

Sheet1

**TRT HARDWARE INTERLOCK RISK ANALYSIS**

updated

01/19/07

<b>NTC Comparator Output</b>	HI = V(in) > V(thr) ; T < T(thr) LO = V(in) < V(thr) ; T > T(thr)	
<b>Comparator Board Output</b> o differential voltage level on twisted pair o separately for Barrel and Endcap	No NTCs over threshold --> +4.75 V decrease by 250mV / NTC over threshold	(BR/EC_SUM = 250mV baseline)
<b>Logic Board Output</b>	Good condition --> HI	

ID	Failure Mode	Cause/Consequence	TRT-HWI Action
<b>NTC Related</b>			
1	Electronics Temp too High	Comp Board V(out) increases by ~250 mV	DCS turns off relevant channels, NTCs stay on
2	Temp too High and DCS Failure	Comp Board V(out) increases by ~250 mV	can cause TRIP [1]
3	Open NTC	V(in) --> 2.5 V (like T=0)	nothing [2]
4	Shorted NTC	V(in) --> 0 V (like T=HI)	can cause TRIP [1]
5	Change in NTC response (Vout lower)	Same as Temperature increase	can cause TRIP [1]
6	Change in NTC response (Vout higher)	Same as Temperature decrease	nothing [2]
<b>TTC Related</b>			
1	TTC (& ELMB) Dies	V(in) --> 0 V (like T=HI for all NTCs on TTC)	TRIP
<b>Cable Related</b>			
1	TTC->Comp Cable broken/disc.	V(in) --> 0 V (like T=HI for all NTCs on TTC)	TRIP
2	Noise on TTC->Comp Cable	Like short-term Temperature increase o all NTCs on TTC	protect against trip by long TRT-HWI integration time o and by filtering
3	Comp->Logic Cable broken/disc.	Same as Comp Board Out --> 0 o like T=HI for all channels on board	TRIP – temporarily disable Comp Brd input on Logic Brd
4	Noise on Comp->Logic Cable	Short-term Temperature increase o all channels on Comp Board	protect against trip by long TRT-HWI integration time o and by filtering
5	Logic->Rack Trip Cable broken/disconnected	Input to rack --> LO	TRIP
6	Noise on Logic->Rack Cable	Short-Term trip signal assertion	TRIP o protect against by good cable & filtering on Logic Board

## Sheet1

Comparator Board Related			
1	Comp Board Dies (V regulator...)	Comp Board V(out) --> 0	TRIP
2	Single Channel Threshold Broken (0)	Channel always appears as T=0	difficult to catch [3]
3	Single Channel Disabled by Mistake	Channel always appears as T=0	notice by position of switch on Comp Board
Logic Board Related			
1	Need to Temporarily Disable a Comp Board Input in USA15	Could forget to re-enable	switch position or LED? on Logic Board
2	Need to Temporarily Disable the Logic Board	For testing purposes	o only possible in USA15 o enable/disable state monitored by DCS
Power Related			
1	DCS ramps down power to (part of) system	Should leave NTCs and Comp Boards ON	nothing
2	Power Tripped at PP2 Box	Comp Board V(out) --> 0	TRIP
3	Power-On State	fully determined by NTC state	no logic to configure

### Notes

- [1] if Logic Board trip condition is met
- [2] must be seen by individual NTC monitoring by DCS
- [3] would have to effectively increase NTC temp and see no response