[redacted] Input on duration floors and uncertainty

Duration Floor – ac

For the ac testing, the longest spurious actuation signal we have remains the 11 minute event seen during the initial EPRI/NEI testing. Next is the 7 minute event from CAROLFIRE. These values are well within the limits of the duration curve. Hence, the probability of a spurious operation signal that never clears is speculative, but cannot be dismissed entirely.

The most likely case for this to occur would be a slow heating exposure such as a hot gas layer. I also would expect it to be more likely for a thermoplastic cable than for a thermoset. With thermoplastic it is more feasible to lock in a spurious operation when the fire is extinguished. That is, if the cable has just reached it's failure point when the fire is suppressed, the insulation may melt enough to allow a short to form and then solidify locking that fault in indefinitely, even if water is sprayed on the cables.

For thermoset, this seems far less likely. Thermosets don't melt and only fail when the insulation gets hot enough to char and burn. This means that fire suppression is less likely to lock in a fault given fire suppression. For thermosets, use of water in firefighting is also more likely to cause cascading shorts to ground rather than lock in a short independent of ground.

This observation is, however, tempered by the dc test results where one of four long duration faults were actually associated with a thermoset cables (see discussion below). Hence, longer duration faults in the thermosets cannot be dismissed.

Overall, I would concur with the proposed value of 1E-3 (0.001) as the likelihood of a non-clearing spurious operation signal for ac circuits. For uncertainty I would assign no higher than 2E-3 as a 95th percentile and about 5E-4 as a 5th percentile.

I could accept use of the same values for both thermoplastic and thermoset cables, but would actually recommend reducing these values by a factor of five for thermoset cables. That is, for thermoset the mean value would be 2E-4, the 95th percentile value 4E-4 and the 5th percentile value 1E-4.

Floor value dc circuits

My assessment for the dc circuits is based on the longer duration spurious actuation signals observed in DESIREE-Fire. In particular, I found four spurious operation signals that exceeded 15 minutes duration, including one that locked in beyond termination of the test. These cases are:

- Penlight test 11, Large Coil circuit – 1052s duration (17.5 min) (TP cable)
- Penlight test 30, MOV2 – 1427s duration (23.8 min) (TP cable)
- Penlight test 43, MOV2 – signal never cleared (in excess of 100 min) (TP cable)
- Penlight test 44, MOV1 – 1195s duration (19.9 min) (TS cable)

The most troubling aspect of this data set is that all come from the Penlight radiant heating tests which only involved individual lengths of cable rather than random fill trays or bundled cables. It is likely that

with grouped cable arrangements, longer duration spurious operations are less likely. However, sparsely loaded raceways also exist and must be considered.

It is also interesting that one of these long duration faults was a TS cable, while the other three were TP cables.

The durations for Tests 11, 30, and 43 nominally fall within the bounds of the general duration curve (e.g., faults up into the 20-30 minute range). However, Test 43 is the clear outlier. Given well over 100 individual dc circuit trials (even discounting the switchgear breaker tests) and only one spurious operation signal that never cleared (and that in a Penlight test), that would argue for a relatively low floor value and a very high likelihood that spurious actuation signals would clear within 30 minutes. Overall, I would recommend a floor value of 0.01 (1%) for the dc circuit case as a somewhat conservative assessment of the test results. I would place the 95^{th} percentile confidence limit here at 0.02 and the 5^{th} percentile as 0.005 reflecting a similar magnitude of uncertainty as assigned to the ac cases.

Duration Curve Uncertainty Factor

I generally agree with the discussion that took place during the meeting and agree that the uncertainty bounds should capture the potential for, in particular, fire scenarios such as the hot gas layer where the duration are likely to be longer than the mean curve would indicate. Overall, I would recommend that the uncertainty bounds be based on an S-factor of 2.0 or less. Certainly the S=3 curve was excessively conservative on the upper bounds.