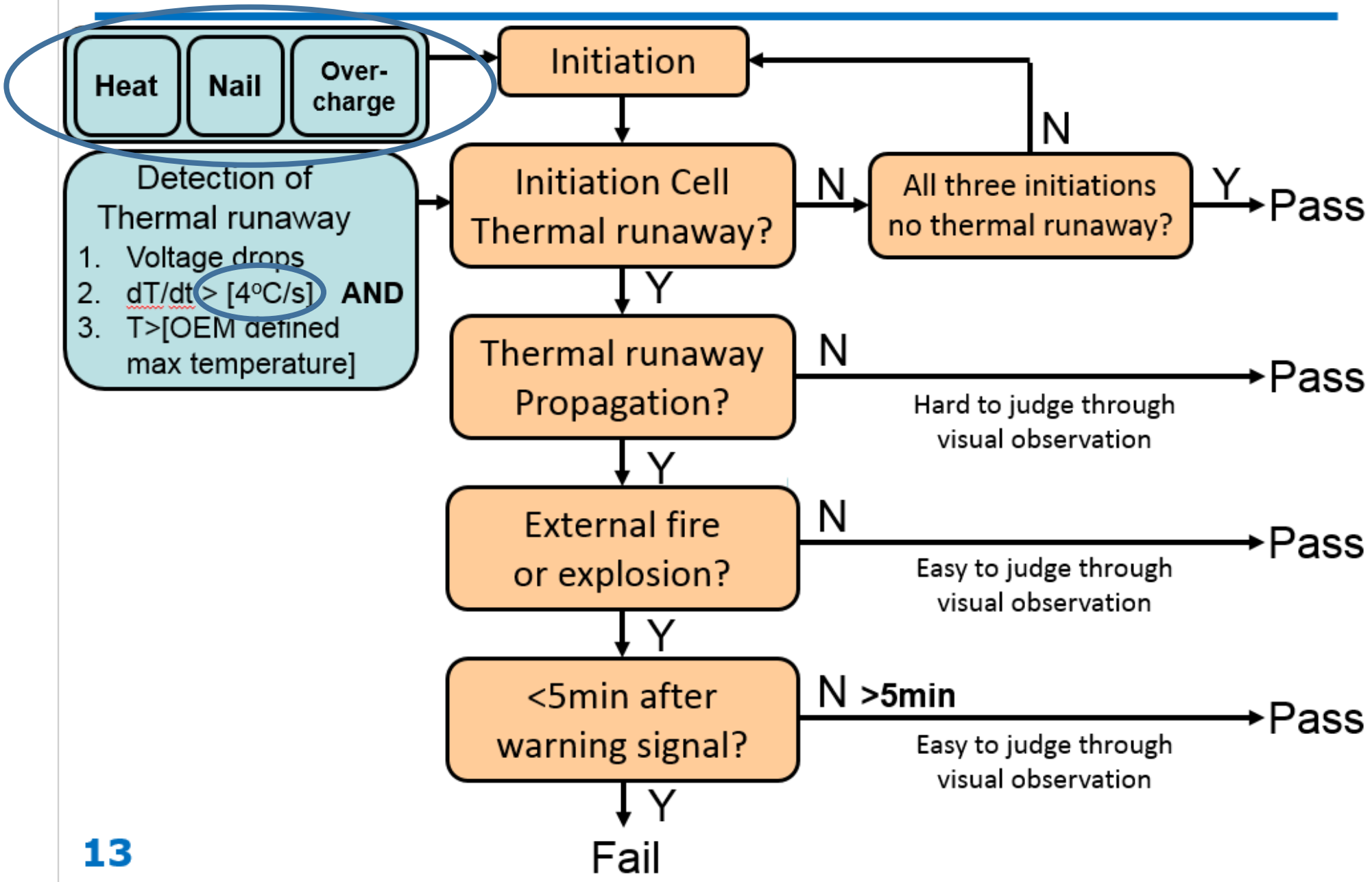
Thermal Propagation Testing

Initiation Method

Quantitative Definition of Thermal Runaway

The pass flow of the thermal propagation test



Initiation Method - Testing overview

- Non-production “modules”
  - **Identical** except for presence of heater
  - Four pouch cells
  - No enclosure
- Heating
  - 0.5degC/s
  - One side of end cell
- Overcharge
  - 3C Rate
  - No voltage limit

Comparison of Test Parameters to Latest Proposal

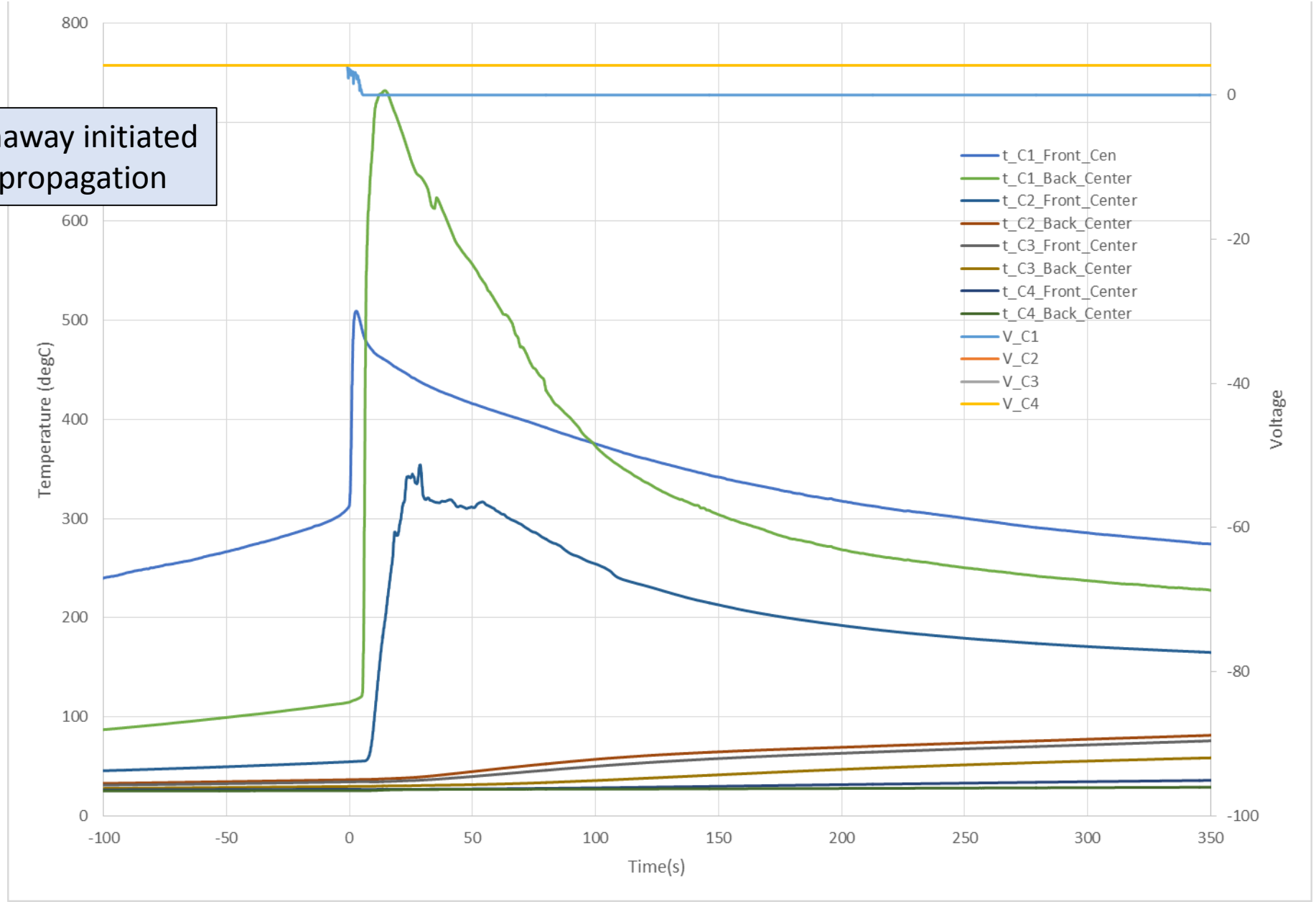
- Compared to procedure distributed on 6/13/16.
- Heating:

Parameter	GTR Proposal	Test
Temperature change rate	To 300 degC in 5 min	150 degC increase in 5 min
Heater recommendation	200-1000 W (100-400 W-hrs)	1500-4000 W (variable to maintain temperature increase)

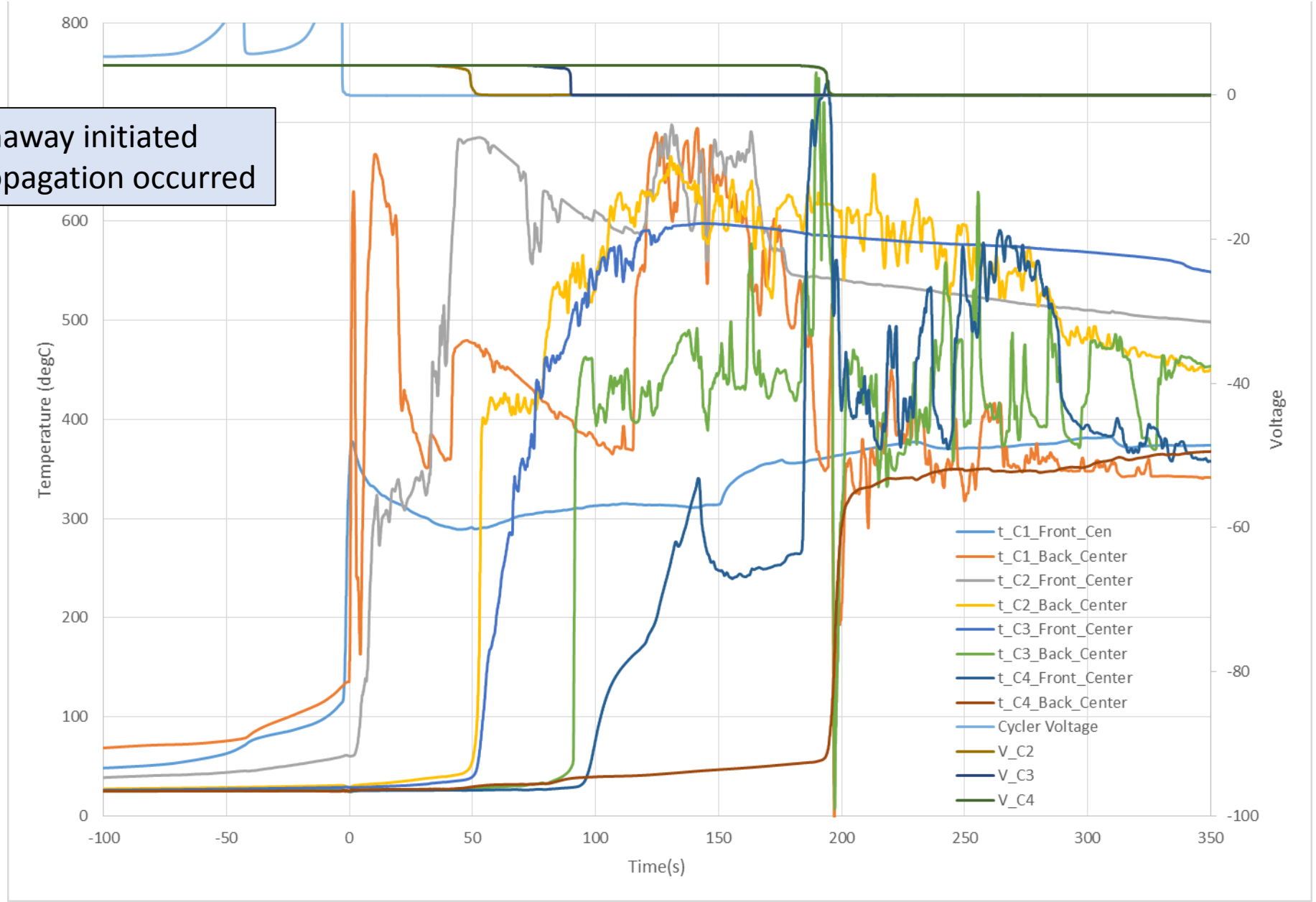
- Overcharge:

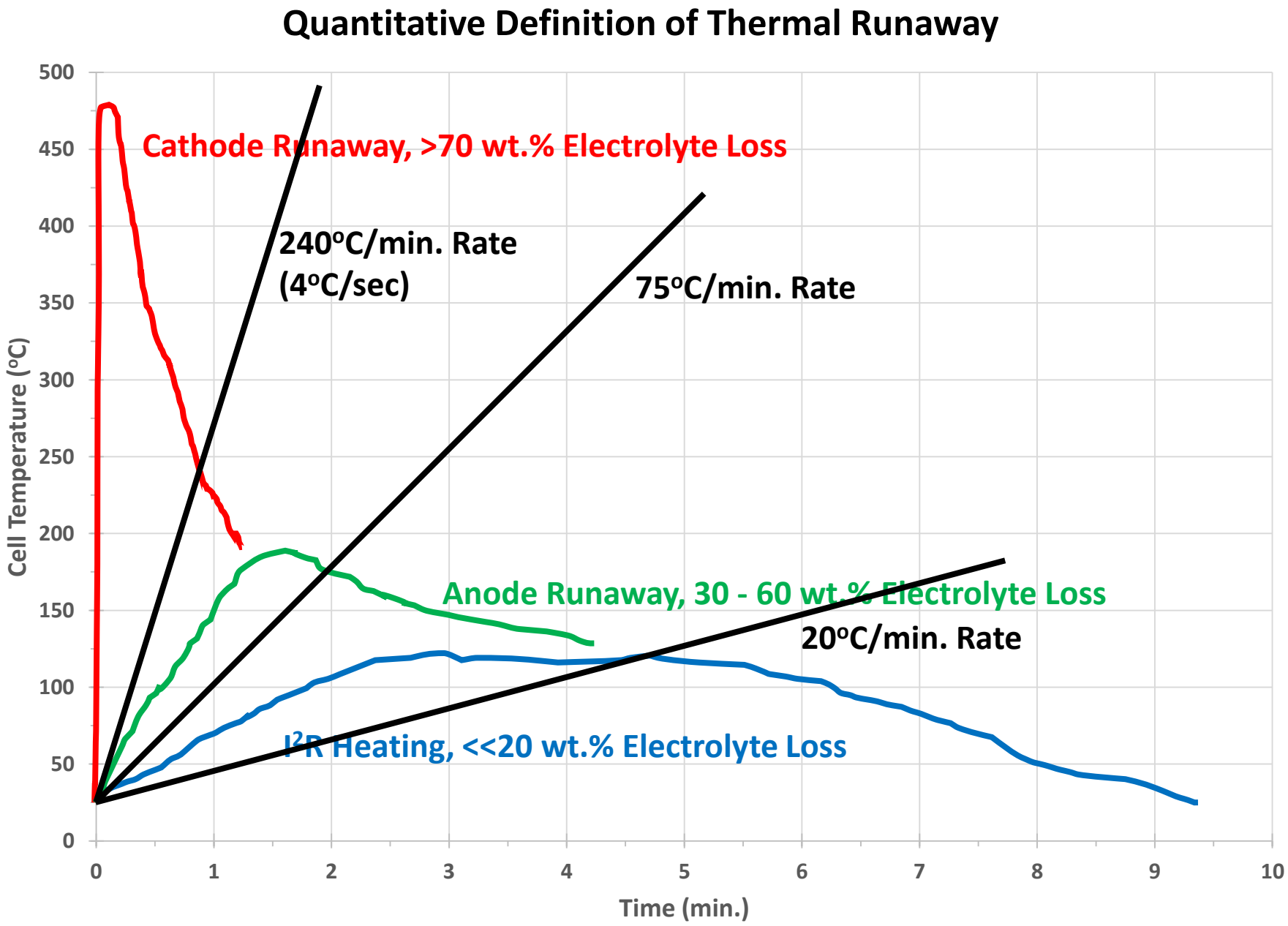
Parameter	GTR Proposal	Test
Current Level	1 C	3 C
Maximum Charge	200% SOC	Unlimited

Thermal runaway initiated
No thermal propagation



Thermal runaway initiated
Thermal propagation occurred




Quantitative Definition of Thermal Runaway
Cell Temperature (°C)
Time (min.)
0
50
100
150
200
250
300
350
400
450
500
0
1
2
3
4
5
6
7
8
9
10
Cathode Runaway, >70 wt.% Electrolyte Loss
240°C/min. Rate
(4°C/sec)
75°C/min. Rate
Anode Runaway, 30 - 60 wt.% Electrolyte Loss
20°C/min. Rate
I²R Heating, <<20 wt.% Electrolyte Loss

Conclusions

- The proposed three initiation methods are not equivalent.
  - Suggest elimination of overcharge
- The quantitative definition of thermal runaway should reflect thermal runaway behavior, cathode or anode.
  - Propose definition change to >1.25degC/sec (>75degC/min) or lower