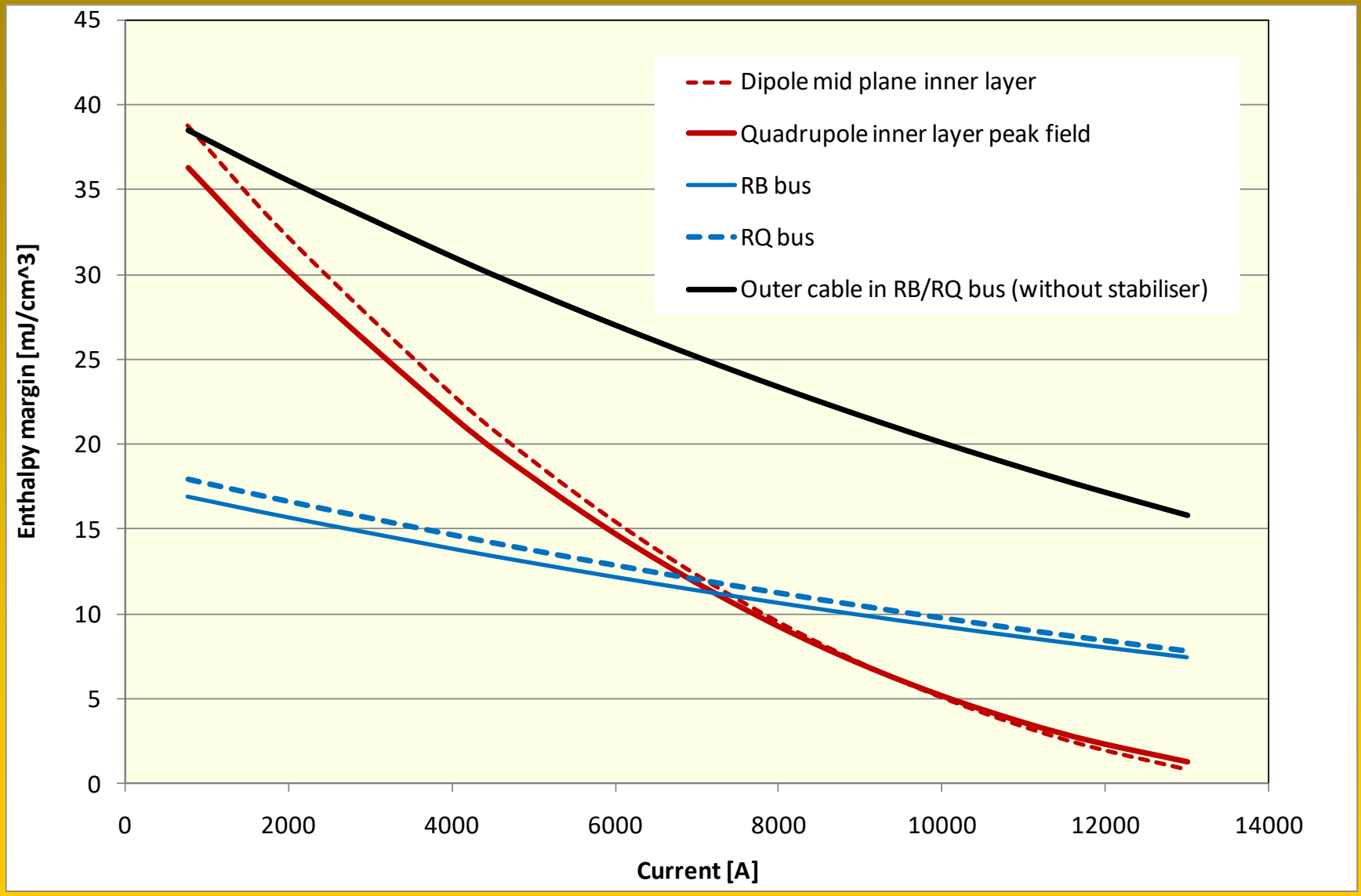
Enthalpy margins & Quench levels for the RB/RQ bus

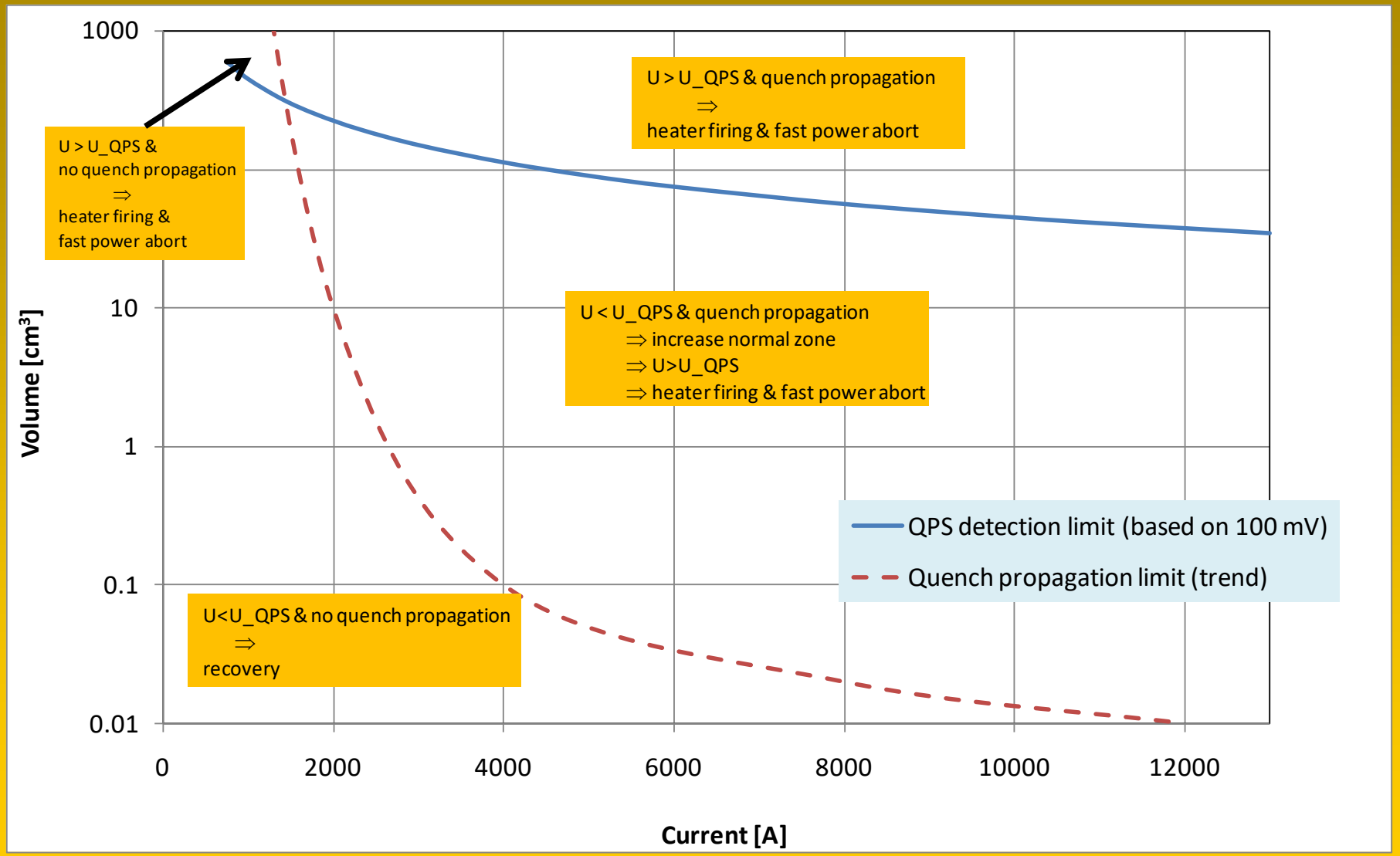
Enthalpy margin: accurate values for short heat pulses

Quench levels: approximate trends. Complicated because it is a function of heated volume, cooling, quench propagation, QPS setting…

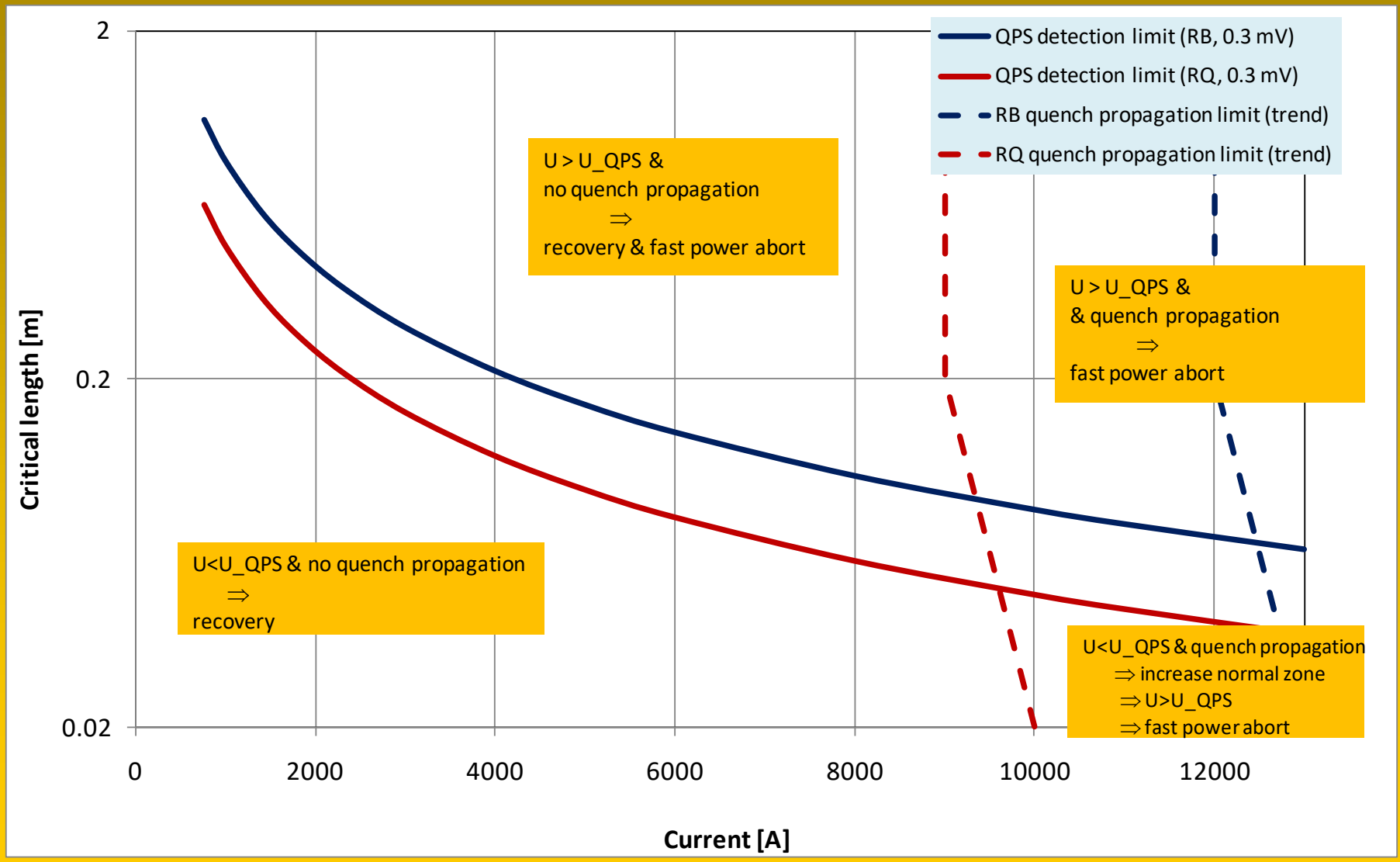
Enthalpy Margin (EM)



What happens if E>EM (RB cable inside coil)



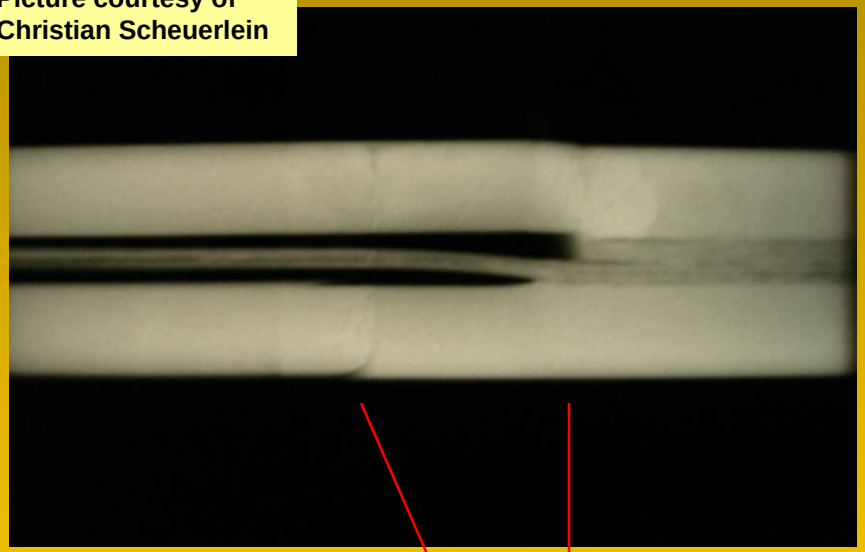
What happens if E>EM
(RB/RQ bus with good bonding between cable and bus)

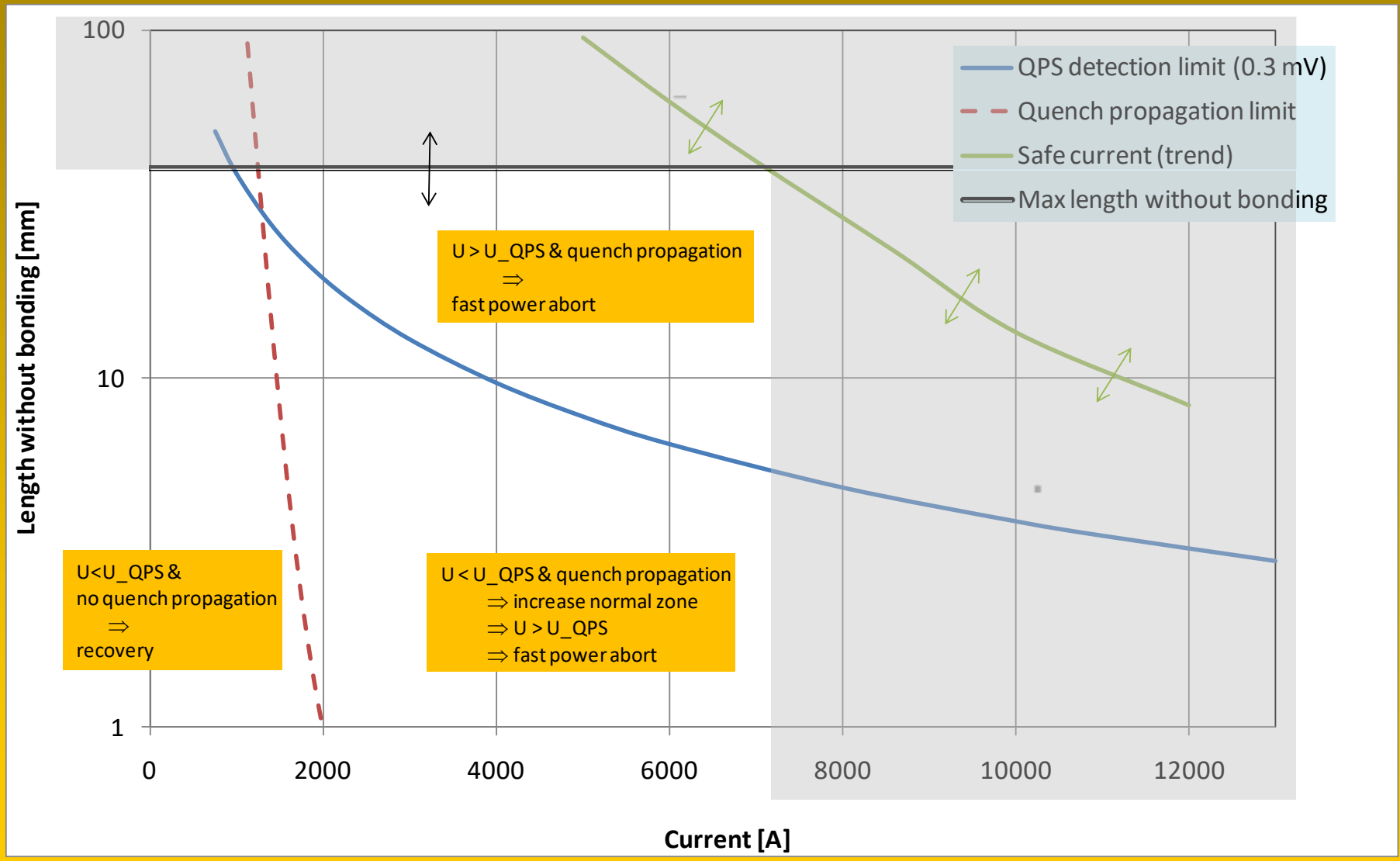


What happens if E>EM

(RB/RQ bus with bad bonding between cable and bus
⇒ use EM given for single outer cable without stabiliser)

Picture courtesy of
Christian Scheuerlein

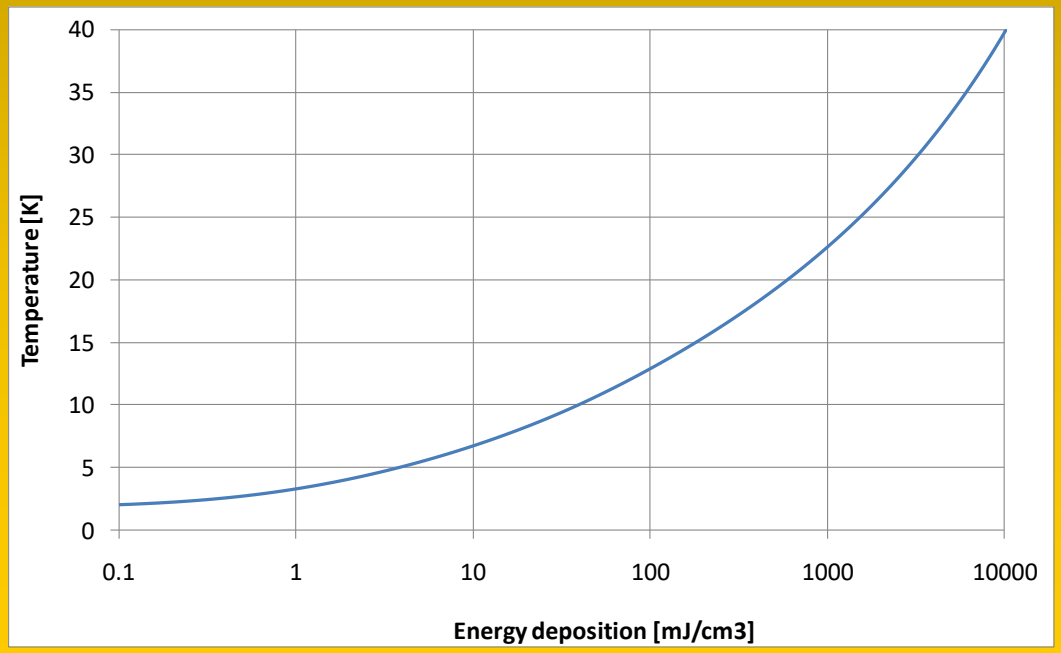



100
10
1
0
2000
4000
6000
8000
10000
12000
Length without bonding [mm]
Current [A]
QPS detection limit (0.3 mV)
Quench propagation limit
Safe current (trend)
Max length without bonding
U > U_QPS & quench propagation
⇒
fast power abort
U<U_QPS &
no quench propagation
⇒
recovery
U < U_QPS & quench propagation
⇒ increase normal zone
⇒ U > U_QPS
⇒ fast power abort

What happens if E>EM
for RB/RQ bus with bad bonding between cable and bus

In principle the operation current will be limited so that the joint can not burn through!!

However:
- One might 'look over' some bad joints, and hence put the operating current to high
- Maybe a bad joint degrades in time
- QPS thresholds are not yet tested, and may have to be increased
- If beam losses 'preheat' the cable too much than the joint can burn at lower currents than foreseen (note that k_{copper} has maximum around 20 K and ρ_{copper} starts to increase above 40 K)



A. Verweij, TE-MPE. 19 June 2009, MPP meeting