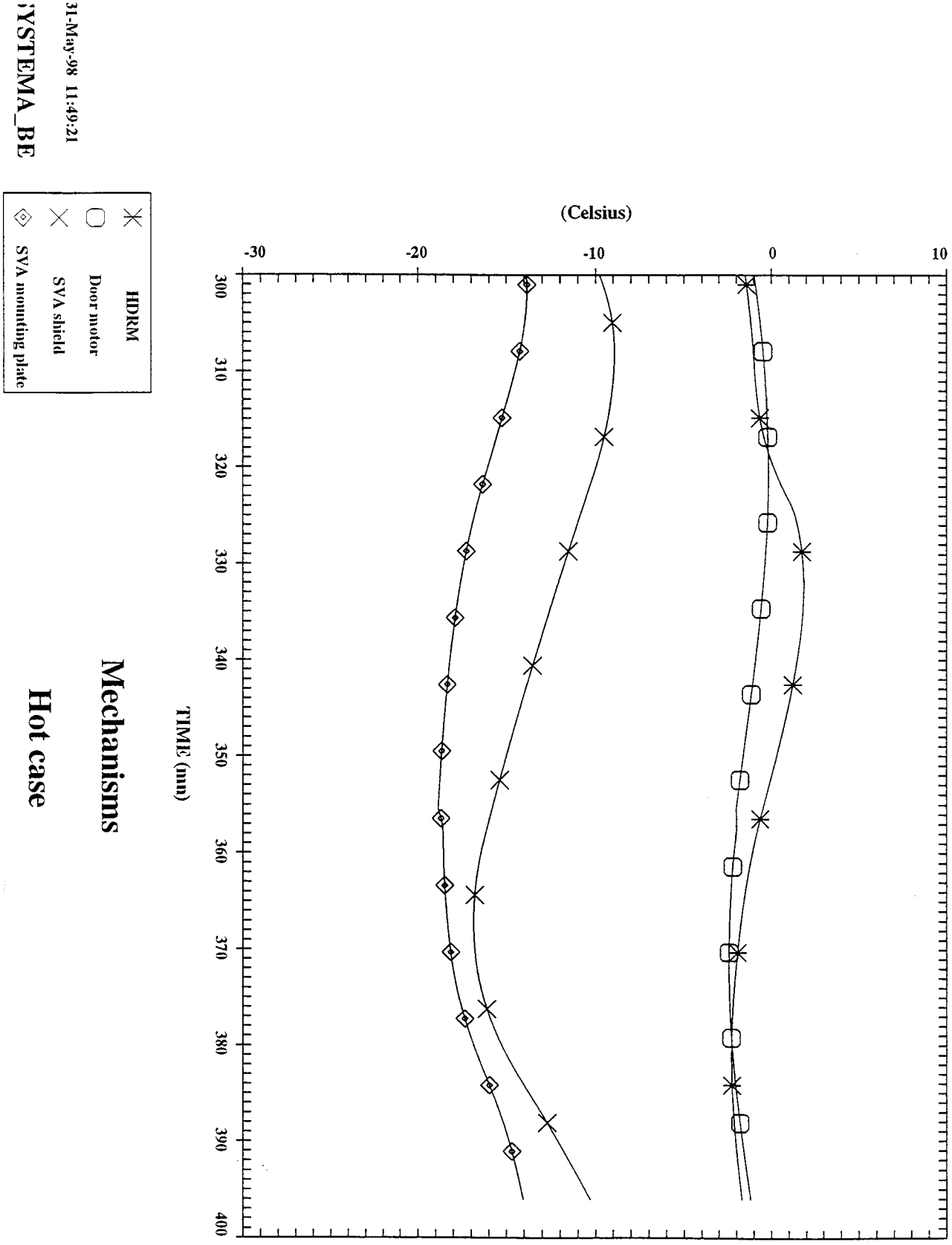


Figure 12.1 Margin Philosophy



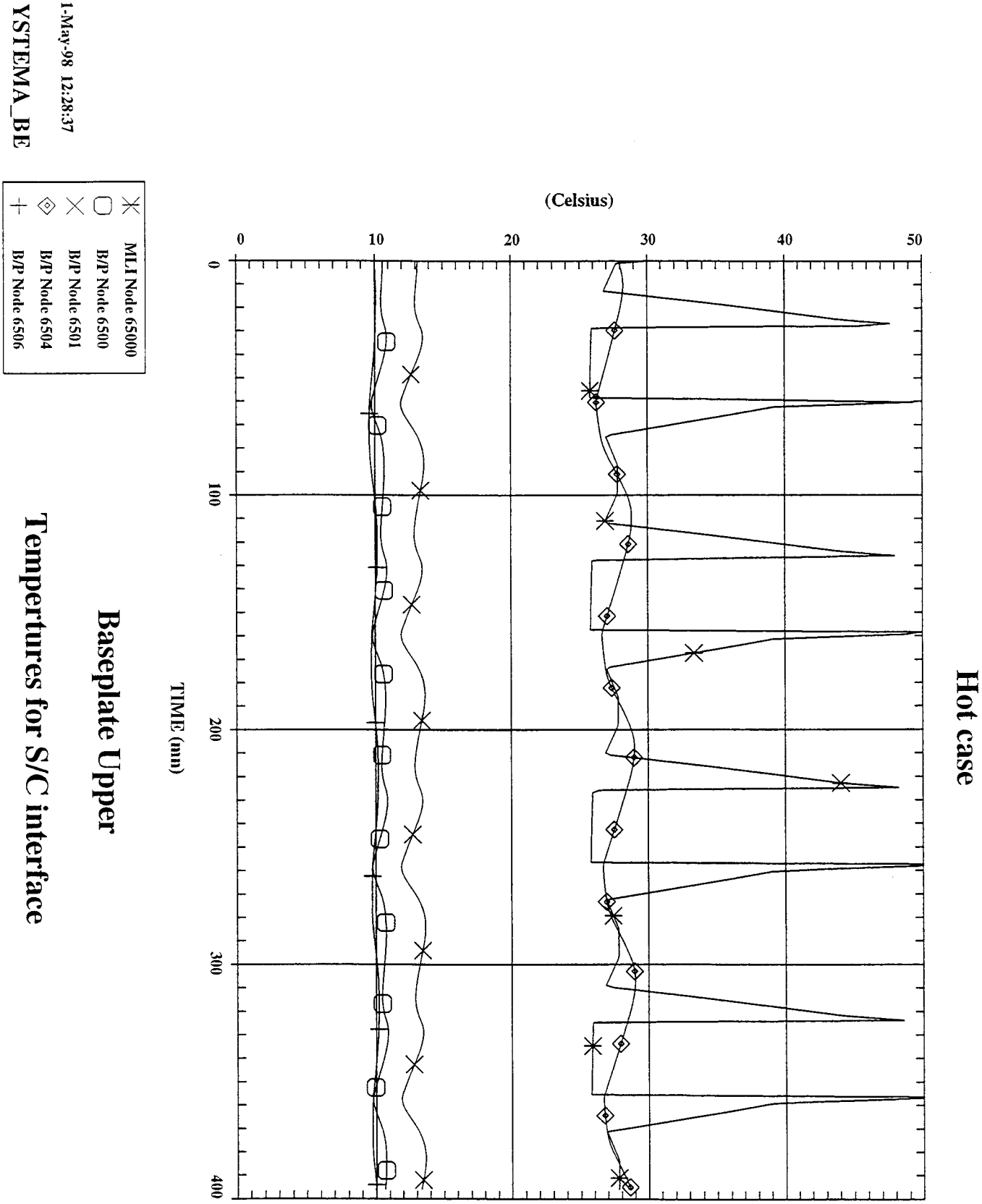
HIRDLS hot case

Equipments



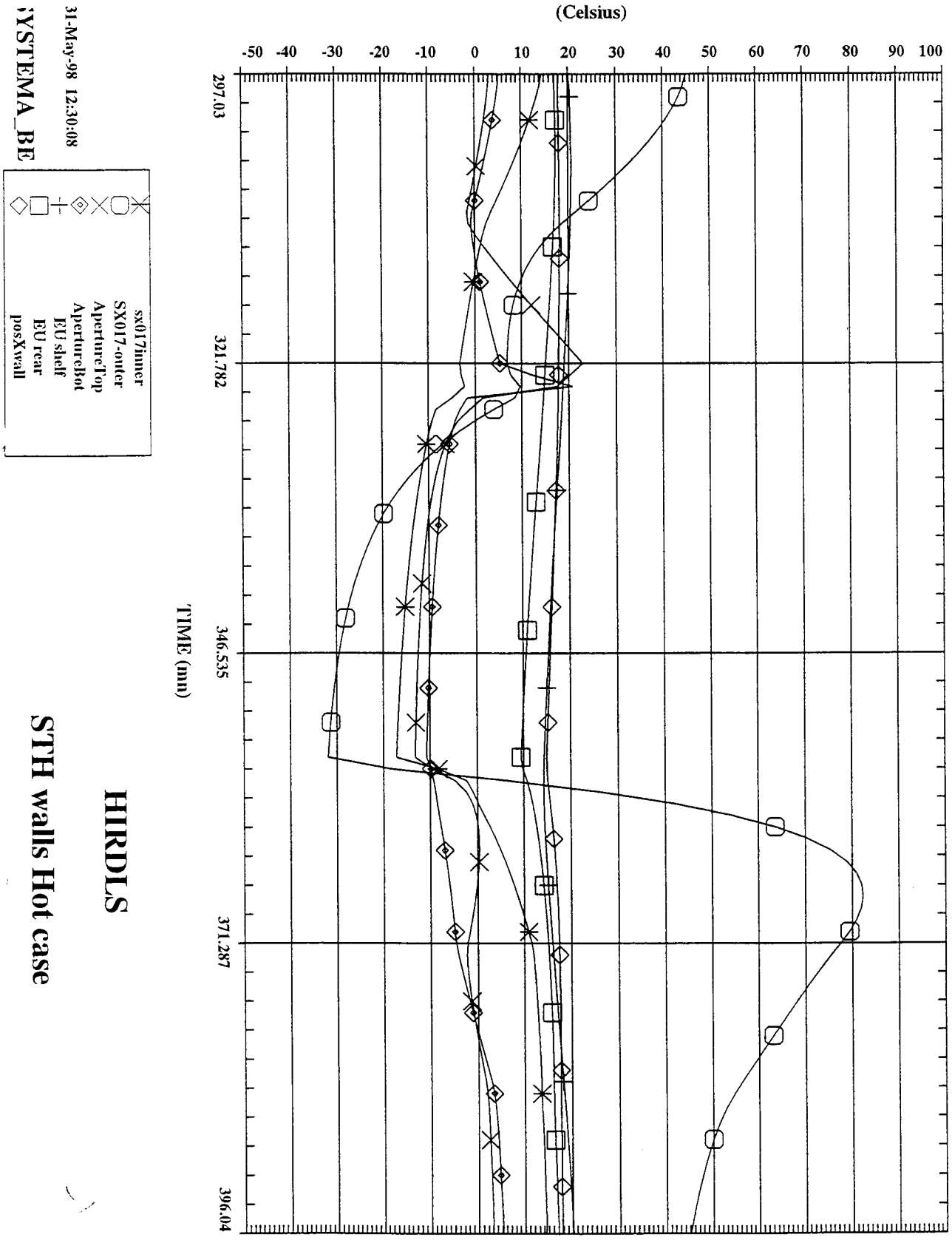
Mechanisms

Hot case



Baseplate Upper

Temperatures for S/C interface

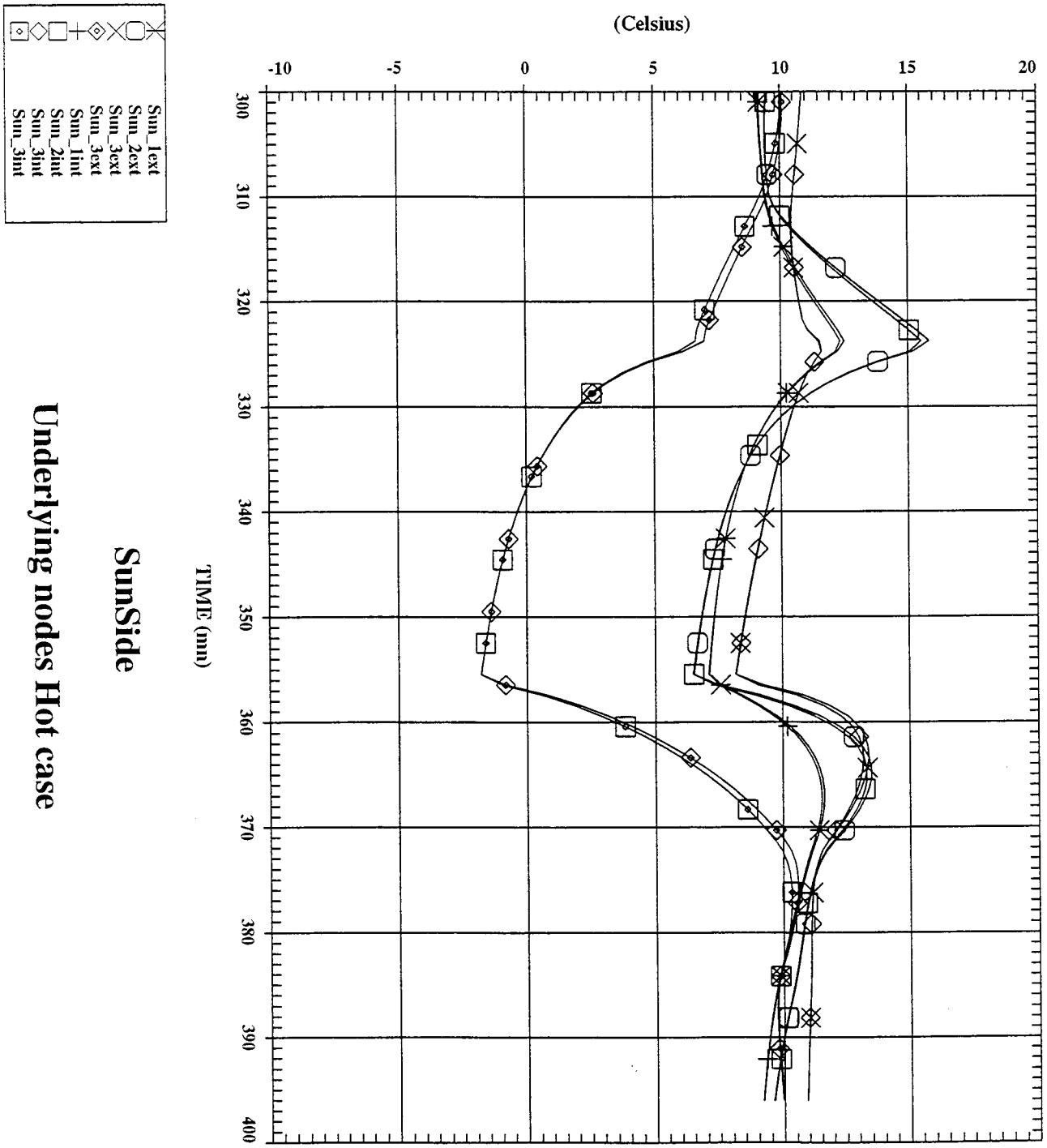


HIRDLS

STH walls Hot case

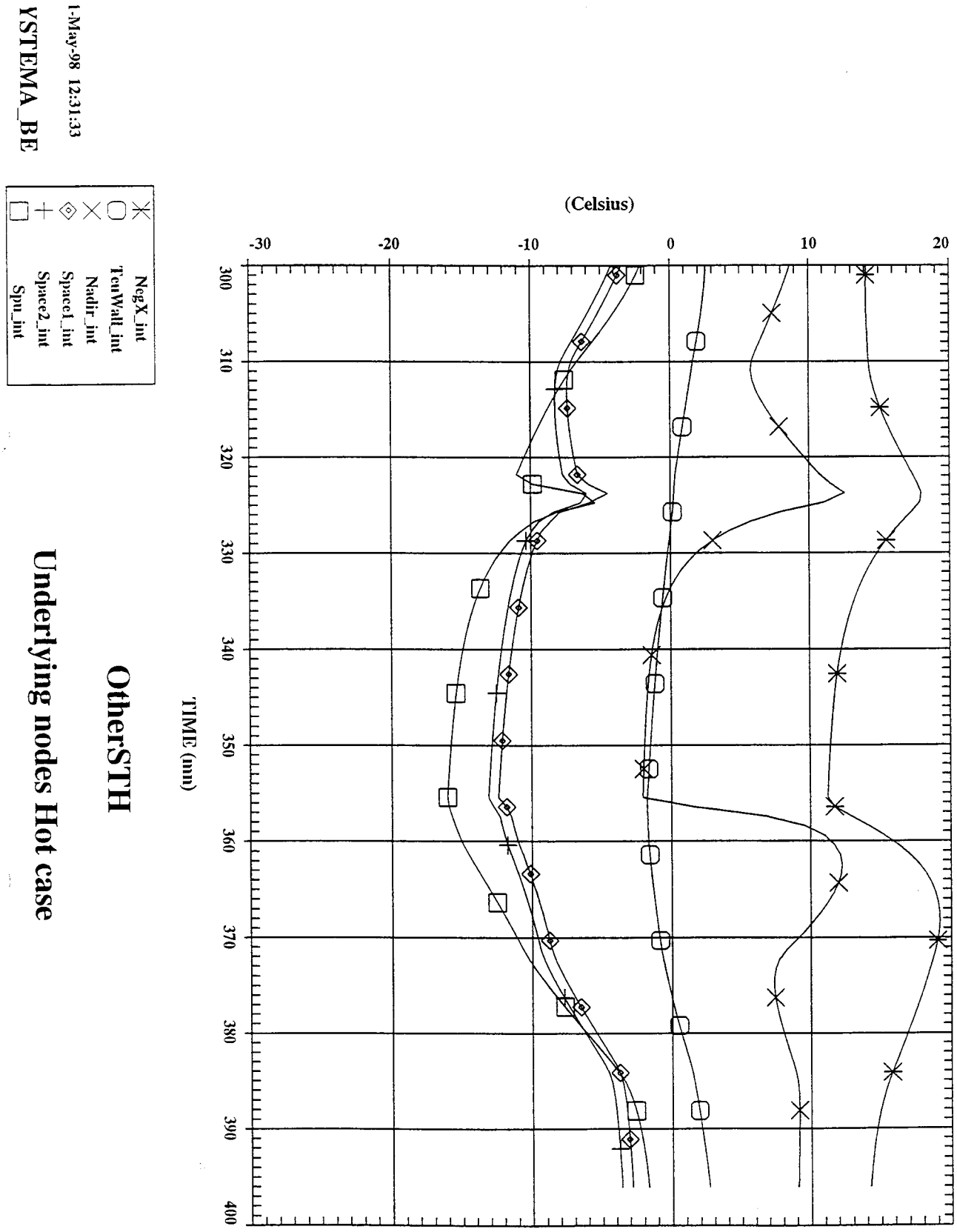
YSTEMA_BE

1-May-98 12:30:58



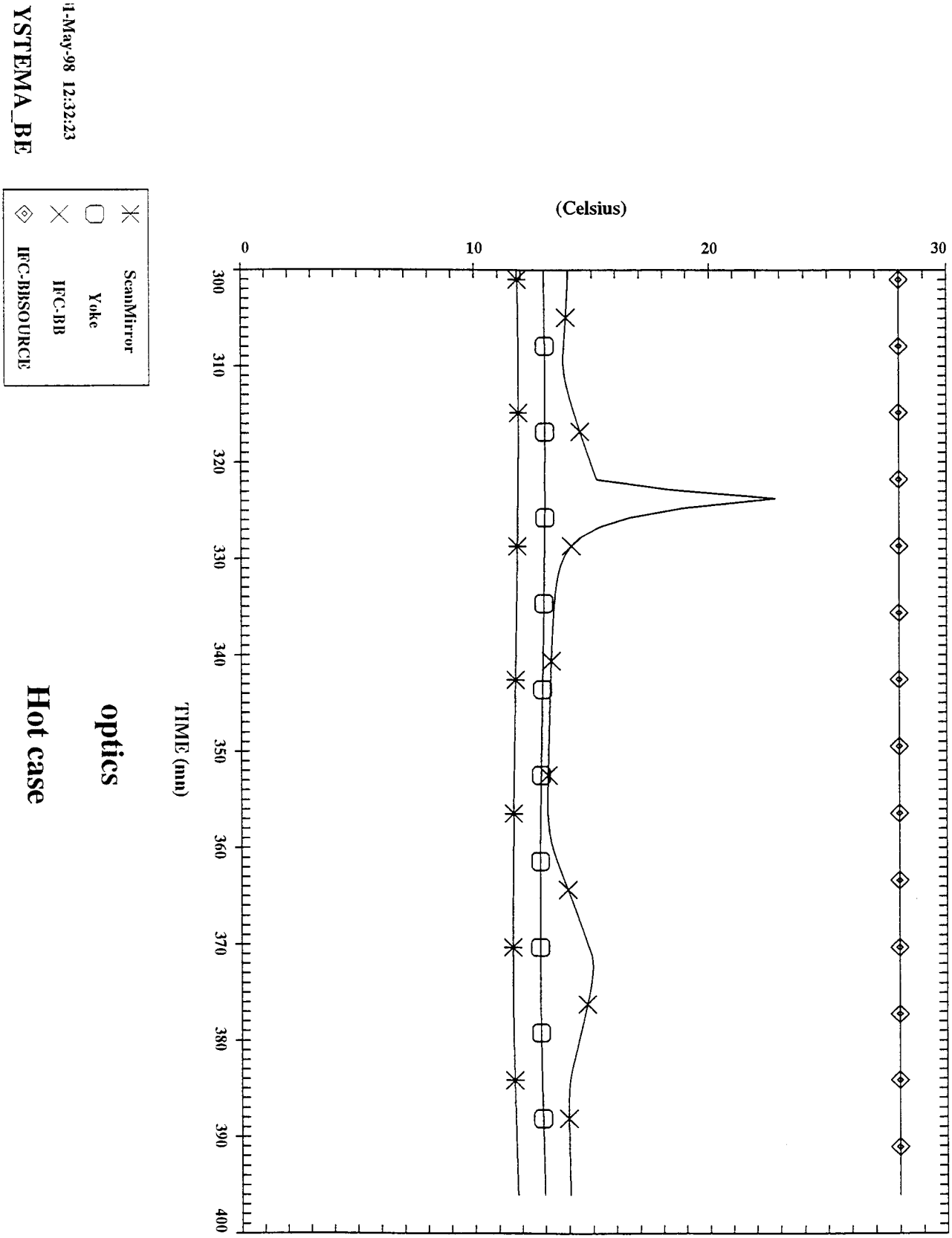
SunSide

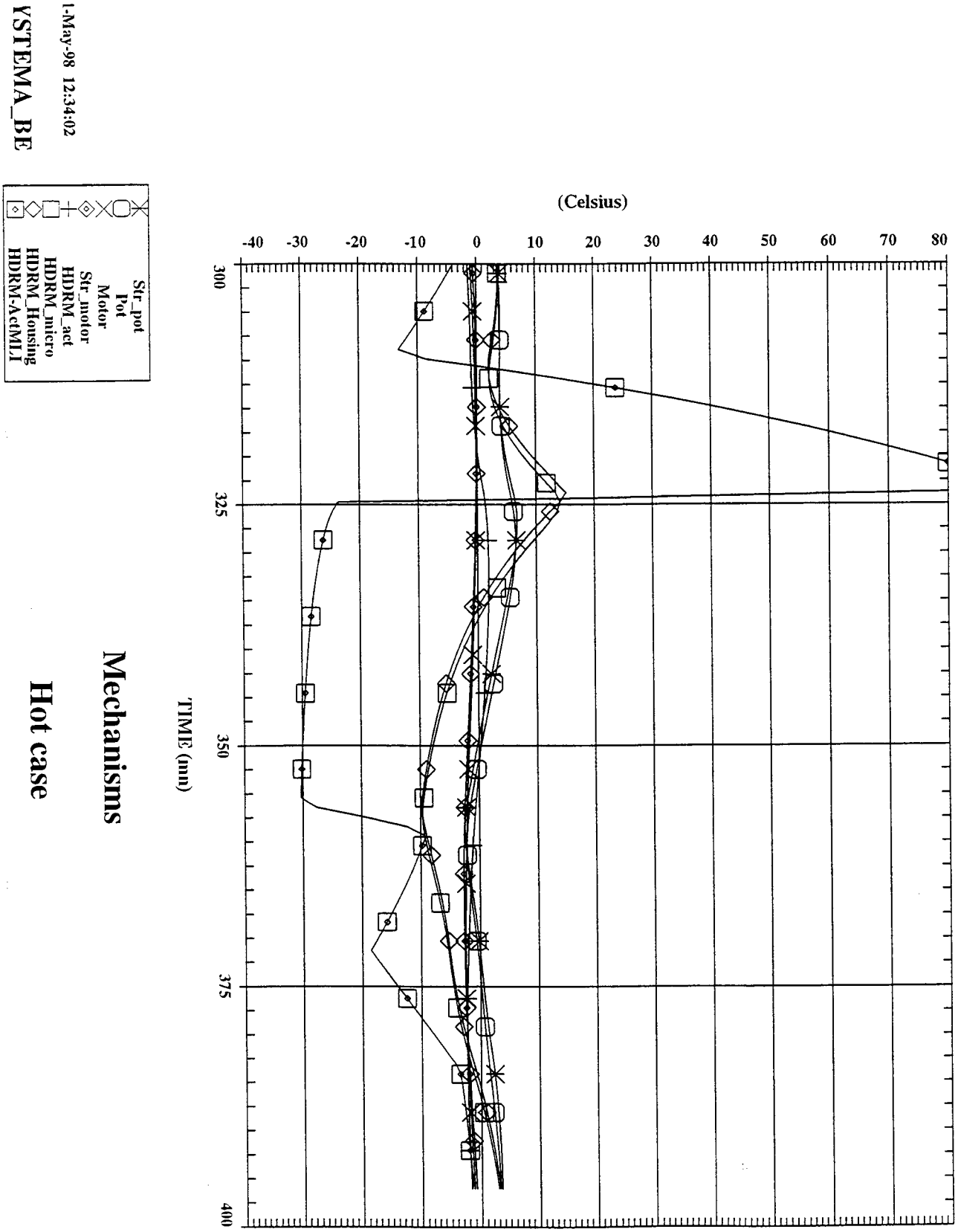
Underlying nodes Hot case



OtherSTH

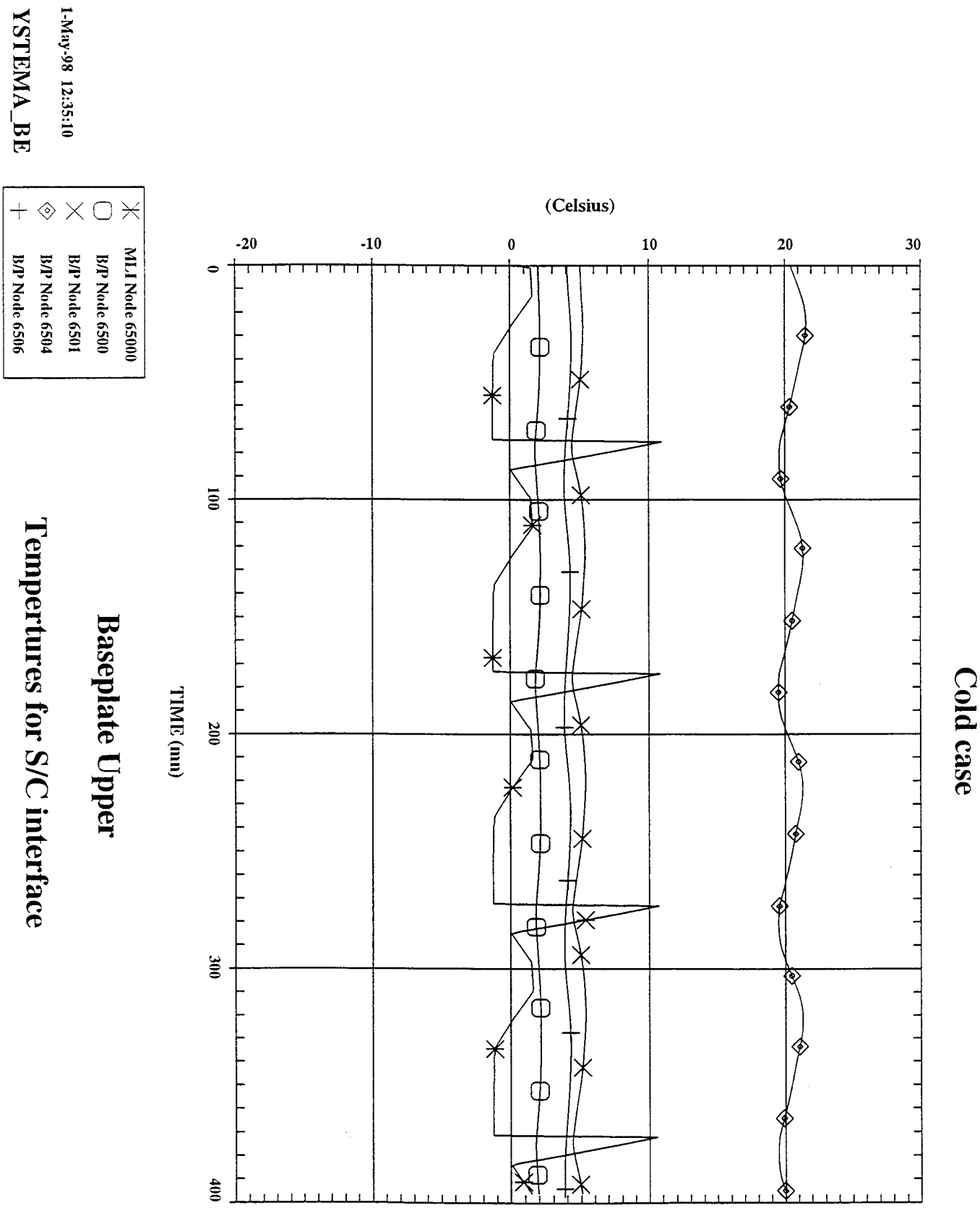
Underlying nodes Hot case


(Celsius)
0
10
20
30
300
310
320
330
340
350
360
370
380
390
400
TIME (mn)
ScanMirror
Yoke
IFC-BB
IFC-BBSOURCE
optics
Hot case
11-May-98 12:32:23
YSTEMA_BE



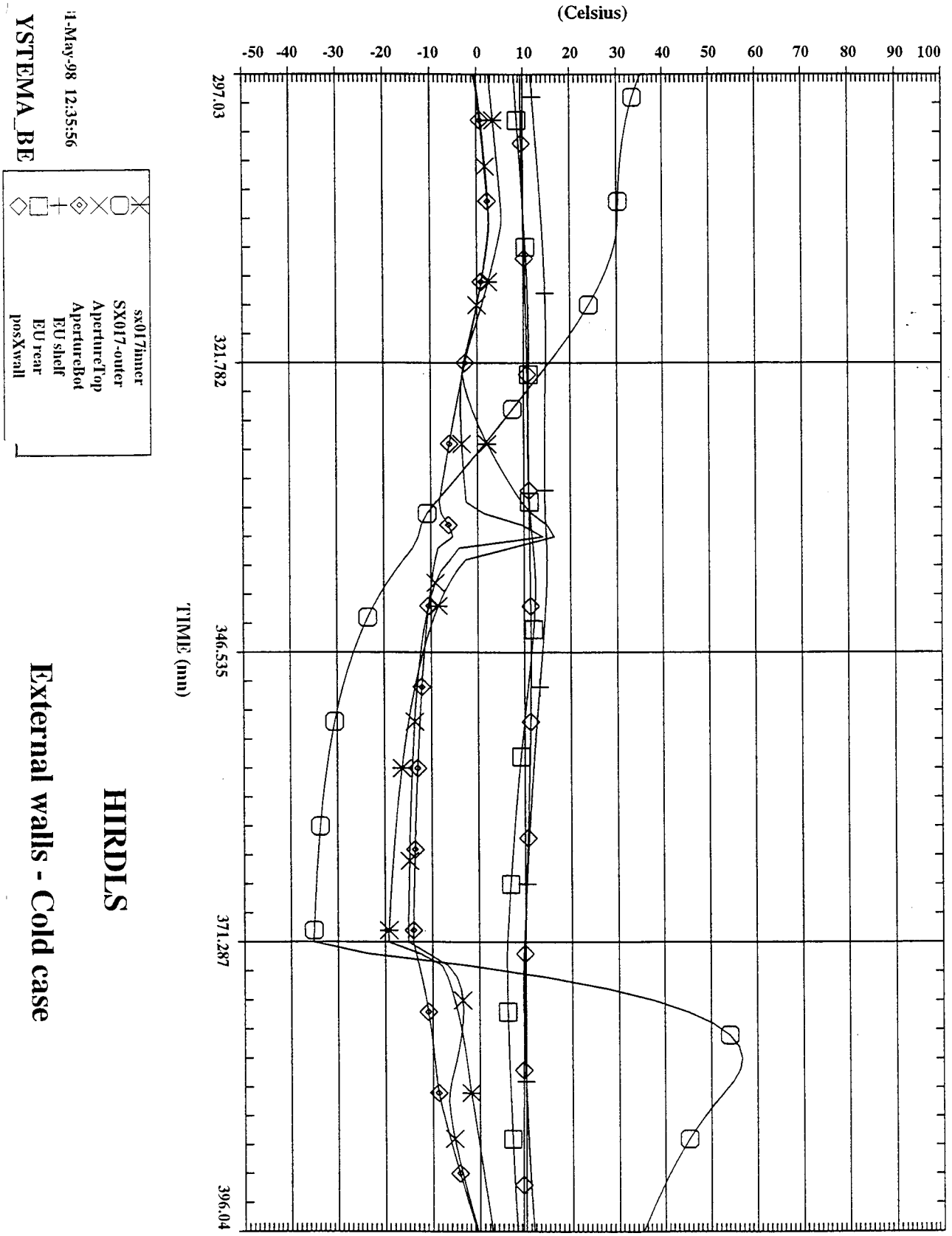
Mechanisms

Hot case



Baseplate Upper

Tempertures for S/C interface



HIRDLS

External walls - Cold case

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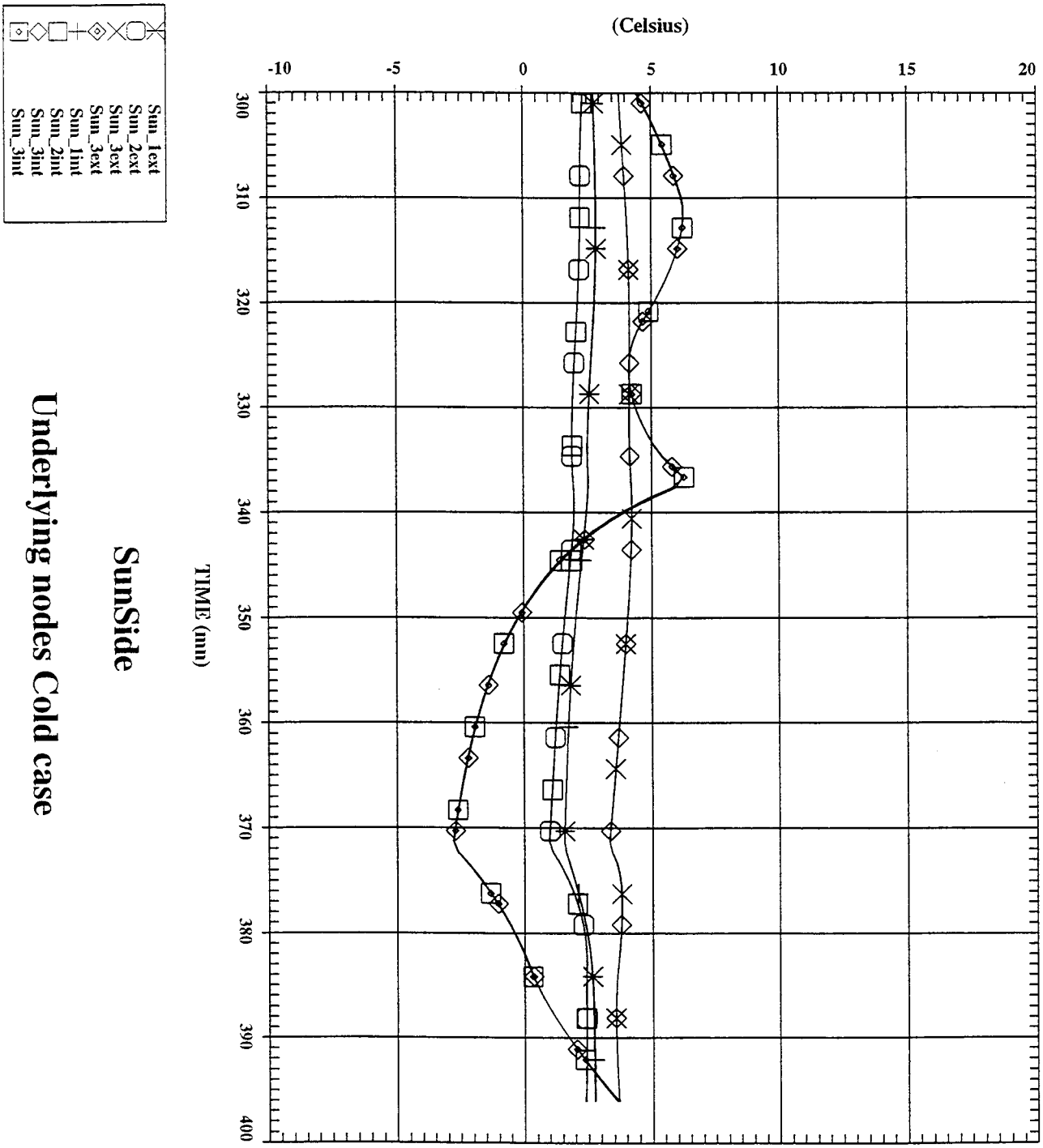
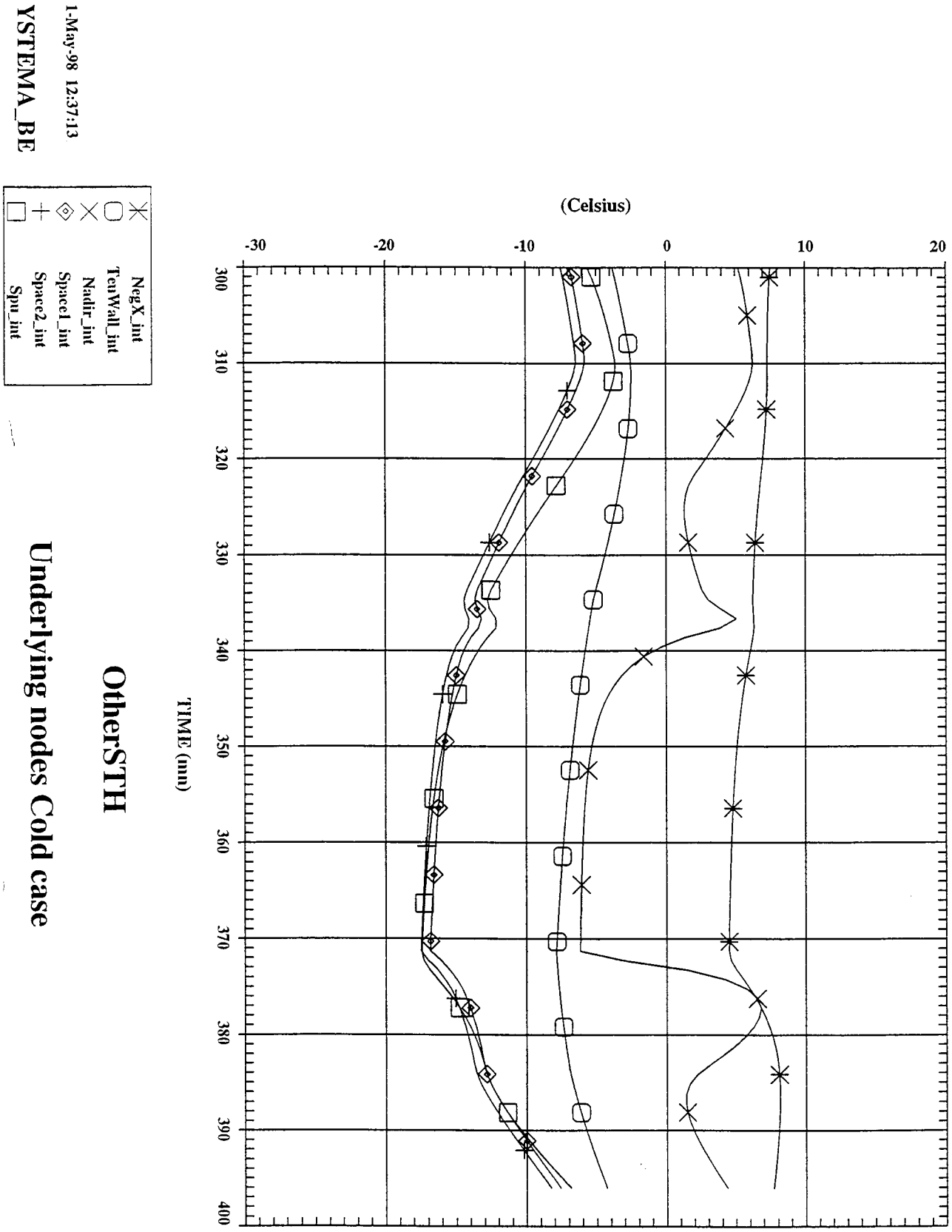
1-May-98 12:36:44



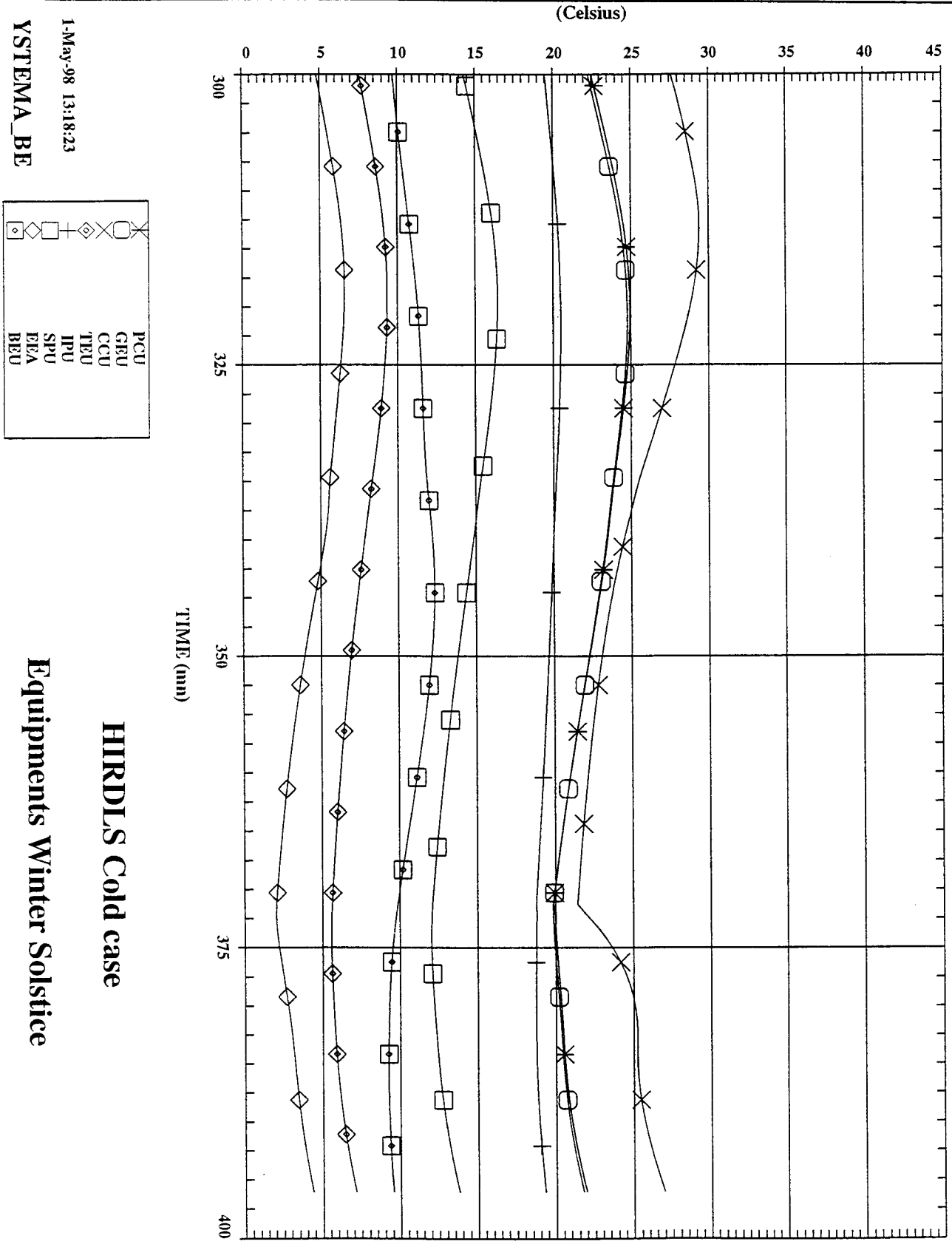
SunSide

Underlying nodes Cold case



OtherSTH

Underlying nodes Cold case



HIRDLS Cold case

Equipments Winter Solstice

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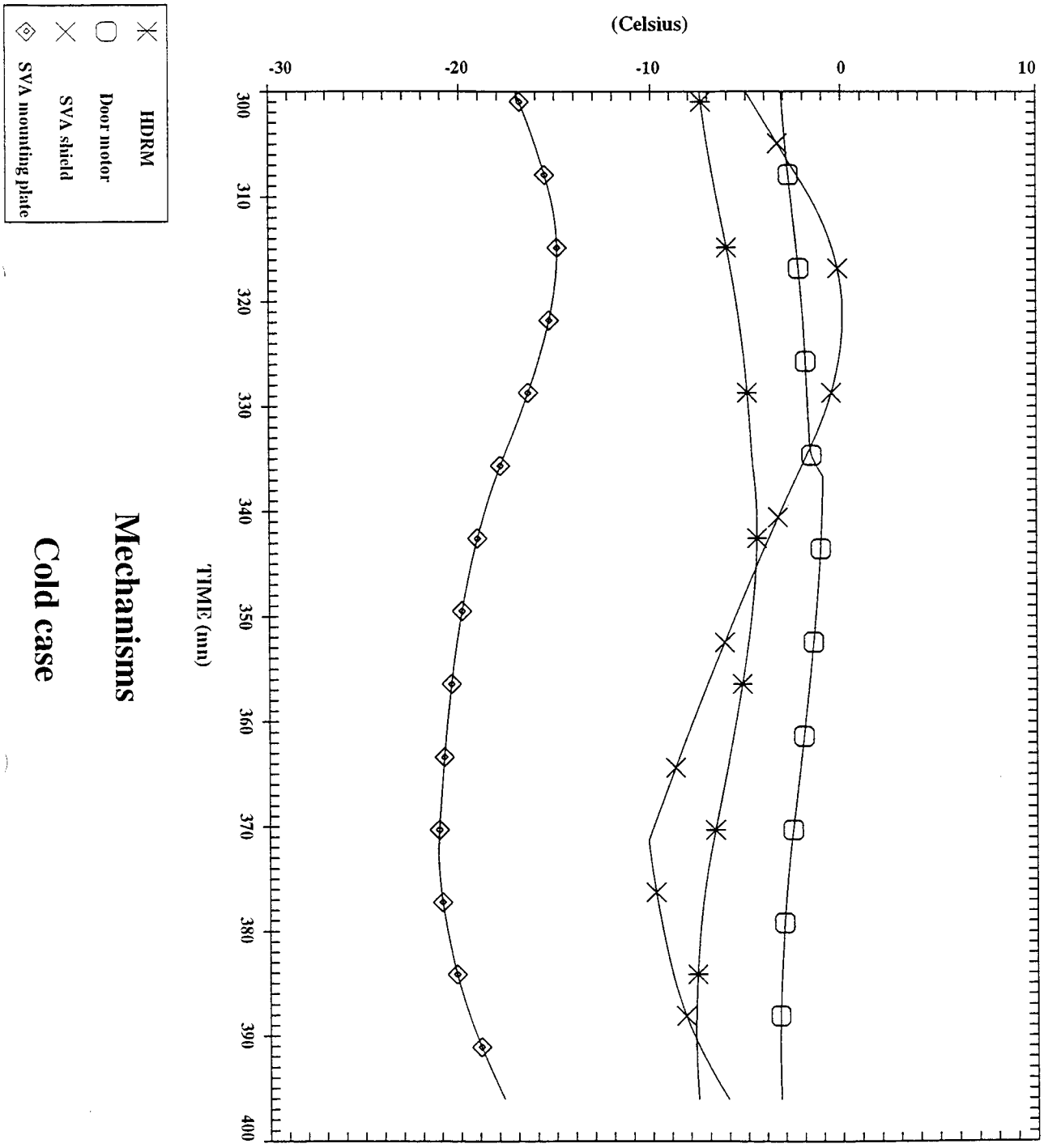
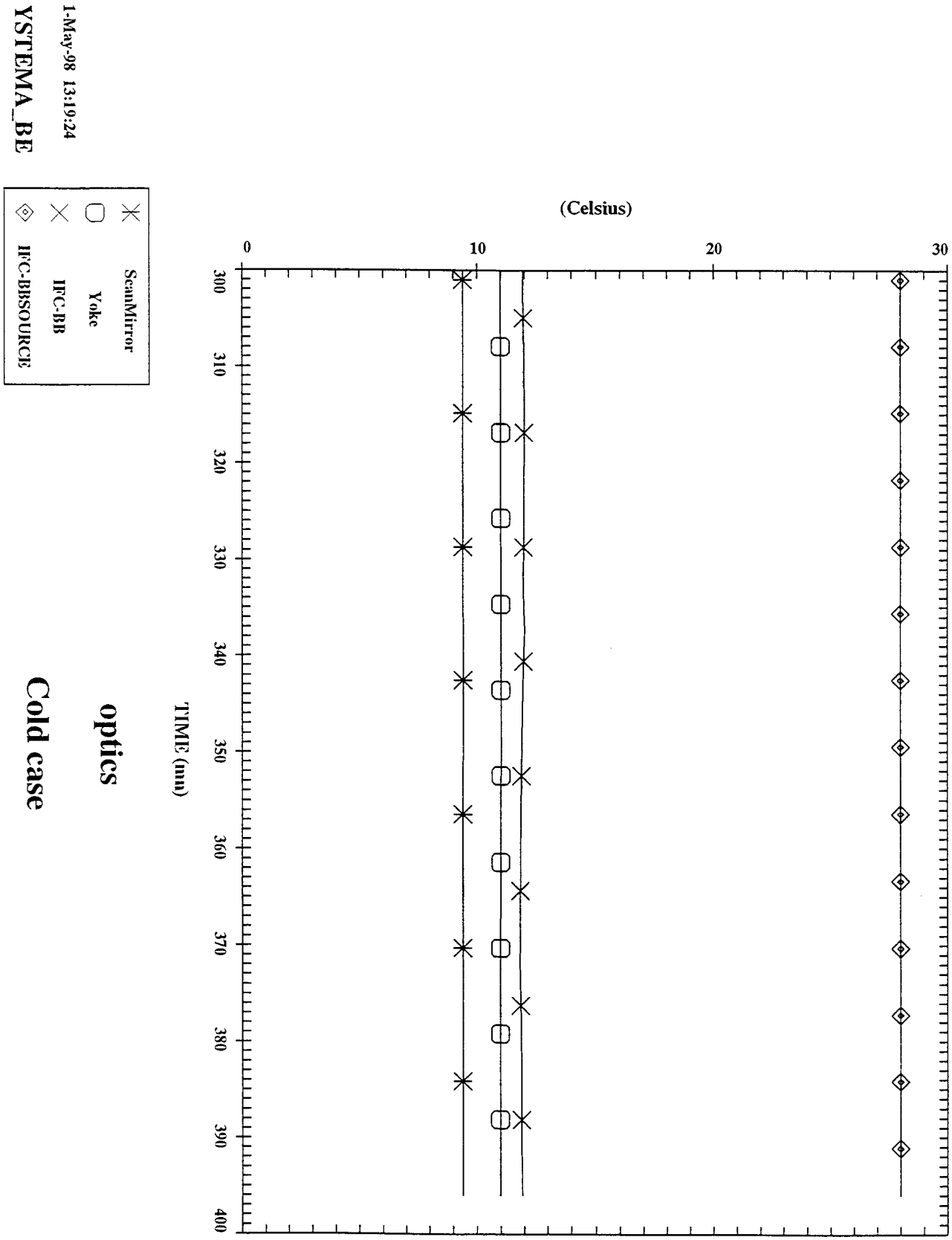
1-May-98 13:18:48



Mechanisms

Cold case



optics

Cold case

YSTEMA_BE

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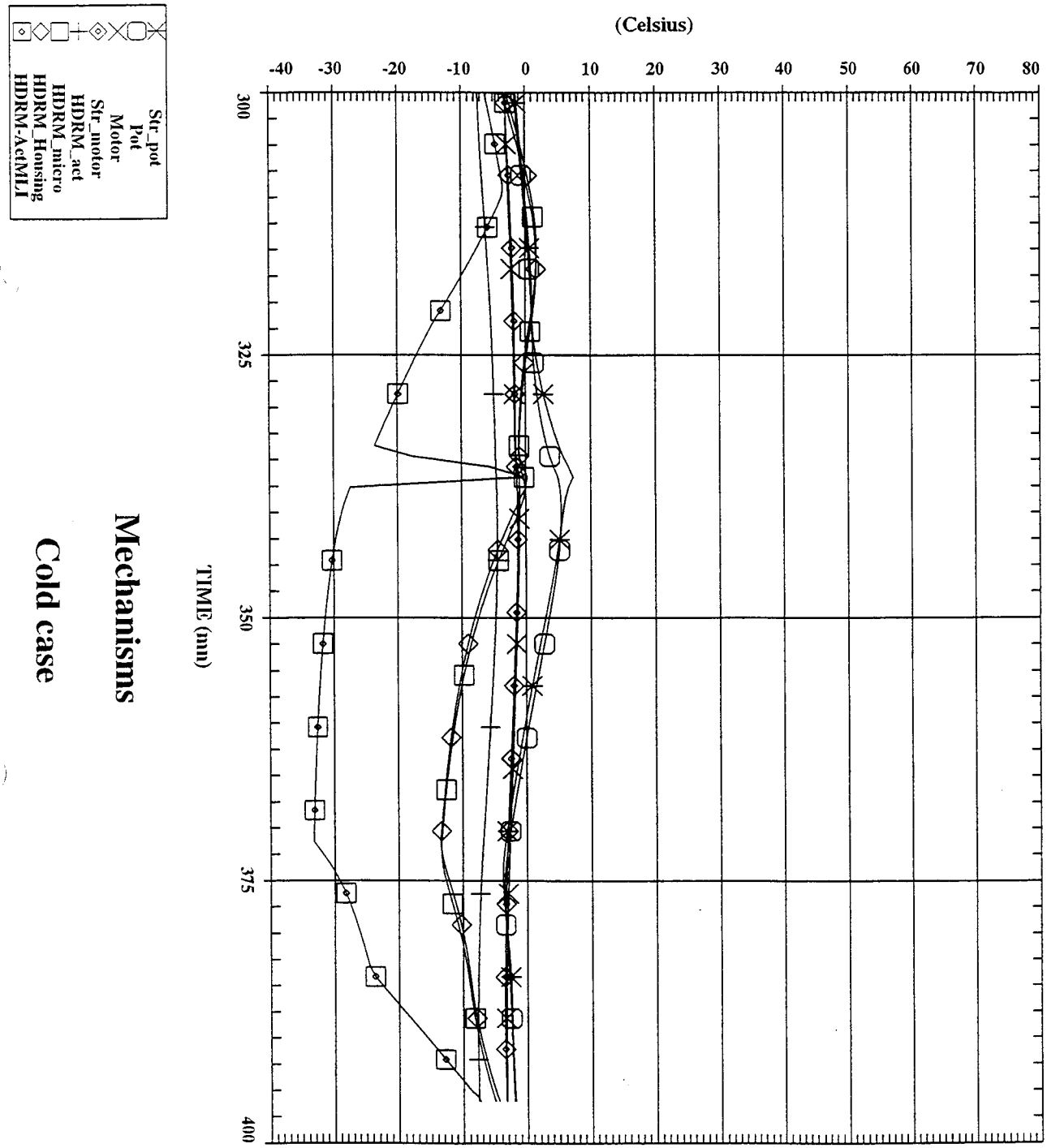

Mechanisms

Cold case

13. Compliance Summary

The following is a table of the steady state temperatures.

Unit/Item	Min Required	Max Required	Min Prediction	Max Prediction
CCU	0	30	25	30
IPU	0	35	20	27
SPU	10	35	15	20
TEU	0	30	7	15
EEA	0	30	5	12
WSEA	0	30	N/A see Note1	N/A see Note1
PCU	0	30	22	28
GEU	0	40	22	28
BEU	10	30	12	16
STH	-50	80	-15	20
SVA	-50	80	-15	-10
Mechanisms	-30	30	-15	15
Door	-50	60	-10	25
Baseplate	0	30	0	13

Note1:The WSEA has been moved into the OBA and its thermal analysis is performed by Lockheed

14. Discussion

The current status of the thermal model is sufficient for the orbital normal operational flight predicitons. For future improvements the following implementations are recommended :

- The Cooler radiator is added to the surface model - this is currently modelled as a shape only to prevent false radiative coupling from the internal STH to space. A more accurate model should be included when the decision is made as to the existance of any blanket material between the cooler radiator and the underlying STH.
- The SVA model is given more detail. Current model is crude and reflects the recent definition of the albedo shield and mounting plate. The mechanism should be added for a more detailed thermal analysis for the SVA components.
- The mezzanine shelf is updated with a decision on method to cool the SPU in light of recent reports of an increase in power output of this unit. There is the possibility of the mezzanine shelf having a hole to access direct radiation from the SPU to the external environment, or a hole in the underlying MLI to access the underside of the shelf itself. There is also the possibility of a conductive thermal link in this area.
- Any updates to the OBA hood geometry be included. Also a full model of the optics should be included to give a more accurate analysis as used in the Calibration Chamber analysis to be compliant with the requirement in the SPRAT.
- The GMU can be modelled for Oxford University if required.