

TRACKER RESULTS

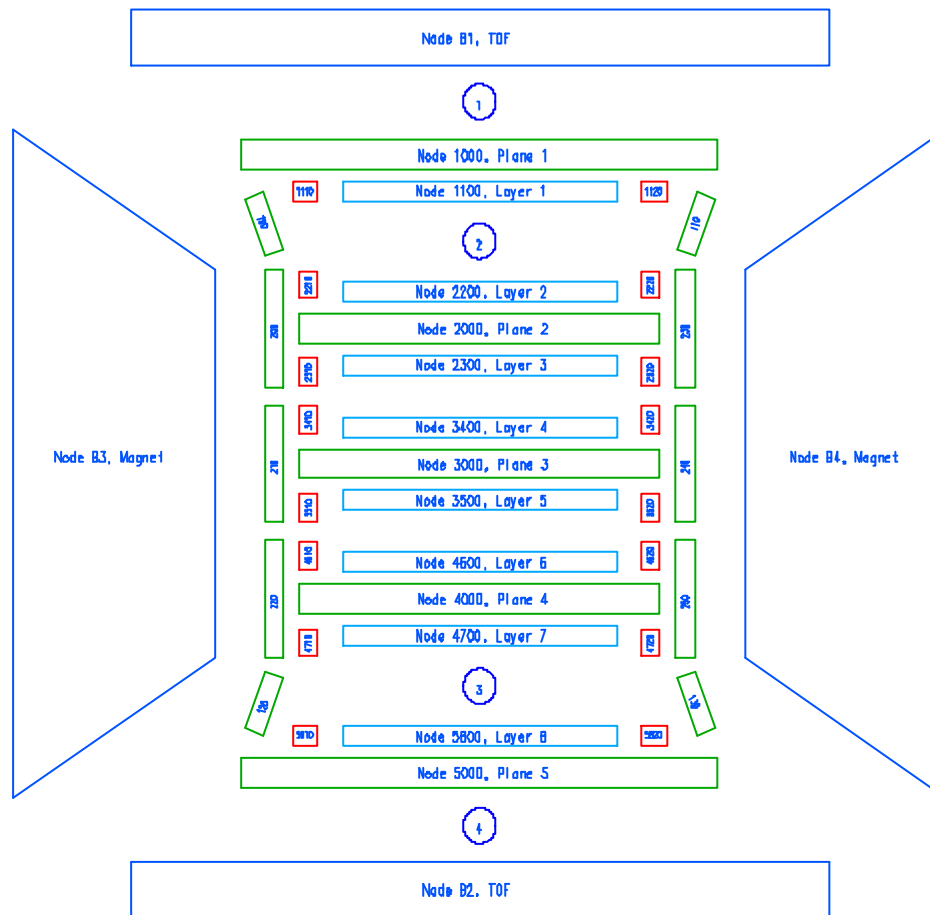
M. Molina and C. Vettore

NLR, Emmeloord, 19th March 2002

TRACKER reduced model

- Tracker modelling review
 - Procedure to exchange and compare data
 - Updating of tracker model inside AMS-02 overall model
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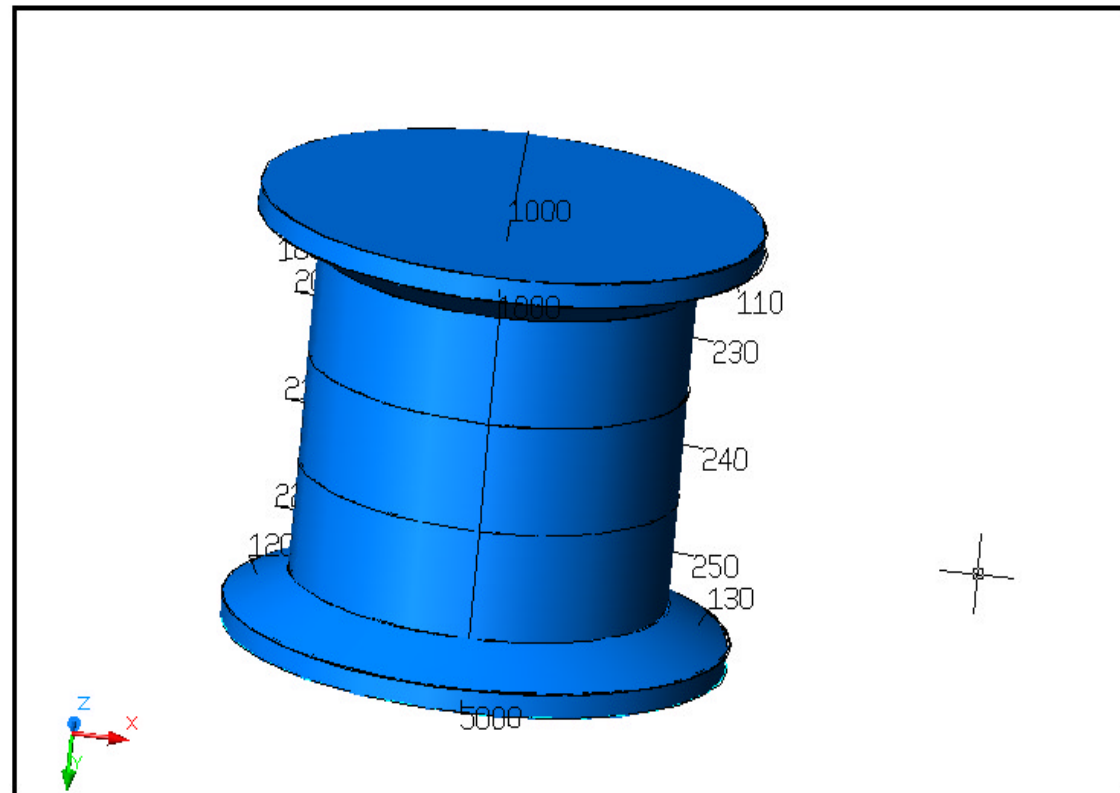
TRACKER reduced model



- Inner radiative links calculated by NLR
- Outer radiative links calculated by CGS
- Conductive links calculated by NLR

Tracker geometric model (only the skin)

External
emissivity = 0.1*

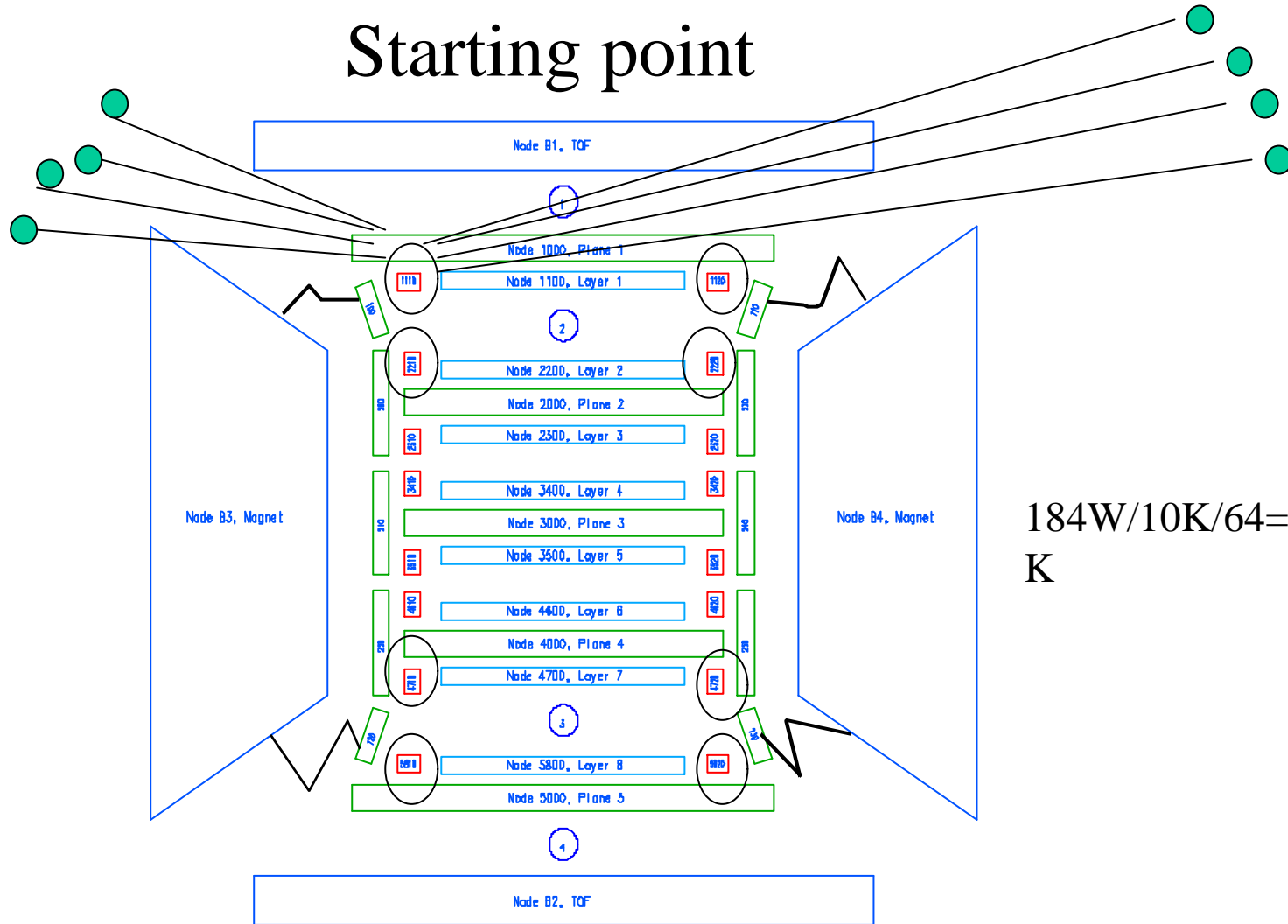


* From Bart excel sheet

AMS 02 –Thermal Control System Design



Starting point



Procedure 1/3

- CGS generates I/F data on the basis of the following assumptions
 - Radiator mass 13.5 kg each side (changed to 18.5 in NLR reduced model)
 - Radiator area is set to 1.63 m² each side
 - Inner radiative links are not under CGS responsibility and they are still unchanged
 - 4 Tracker shell nodes are connected to the VC by means of 0.055 W/K each
 - Fluidic links connect inner and outer thermal bars nodes to the radiator nodes
 - Power applied to all the 16 thermal bars nodes nearly 192 W
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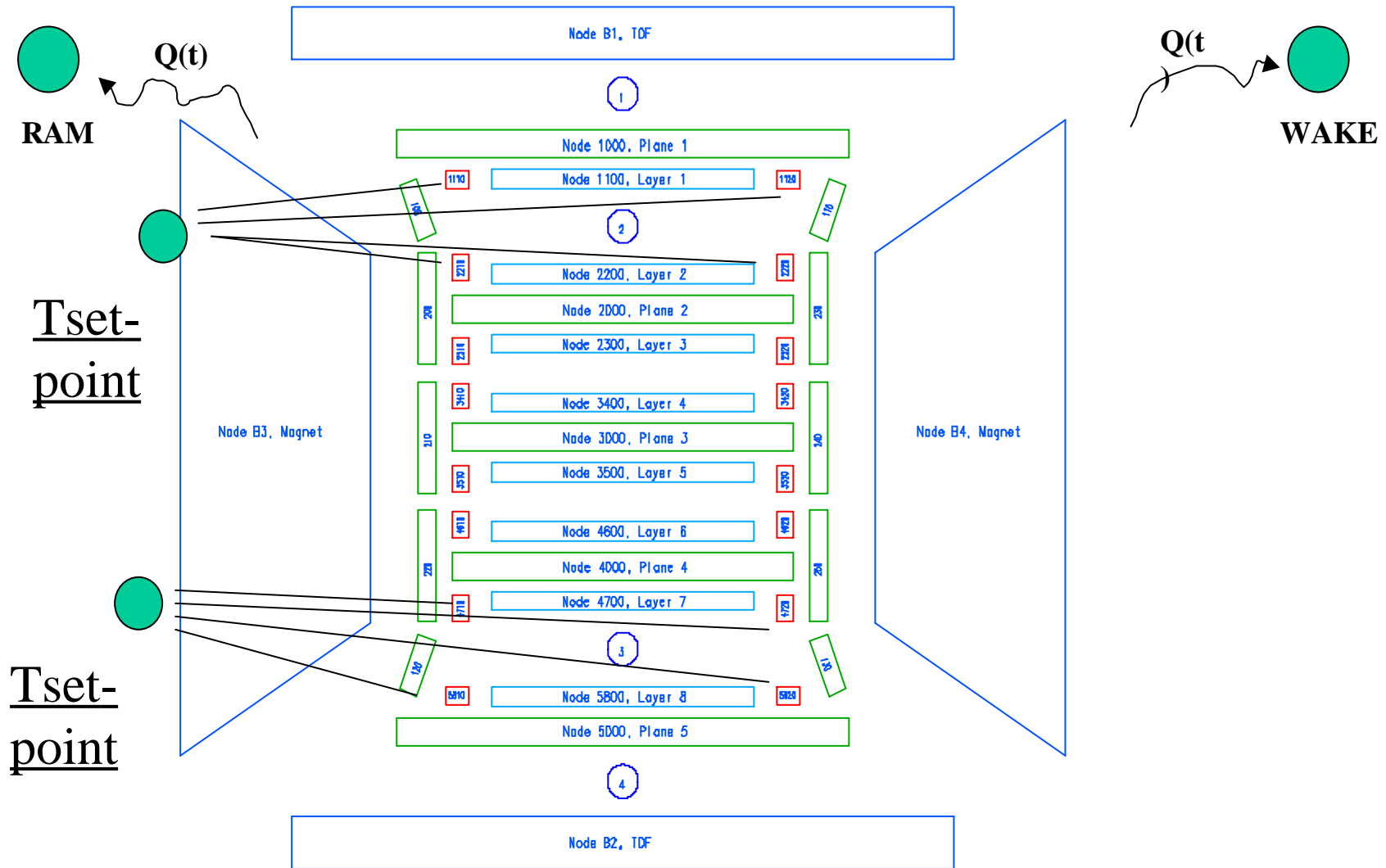
Procedure 2/3

- NLR runs its own detailed model (using CGS I/F data ..all of them have been used ?) and defines workable set point and $Q(t)$ on radiators for different beta hot cases
 - Pre-heaters included proportional to Dt
 - CO₂-liquid enters the evaporators approximately $t=t_{\text{saturation}}$ resulting in heater power if t_{liquid} below $t_{\text{saturation}}$
 - Boundary conductive sinks representative of magnet are used
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Procedure 3/3

- In order to compare radiator temperatures the following measures are taken:
 - Boundary node (only one) at workable set-point is added in the reduced model, linked to inner (#2210, #2220, #4710, #4720) and outer (#1110, #1120, #5810, #5820) thermal bars. Conductive links values are set by NLR.
 - De-coupling radiator from tracker ...in other words equivalent fluidic links removed
 - $Q(t)$ (NLR output) is applied to the radiator nodes and radiator temperature results are compared
 - Internal power (nearly 192 W) is still applied but it is mainly sucked by the boundary nodespartially it flows to the tracker feet.
 - If discrepancy exists another round has to be computed
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AMS 02 –Thermal Control System Design

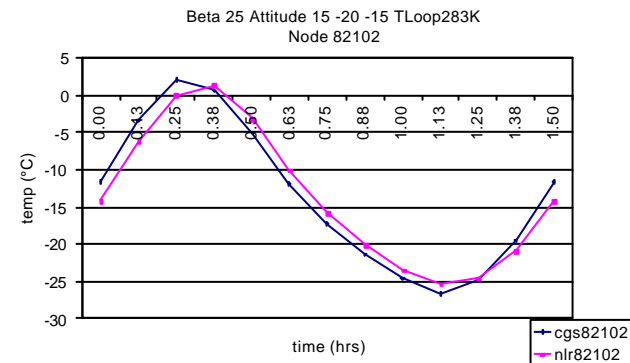
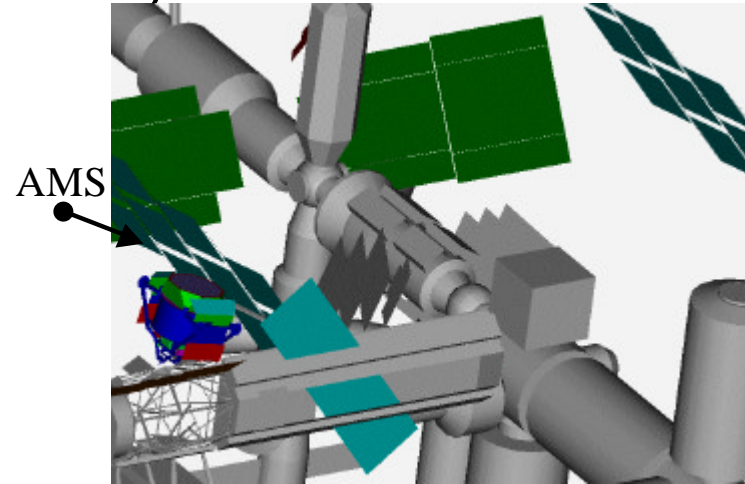


In summary:

Step #1: CGS generates I/F data for radiative heat flux over the surfaces of AMS, simulating its environment on the ISS.

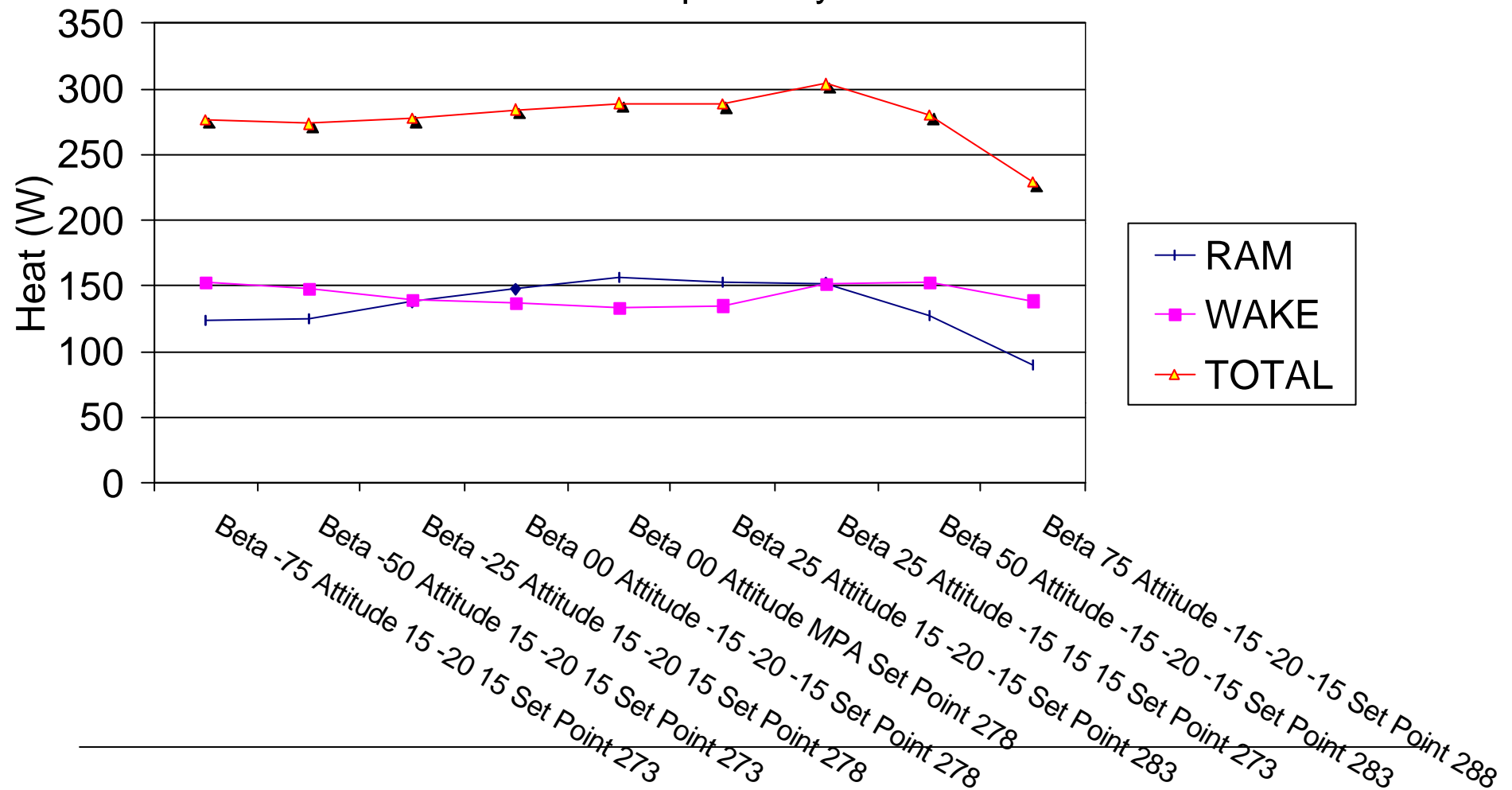
Step #2: NRL runs a detailed 2-Phase loop model to calculate heat transfer from the tracker to the radiators in operating conditions

Step #3: CGS receives NRL data simulation, in particular $Q(t)$ on the radiator and the Set Point Temperature for the loop and generates I/F data again



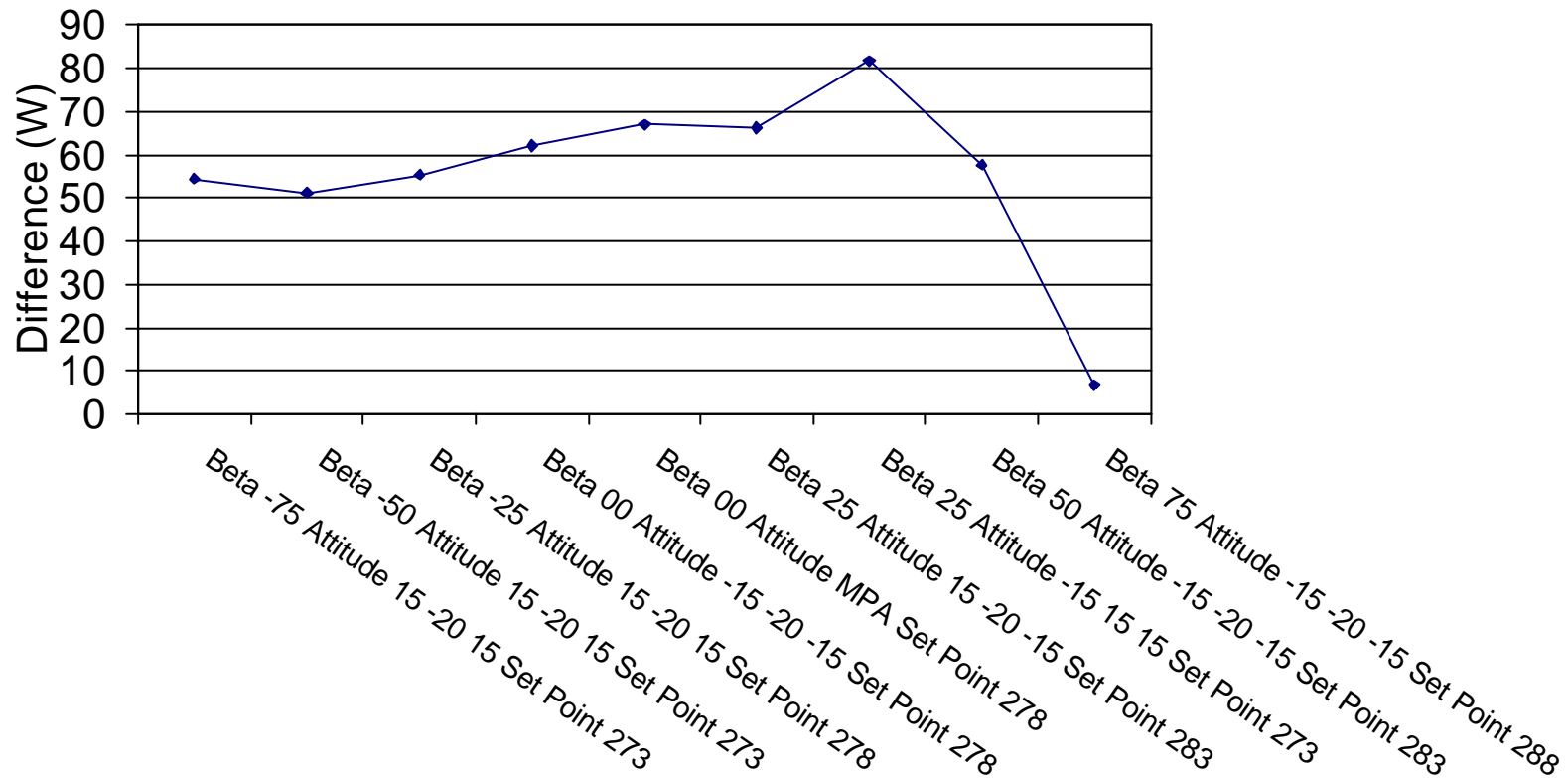
TTCS: Total Heat dissipation

Heat dissipated by radiators



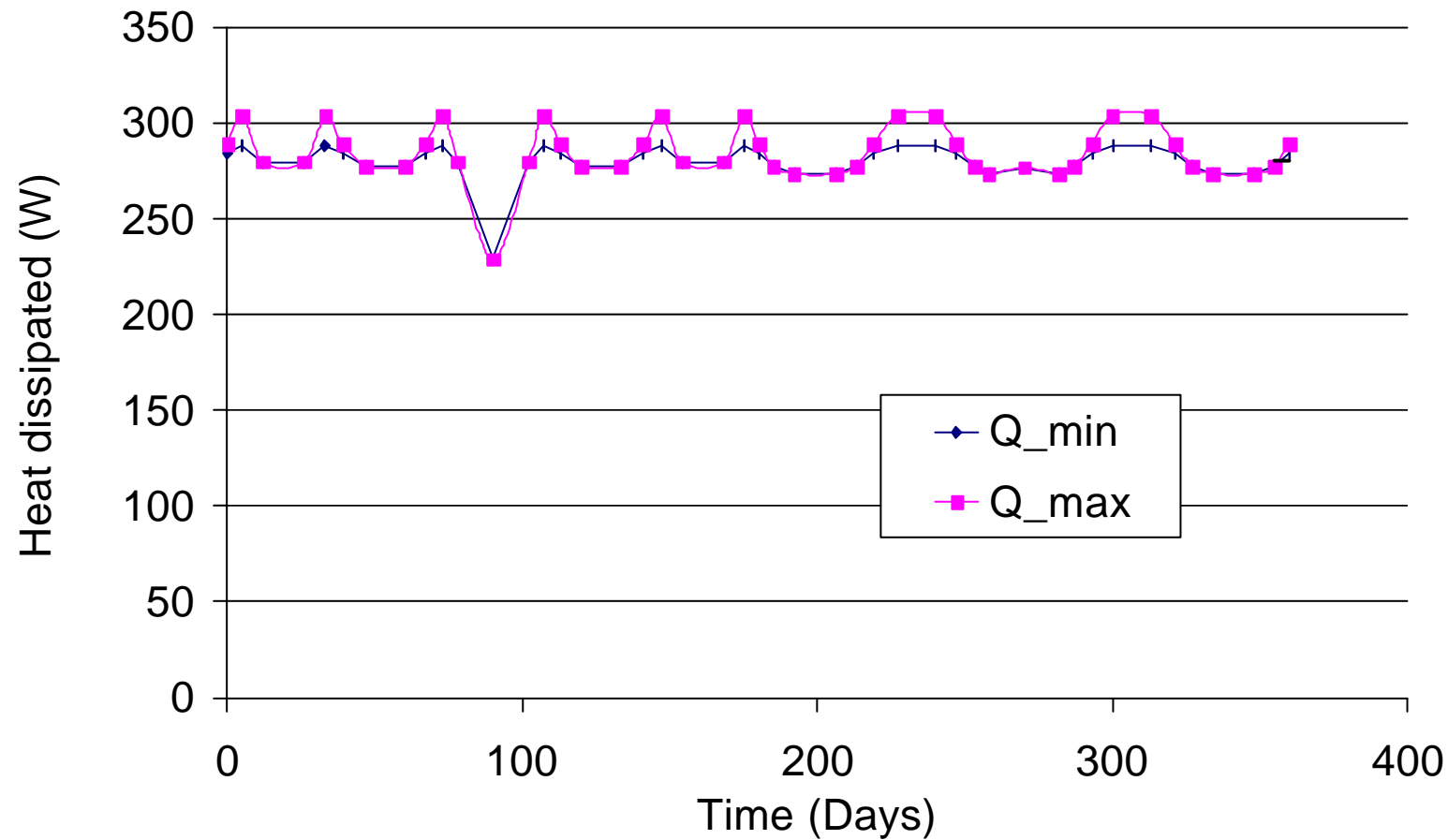
Heaters TTCS power

Q pumped by the loop - Q generated in the Tracker - Q Pump



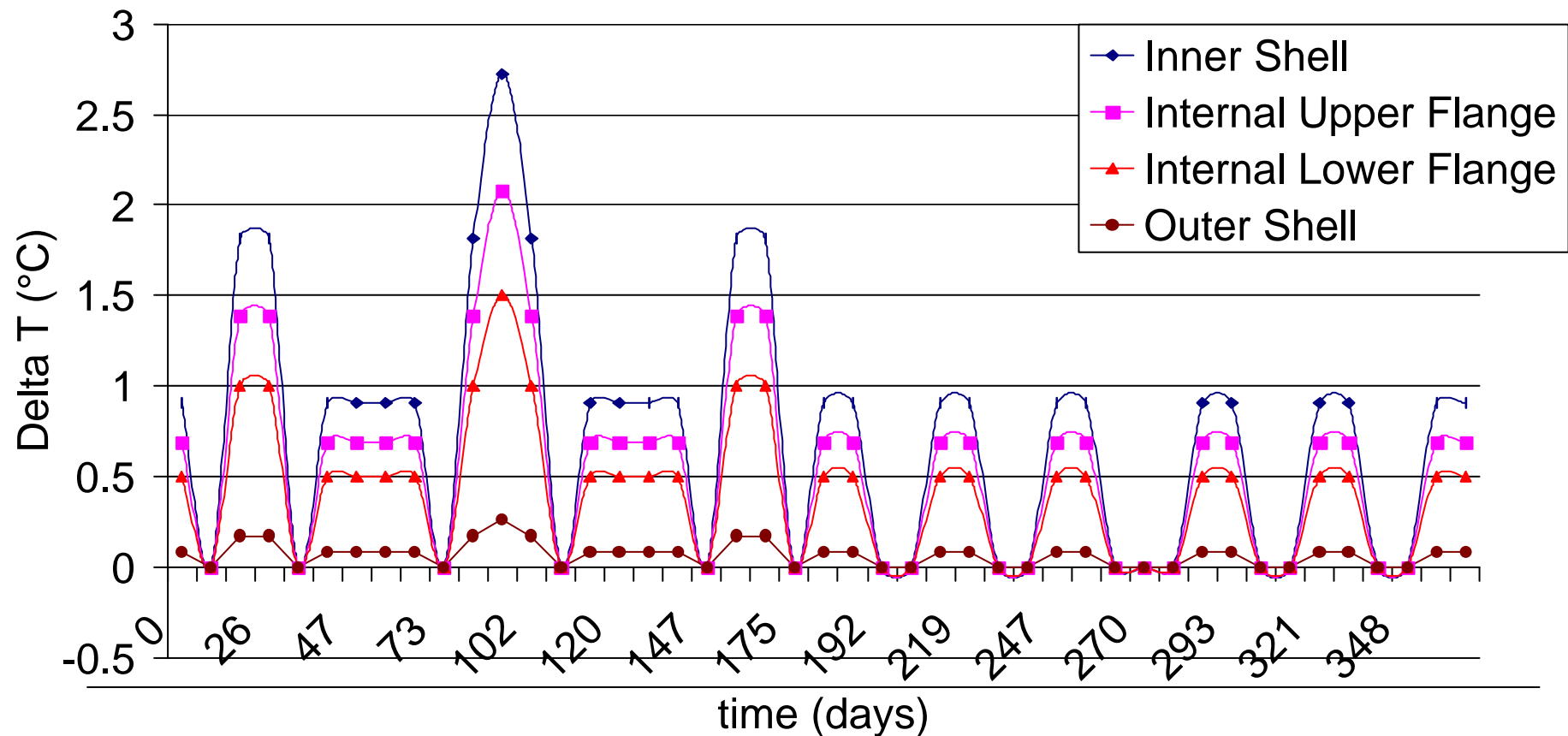
Total TTCS dissipation

Seasonal variation of heat dissipated by both radiators



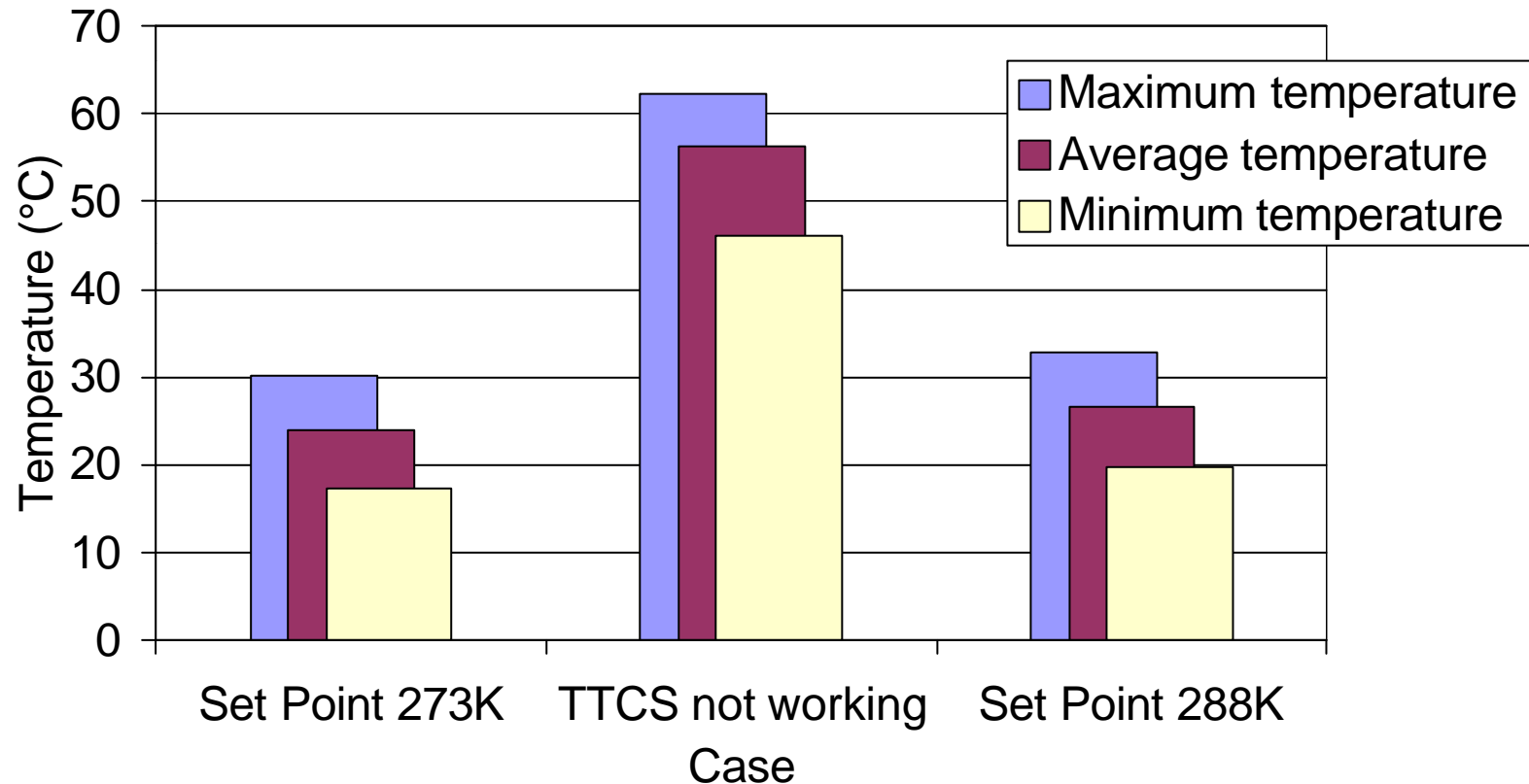
Magnet Temperature increments

Increment of the Temperatures of Magnet w.r.t. Set Point 273 K
in dependence of time



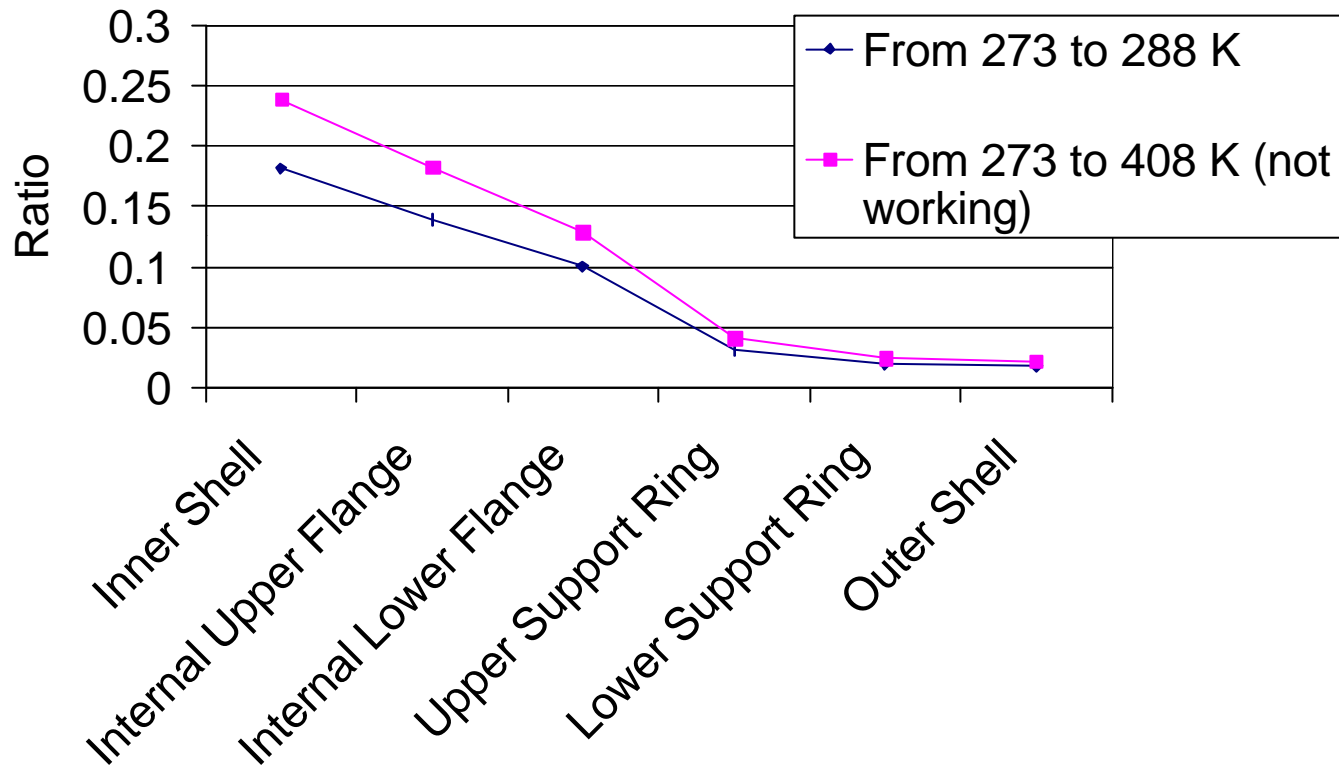
Inner Shell temperature

Temperature ranges for nodes in
INNER SHELL
during an orbit

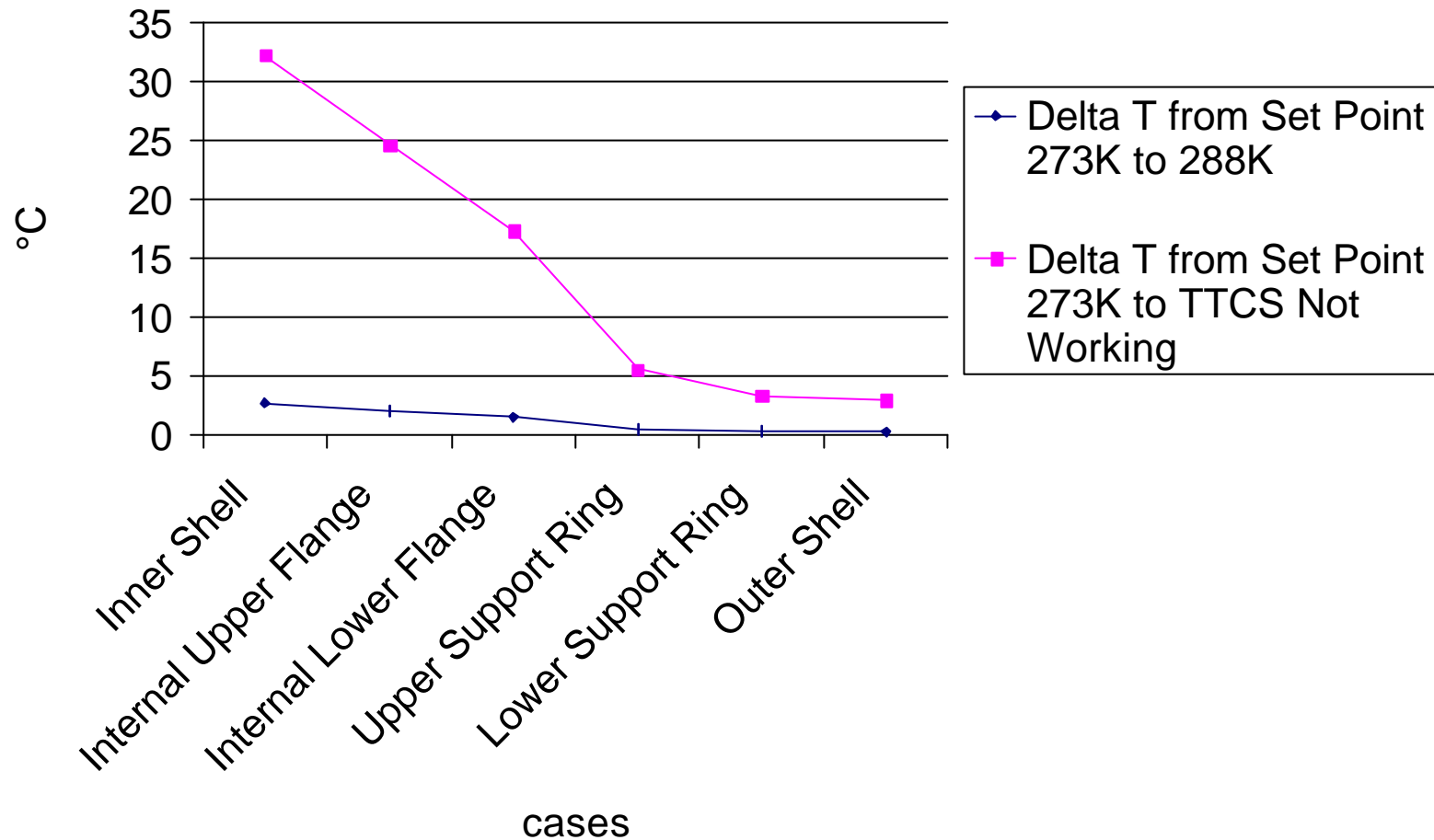


Vacuum case temperature Attenuation w.r.t. Loop set point

Attenuation Ratio
 $(T (@T_{loop}) - T (@273K)) / (T_{loop} - 273K)$



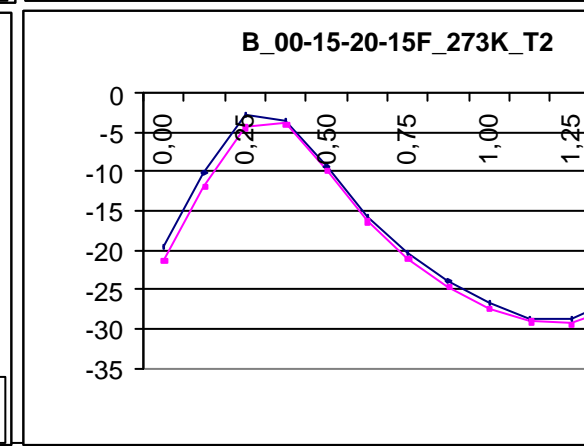
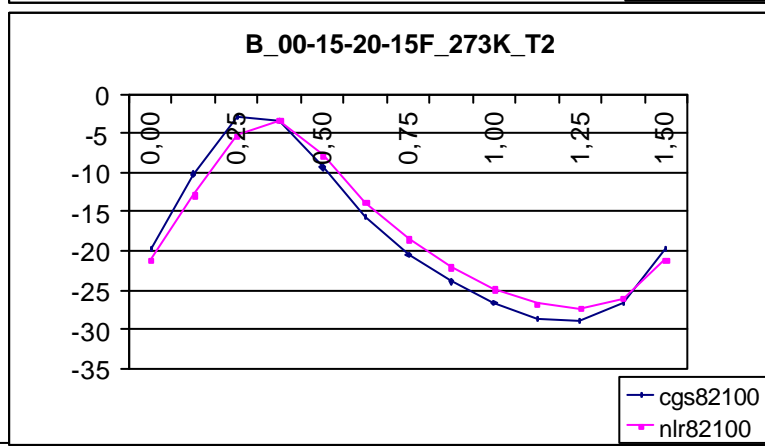
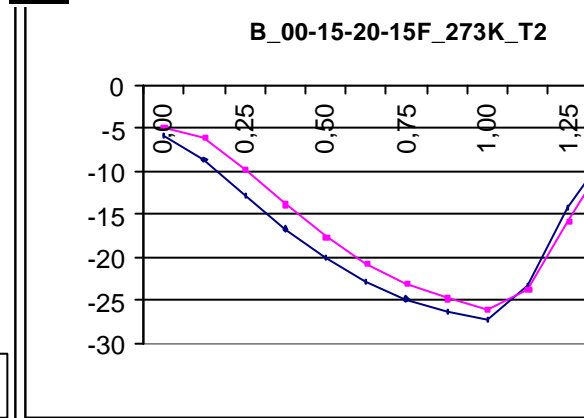
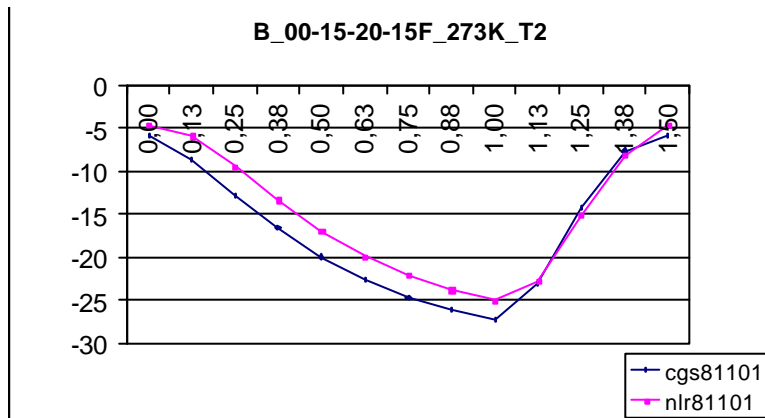
Vacuum case temperature Attenuation w.r.t. Loop set point



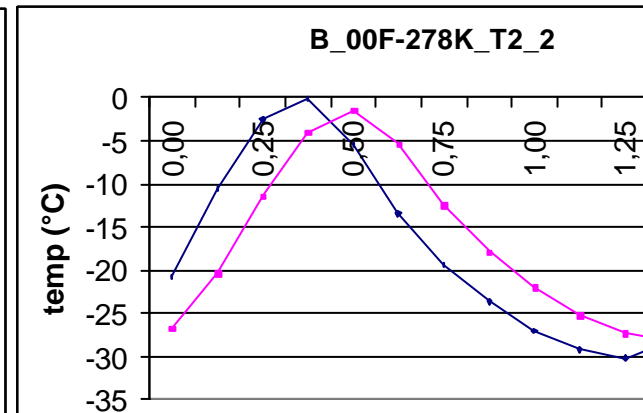
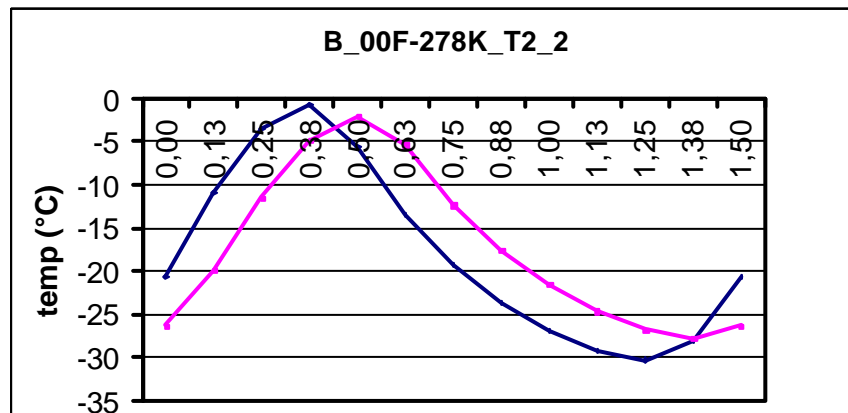
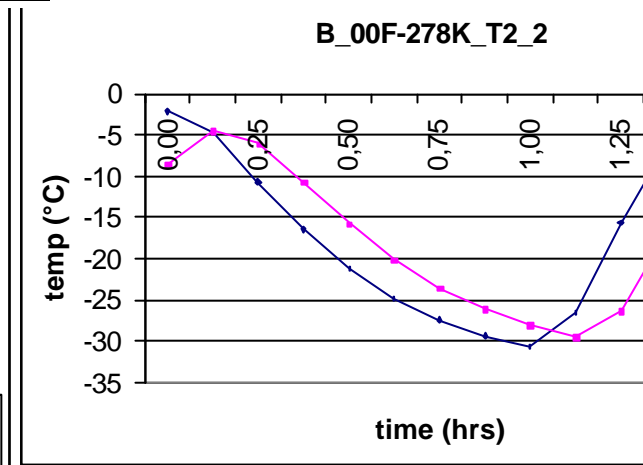
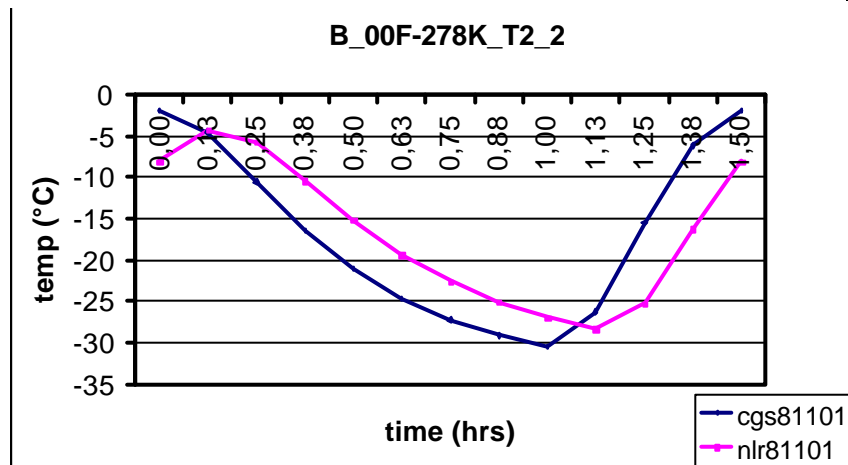
9 cases compared

- DATI_B_75-15-20-15F-288K2
 - B-00F-278K_T2
 - B-25_15-20_15F-278K_T2
 - B-50_15-20_15F-273K2
 - B-75_15-20_15F-273K2
 - B_00-15-20-15F-278K_T2
 - B_25_15-20-15F-283K_T2
 - B_50-15-20-15F-283K2
 - B_25-15_15_15F-273K2
-

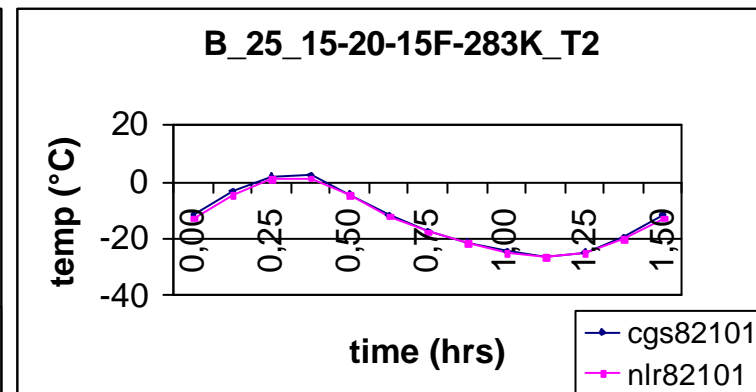
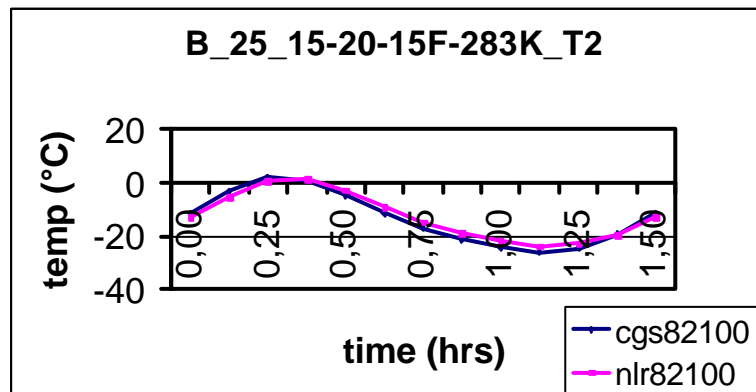
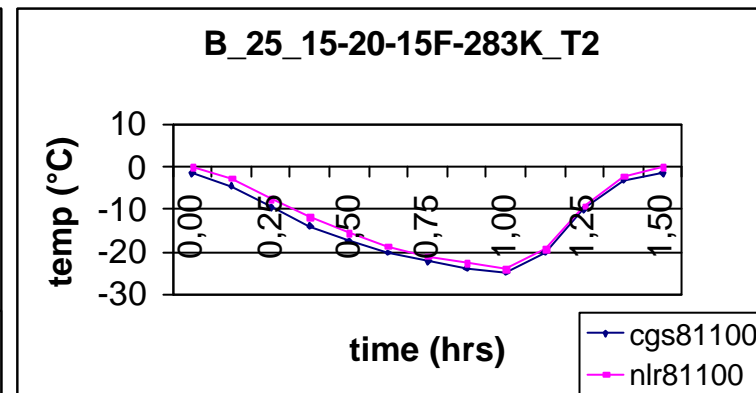
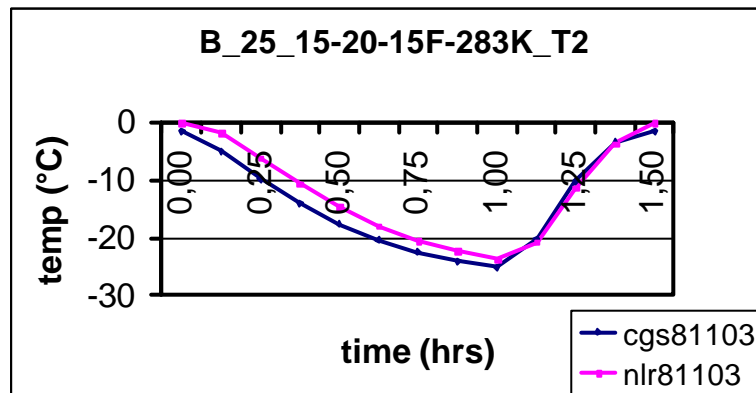
Beta=0° YPR=-15-20-15 F 278K_T2



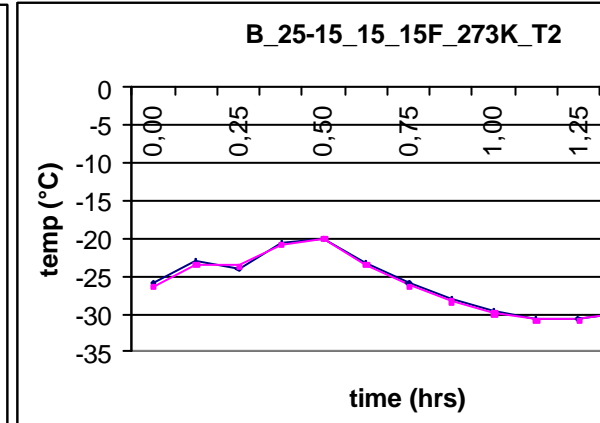
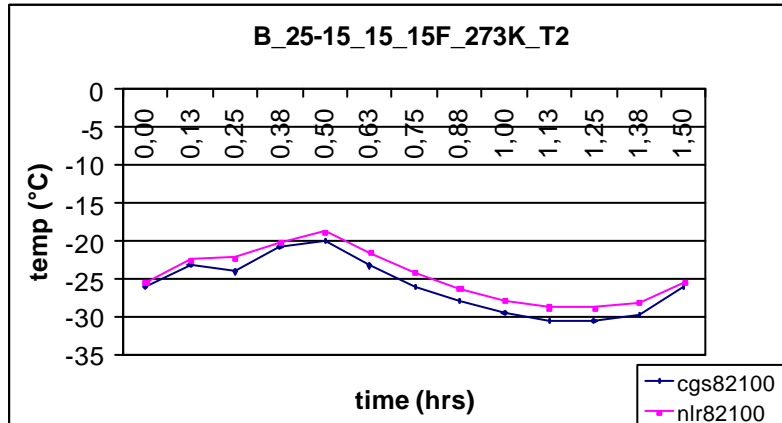
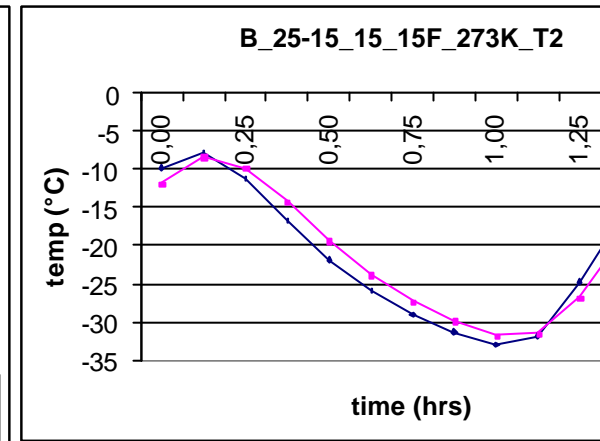
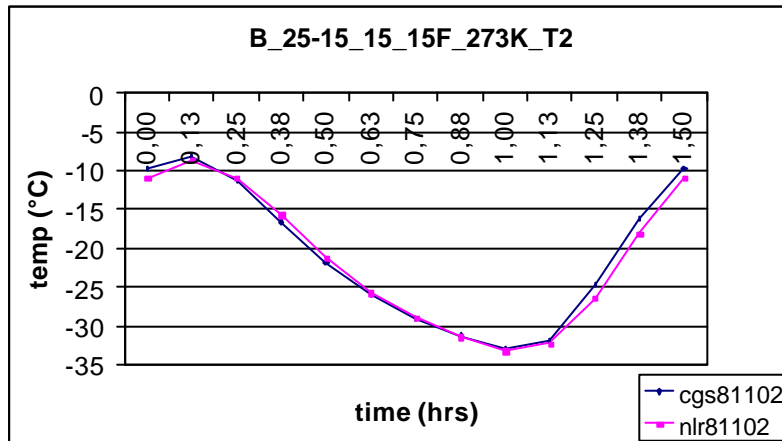
B=0° MPA F-278K_T2



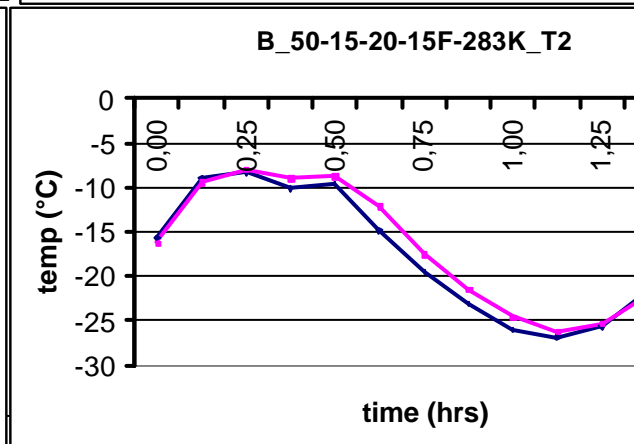
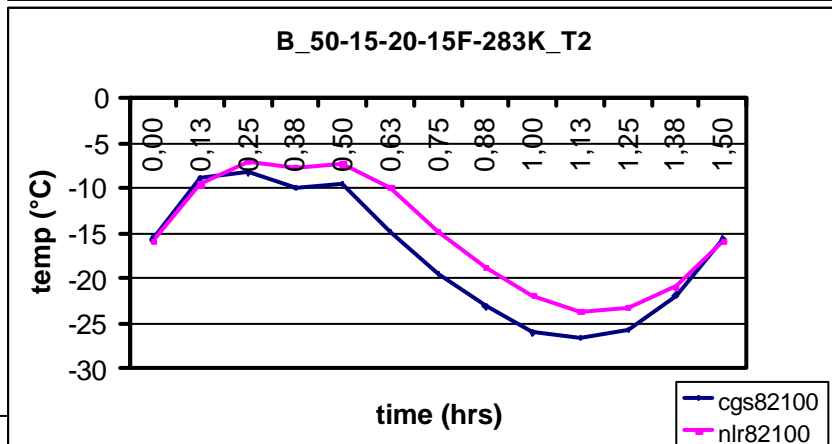
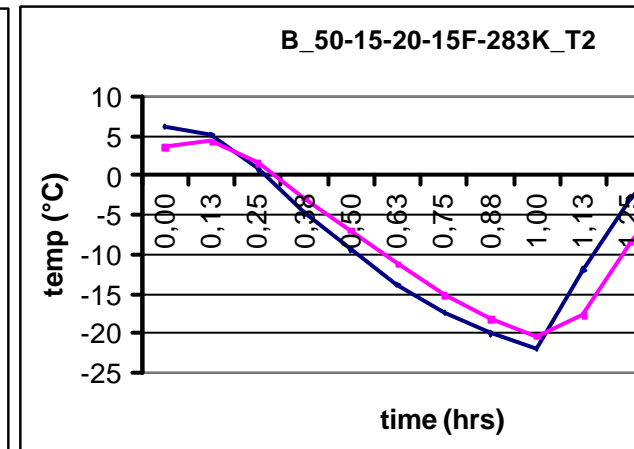
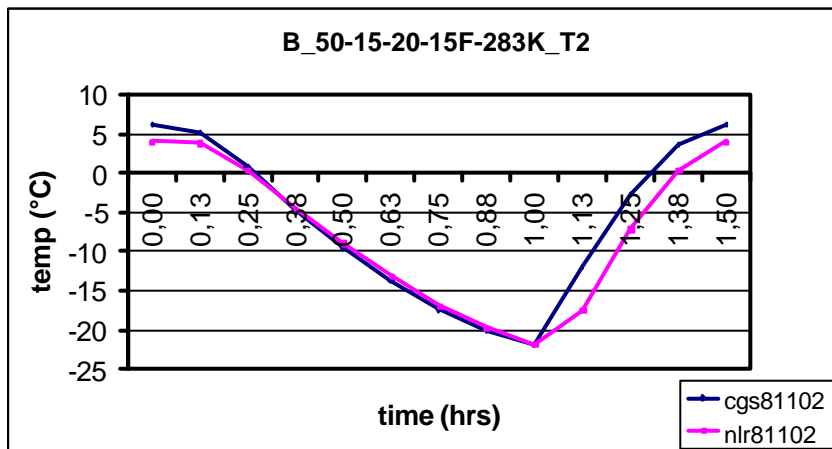
Beta=+25° YPR=+15-20-15 F 283K_T2



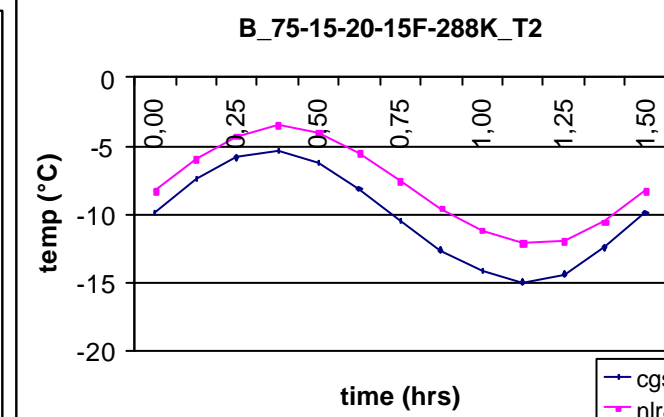
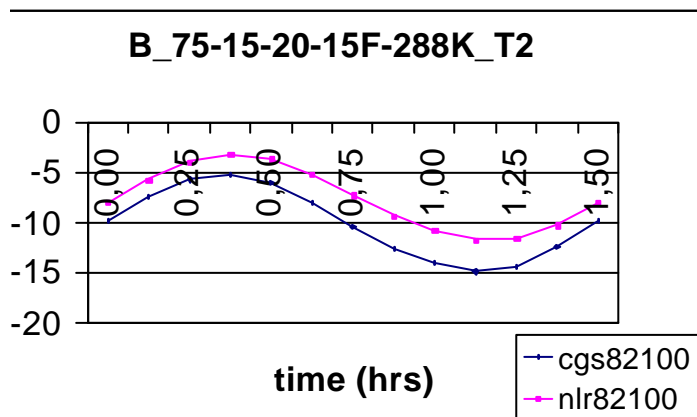
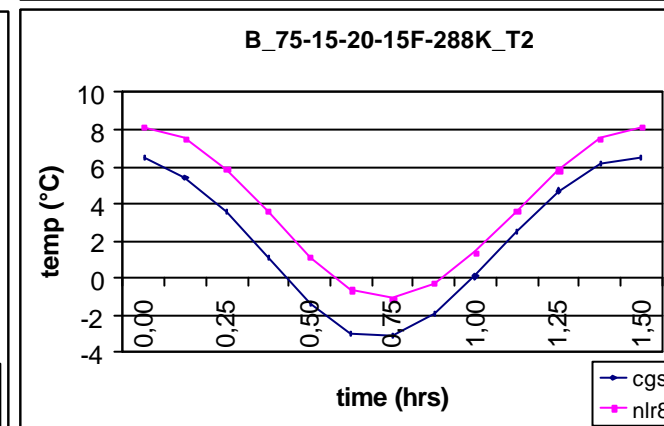
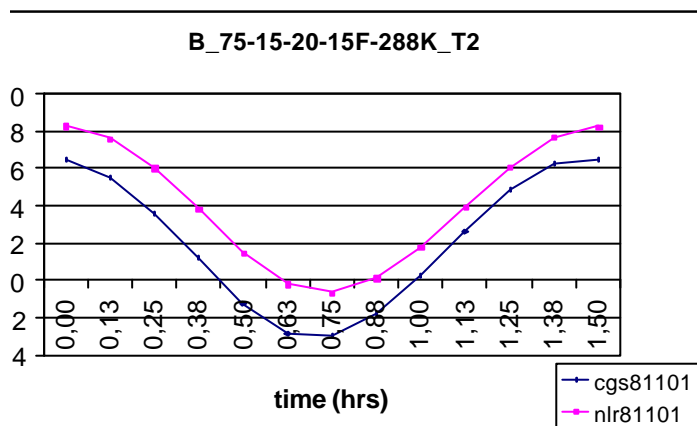
Beta=+25° YPR=-15+15+15 F 273K2



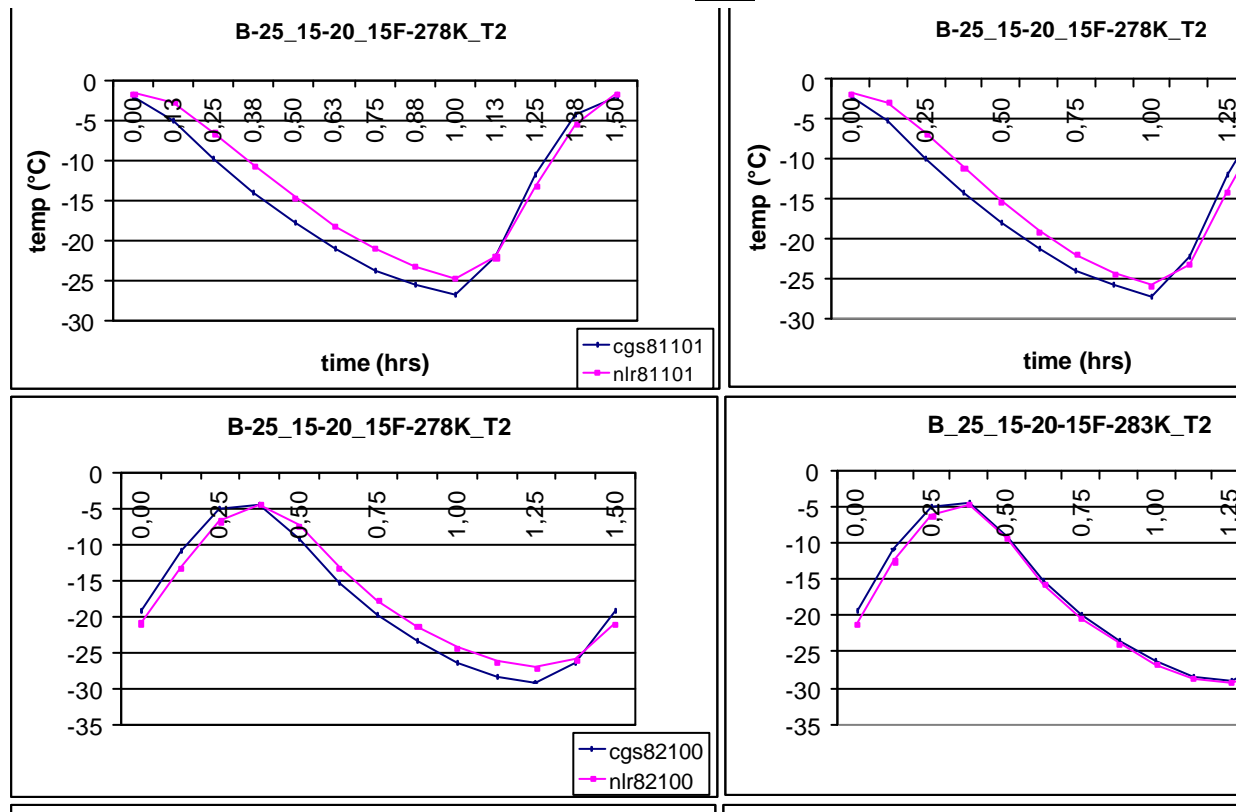
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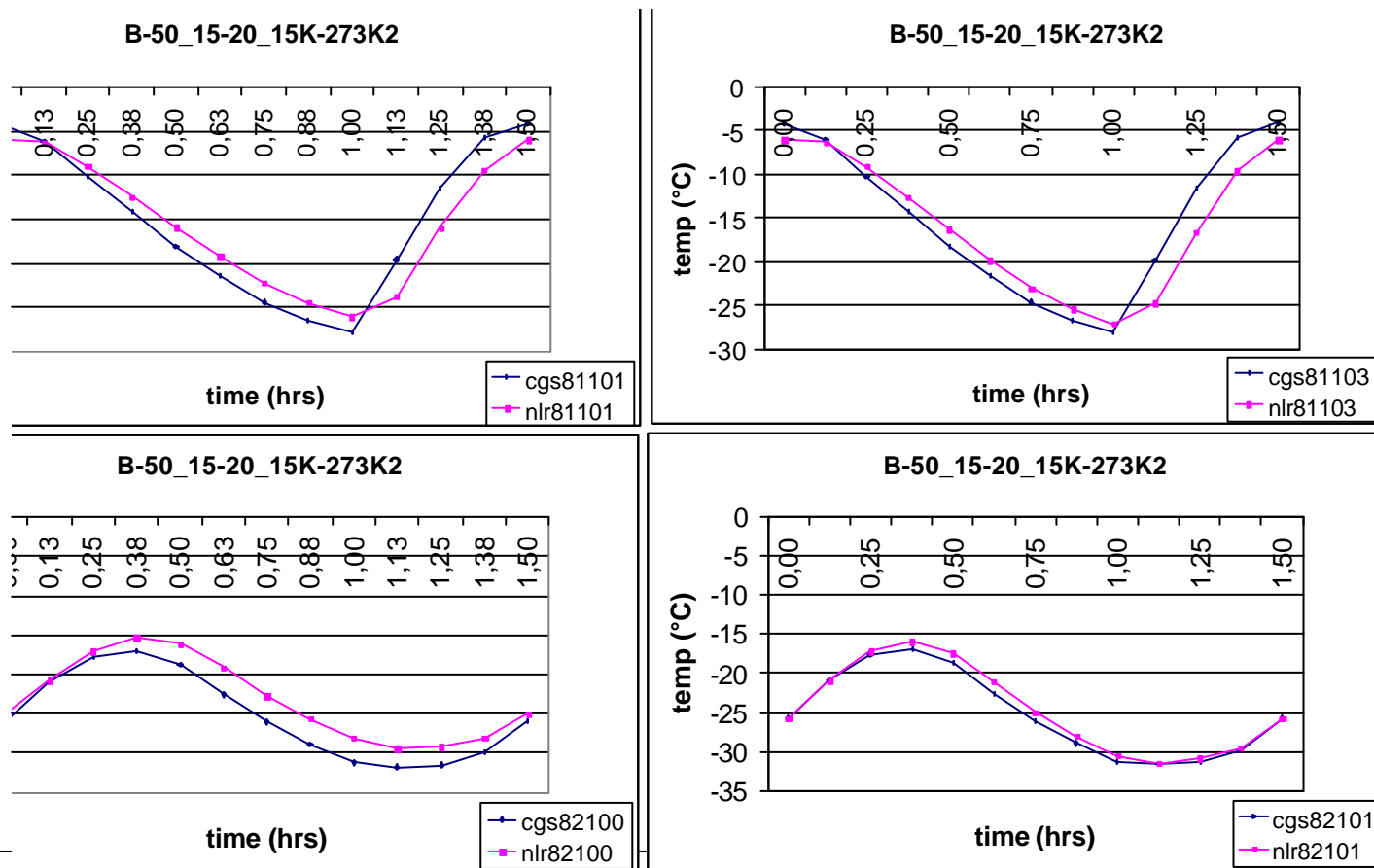
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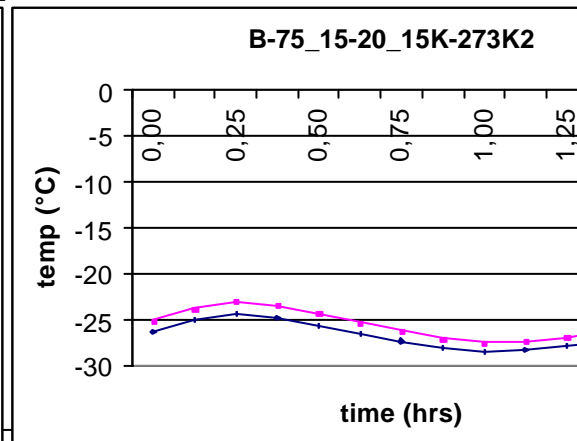
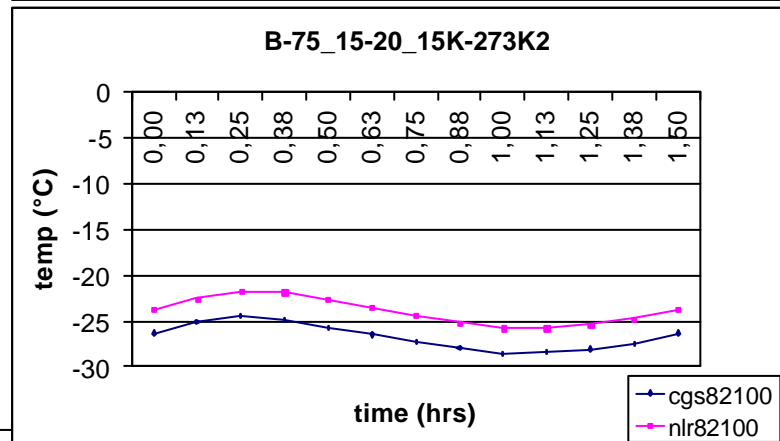
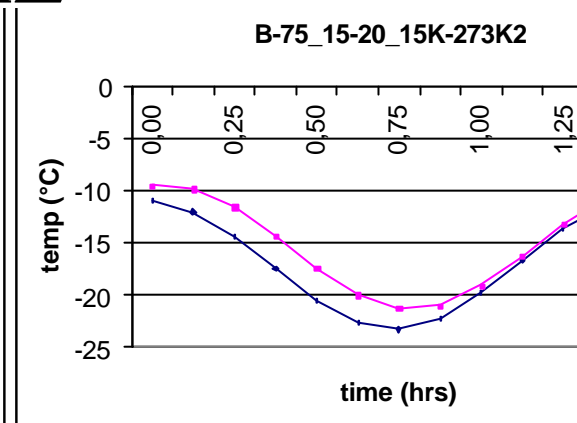
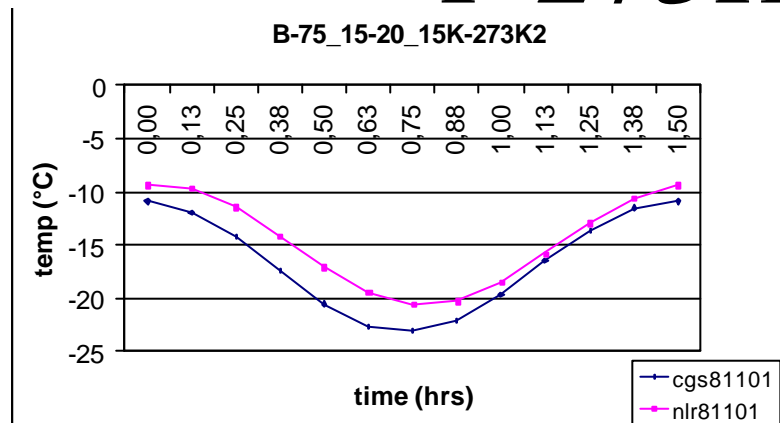
Beta=-25° YPR=+15-20+15 F 278K_T2



Beta=-50° YPR=+15-20+15 F 273K2



Beta=-75° YPR=+15-20+15 F 273K2



NLR CGS results comparison

Maximum deviation of the two solutions one from the other

