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Heat transfer simulation to liquid nitrogen from HTS tapes at current overloads

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Knowledge of HTS materials behavior at overload currents is important to design fault current limiters or fault protection systems of electro-technical devices. Recently we observed sharp voltage peaks during rectangular current pulses on HTS tapes cooled by boiling liquid nitrogen. We explain these peaks by analysis of transient cooling regimes in liquid nitrogen. It is common knowledge that a homogeneous liquid can withstand certain amount of superheat before switch to the boiling phase. In the transient regimes even inhomogeneous nitrogen can withstand a certain overheating. Basing on the measurements of voltages and temperatures of the HTS tapes during current overload and numerical analysis of the process we estimated the transient heat-transfer characteristics from the HTS tapes into liquid nitrogen. We also obtained important information about limiting superheating of the liquid nitrogen. Influence of covers of the HTS tapes on superheating of the nitrogen is discussed also.

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