Cool Time Constant Calculations

GE Power Management No. GET-8420

DESCRIPTION

The Cool Time Constant may be calculated from the actual cool time. The actual cool time (t) decays exponentially at the rate dependent on the time constant (τ). A larger value for τ gives longer cool time.

The Thermal Capacity Used after time t is given by:

$$TC_{used} = (TC_{used\_start} - TC_{used\_end})e^{-t/\tau} + TC_{used\_end} \qquad \text{(EQ 1)}$$

where: TC_{used_start} = TC at the start of the cooling period
TC_{used_end} = minimum running TC dictated by the hot/cold ratio or 0 for a stopped motor.

EXAMPLE

Calculate the stopped cool time constant for a motor that requires 3 hours cooling after being stopped just after a second start. The motor data allows two cold starts.

Permission of only two cold (0% TC) starts indicate that the motor thermal limit (100% TC) is reached after two starts.

It implies that one start requires 50% TC. To allow another start the relay must grant permission when TC falls below 50% and the programmed time constant ensures that this happens after 3 hours has lapsed

Substituting this information into Equation 1, we have:

$$\begin{aligned} TC_{used} &= (TC_{used\_start} - TC_{used\_end})e^{-t/\tau} + TC_{used\_end} \\ \Rightarrow 50\% &= (100\% - 0\%)e^{-180\text{ min.}/\tau} + 0\% \qquad \text{(EQ 2)} \\ \Rightarrow \tau &= 260\text{ minutes} \end{aligned}$$

Therefore, the required Cool Time Constant is 260 minutes (or 15600 seconds).