FUSE TIME/CURRENT CURVE

CURRENT IN AMPERES X 10 AT 13800 VOLTS

Note long time melting point

FS-1
S&C
SMU
SMU-40
100E

This side of curve: Fuse element melts, current flow interrupted.

Within this area fuse will be damaged but current may or may not be interrupted.

TIME IN SECONDS

This side of curve: Fuse element intact, no fuse damage

Wide plot in instantaneous range shows fuse to be non-current limiting.

CURRENT IN AMPERES X 10 AT 13800 VOLTS

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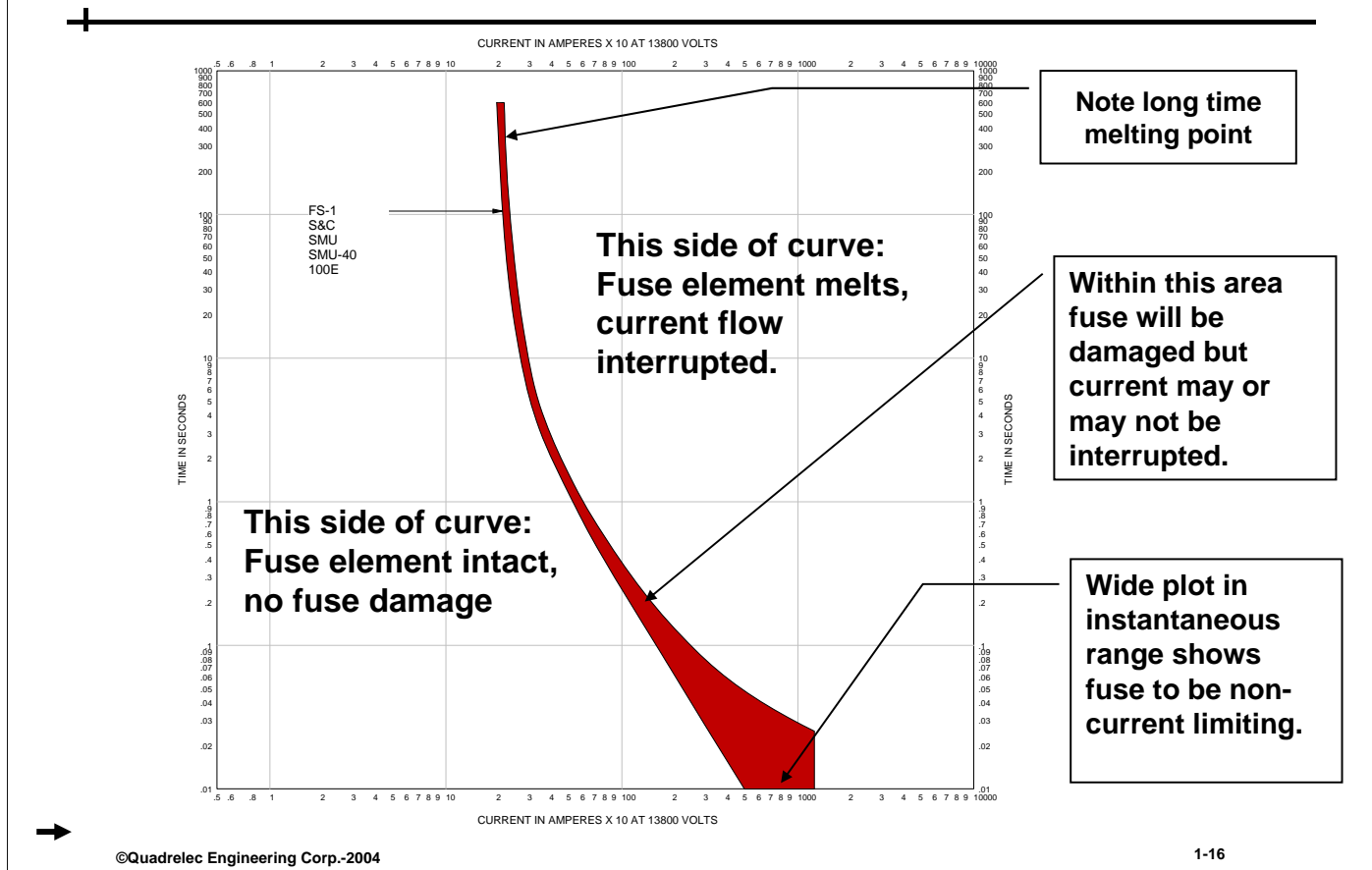
The **left side** of this curve is the **minimum melt** curve and the **right side** the **maximum clearing** curve. The solid band is actually shaded between these two curves. If this fuse was rated as a current-limiting type fuse, then the right side of the curve would extend down below the plot instead of tending to flatten out as the one depicted. Published fuse curves are *only valid* for a fuse that has *no load prior to injection of the test current and a certain ambient air temperature (25-30 degC)is* present. If fuse is fully loaded or if the air temperature is any higher, the whole curve would shift to the left. A full loaded fuse curve would shift about 20% just due to being full loaded. The actual shape of the curve would change due to loading and temperature. In actuality the entire curve would not shift the same amount according to IEEE C37.48. More shifting would actually occur in the long time range. It is nevertheless the practice of most coordination engineers to shift the entire minimum melt side of the curve 20% to the left to compensate for a fully loaded condition. In the absence of other data IEEE C37.48 states that open power fuses and cutouts should be derated an additional 0.4% per degC above 25 degC. It is always best to get the manufacturers data for actual derating factors for both preloading and temperature. Why is all of this important? Remember these effects when we get to the discussion of coordination time intervals.

Note that the 100 A fuse depicted in this plot can handle almost 200 A continuously. This gives us a rule we can use for setting adjustable trip breakers. How? If a fuse properly protects a cable having a certain ampacity, a breaker mimicking the fuse operation should also provide adequate protection. **If you had an adjustable trip device such as a relay mimicking this fuse curve, what set point value could you use as a pickup point to protect a 100A rated ampacity cable?**

PLOTTING DEVICE CURVES VS TRANSFORMER CONNECTIONS

- Transformer winding connections are also a factor when plotting log-log curves.
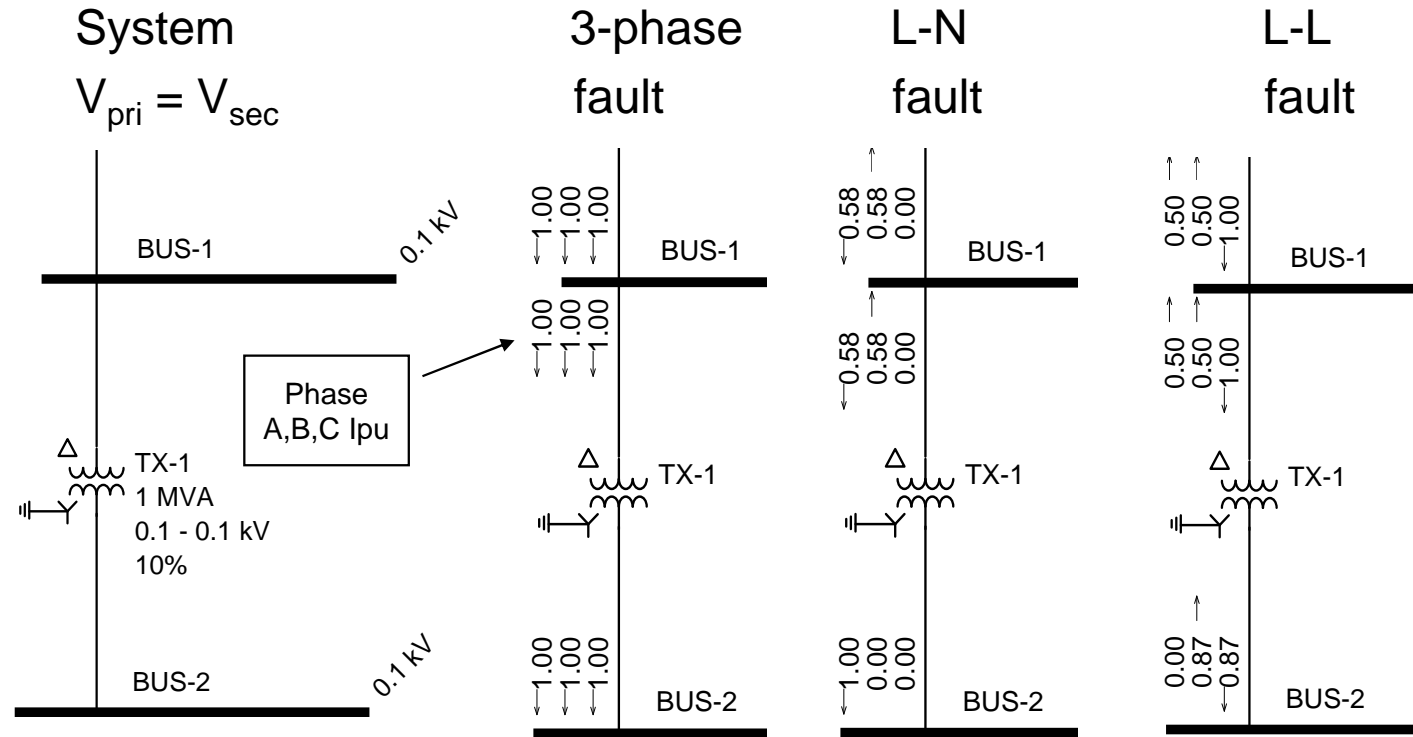
1-33

If transformers are connected Y-Y, Y-YG, YG-YG, or delta-delta, all secondary faults will reflected into the primary by the transformation ratio. If a delta-wye or delta-zigzag connection is used, we must also compensate the log-log plot by an additional factor to handle the ratio of primary to secondary current. In the above example I have made the transformation ratio 1:1 so that you can see the effect of the transformer connection for different faults. In each diagram from left to right are shown the A,B, and C phase fault current values in per-unit. Notice for 3-phase faults no correction is necessary. The primary and secondary current are the same. For L-N faults the primary currents will only be 58% of the secondary currents. From the secondary current standpoint this makes the primary device appear 1/.58 or 1.732 times larger. For the L-L fault the ratio of largest phase current to secondary current is 87%. This has the effect of making the primary side device 87% smaller.