Comparing 240 V_{ac} to 120 V_{ac} Series Arcing Faults

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Abstract – A comparison of the two system voltages, $120V_{ac}$ and $240V_{ac}$ at 60Hz, available in North American residential applications, was made to determine why a series arcing fault at $240V_{ac}$ had a significantly higher probability of fire ignition than at $120V_{ac}$. Experiments using SPT-2 wire were performed per UL1699 standards at each voltage level with equal nominal steady-state non-arcing load currents (e.g. $5A_{rms}$, $10A_{rms}$, $15A_{rms}$, and $20A_{rms}$). It was shown that the arc power dissipated in the series arc was greater at $240V_{ac}$ than $120V_{ac}$. This increased arc power was due to a higher average arcing current at 240Vac. This was attributed to the arcing path resistance having a larger affect at the lower system voltage and also due to an increase in the number of continuous arcing half-cycles at 240Vac because the higher system voltage could more readily breakdown the gap than at 120Vac. Furthermore, the increased arcing power would increase heating of the gap thus reducing the breakdown strength of the series fault gap. The average arc voltage however remained about equal for the two voltage levels. These results may be useful for exploring additions to the UL1699 "fire curve" for "straight" $240V_{ac}$ applications.

Keywords: series arc, arcing fault, arc voltage, fire, residential, AFCI, combination-circuit-breaker, UL1699