

Alternate Method of Determining Average Oil Temperature

This is not an original thinking but
derived from an IEC standard
(IEC6XXX) read in 1998

Traditional Average Oil Temperature
= Top Oil Temperature – 0.5* (Top Radiator
Header Temperature – Bottom Radiator
Temperature)

This means if the radiator was a tall one there would be more difference between the top and bottom header and the average oil temperature would be lower.

However if the radiator was a short one there would be less difference between the top and bottom header and the average oil temperature would be higher.

Traditional Average Oil Temperature

This does not seem logical that radiator length (height should have such predominant effect over the average oil temperature.

Since the winding gradient is the difference of shut down temperature of the winding and the average oil temperature thus it appears that the gradient becomes a function the height of the radiator.

This does not make any rational sense; let us look of an alternative method.

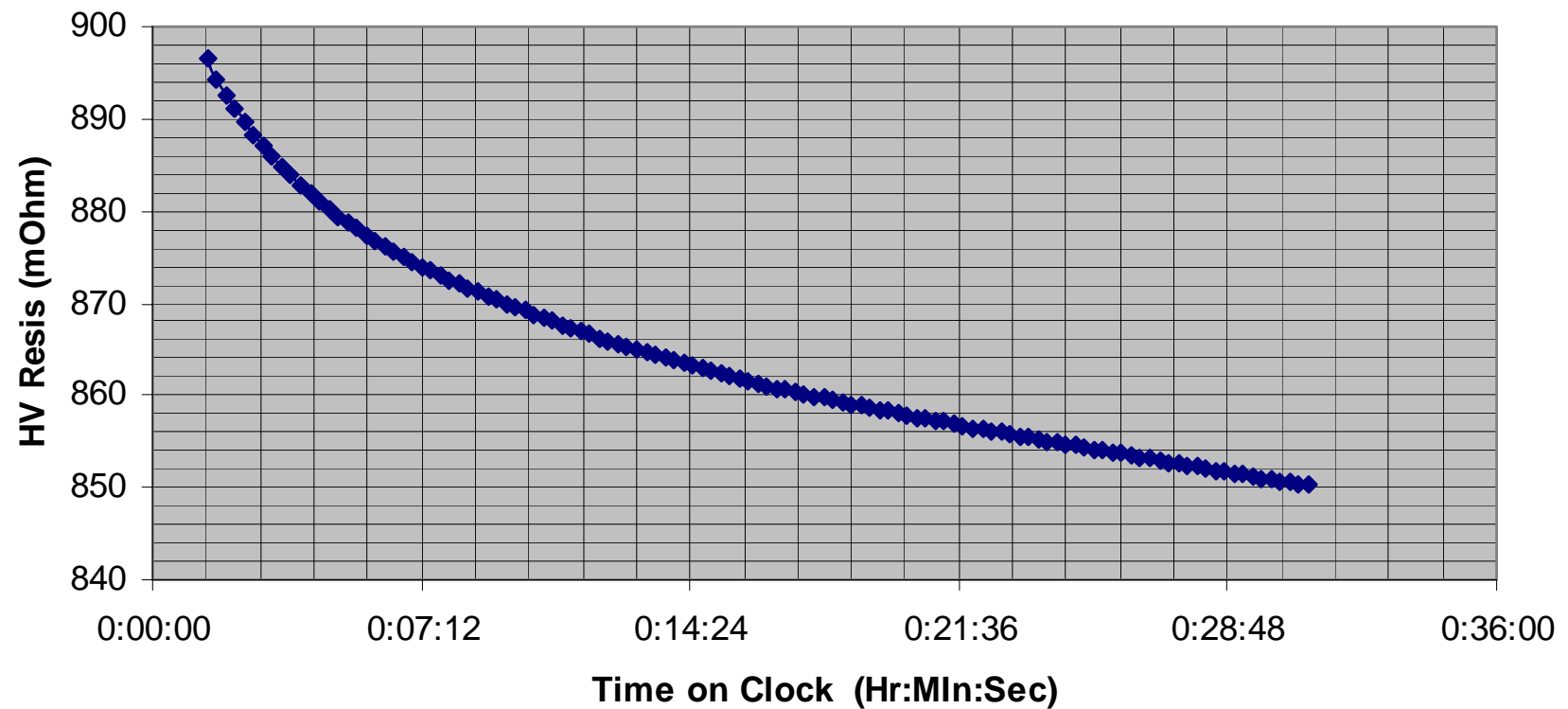
Alternate Method of Deriving Average Oil Temperature

Usually the resistance measurement during shutdown is limited to less than 15 minutes often less than 10 minutes.

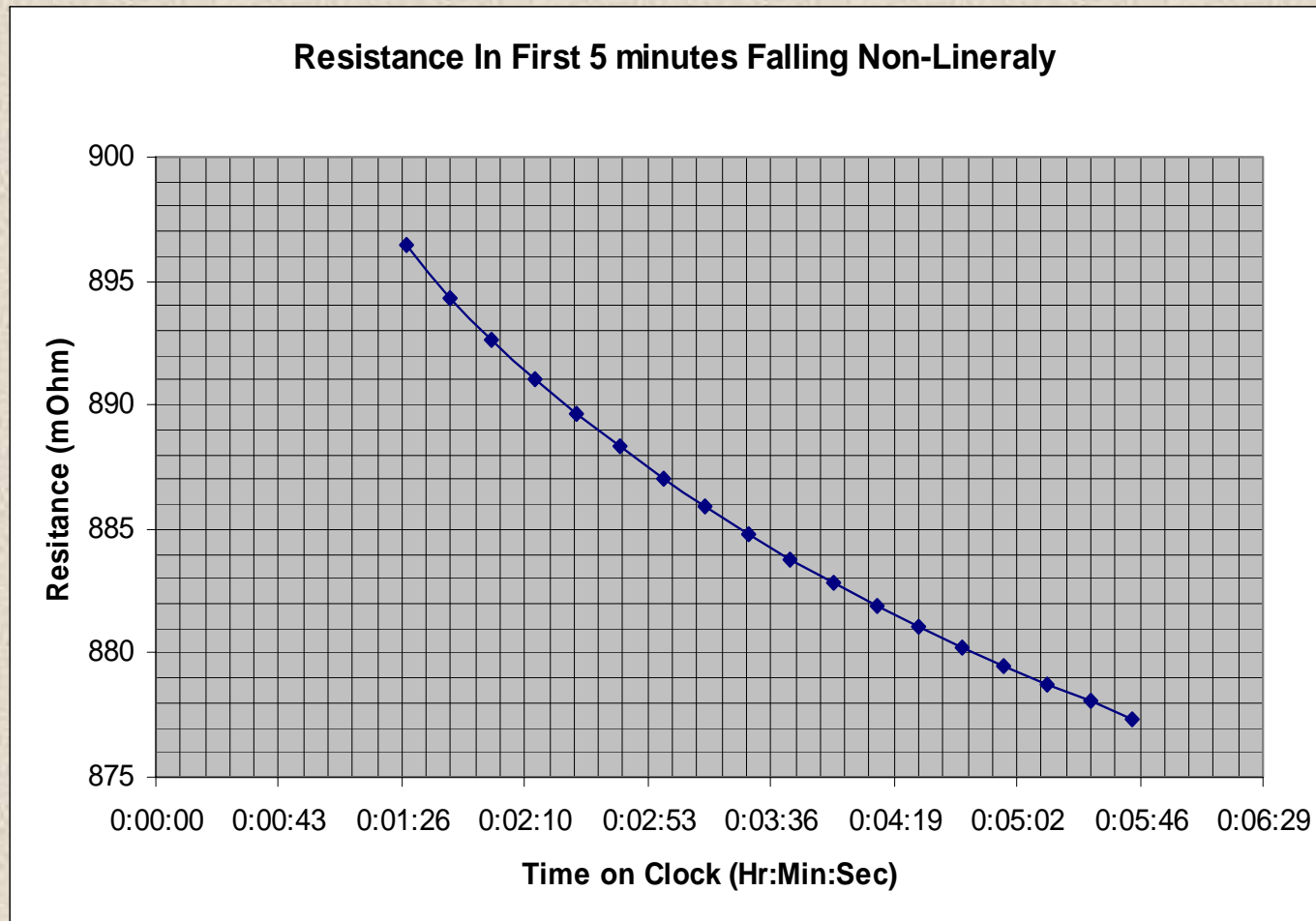
In our alternate method it is proposed that the readings are recorded up to thirty minutes; this will vary based on the specific transformer rating. We will use 30 minutes for this transformer and leave the time duration for other transformers for another discussion.

Alternate Method of Deriving Average Oil Temperature

Graph of Resistance Vs Time up to 30 minutes after shut down



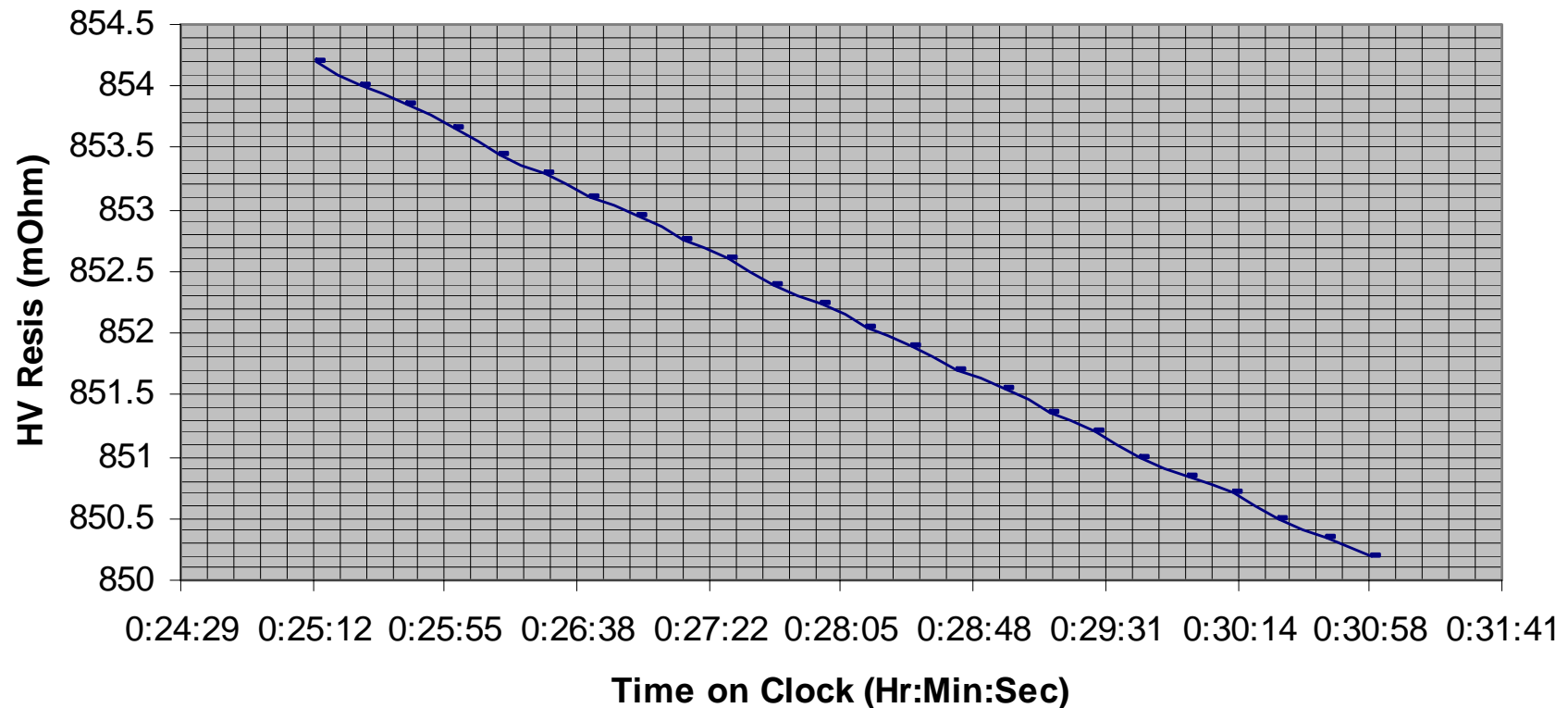
Alternate Method of Deriving Average Oil Temperature



Author: Sanjib Som
Oct2009

Alternate Method of Deriving Average Oil Temperature

Resistance in Last 5 min falling Linearly

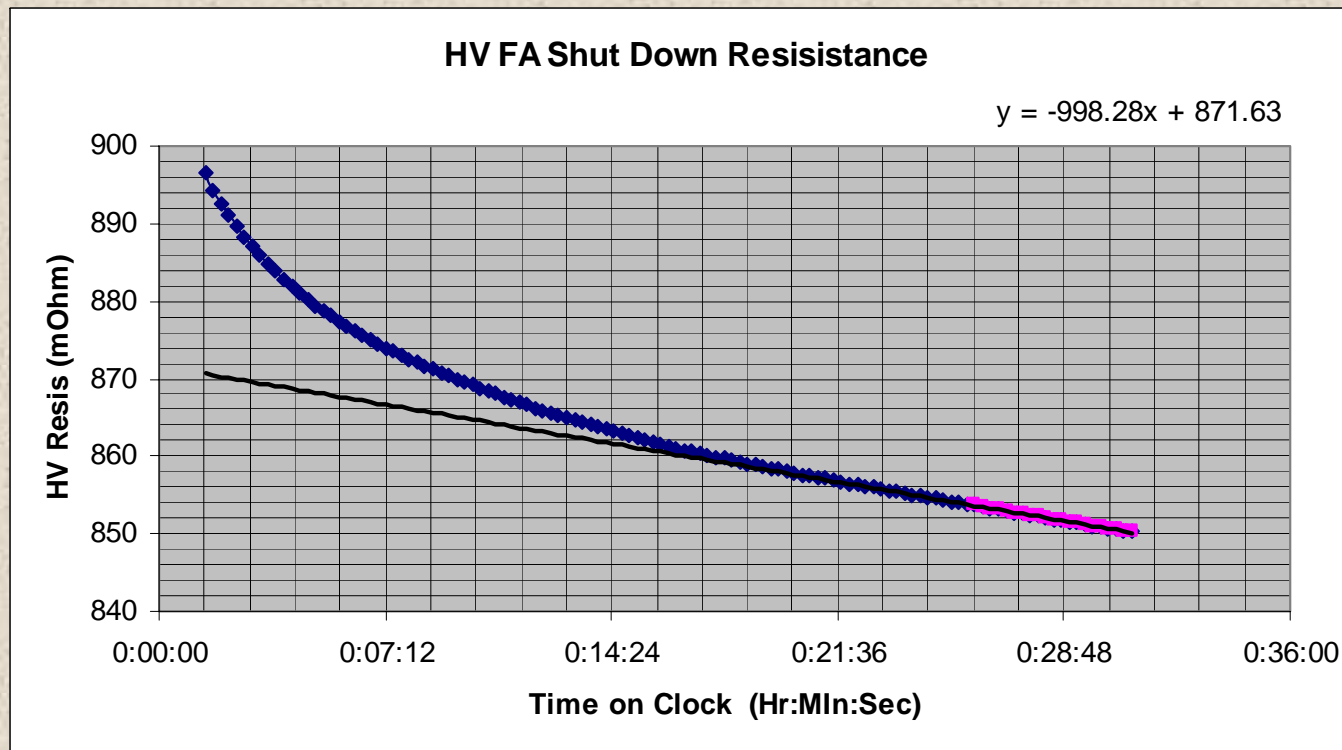


Alternate Method of Deriving Average Oil Temperature

Thus during the last five minutes the temperature of the winding and the surrounding oil is same and also falling at the same rate.

Since it can be safely presumed that oil temperature falls linearly during the complete 30 minutes, the linear graph taken backwards to cross the y-axis will provide the temperature of the surrounding oil at shutdown .

Alternate Method of Deriving Average Oil Temperature



Thus temperature of surrounding oil at shutdown corresponds to 871.63 mOhms

Alternate Method of Deriving Average Oil Temperature

Since cold resistance is 775.5 mOhms at 38°C this makes the oil temperature at shut down = 71.78°C.

However by traditional method the average oil temperature = 69.9 °C

The shut down resistance being 908.812mOhms, the shut down winding temperature = 84.8 °C; Top Oil Temperature = 83.1 °C

Alternate Method of Deriving Average Oil Temperature

| | Traditional Method | This Method |
|------------------------------------|--------------------|-------------|
| Average Oil Temperature | 69.9 °C | 71.78 °C ↑ |
| Winding Gradient | 14.9 °C | 13.02 °C ↓ |
| Winding Hot Spot (assumed 1.3 hsm) | 102.47 °C | 101.73 °C ↓ |

Alternate Method of Deriving Average Oil Temperature

This alternate method considers the average oil temperature as the temperature of oil surrounding the winding and eliminates the effect of length of radiator on average oil temperature. This also eliminates the need to record top and bottom radiator header temperatures.

Transformer used 7.5/10.5MVA 34.5/13.8kV
 $\%Z=5.75$.