THE STATE CORPORATION COMMISSION
OF THE STATE OF KANSAS

Before Commissioners: Pat Apple, Chairman
Jay Scott Emler
Shari Feist Albrecht

In the Matter of the Complaint Against Kansas City Power & Light by Jamie Littich	))	Docket No. 16-KCPE-195-COM

RESPONSE TO KCPL'S KCC REPORT 2 RESPONSE

This response is primarily corrective on key arguments made by KCPL but it also includes additional considerations for NFIRS records and the KCPL surge protection product.

The KCPL provided Cooper Industries standard and resultant KCPL calculations:

- The Cooper Industries standard that KCPL attached is one vendor's guide to calculate what is referred to as prospective short circuit current. The guide is intended to provide Cooper Industries' customers with a method to determine the minimum interrupt rating of Cooper Industries' protective devices such as a fuse. Given that the examples and methodology are simplified, the manufacturer has included multipliers in the short circuit calculation to cover worst case variances for any application. This means the calculations go beyond system-specific short circuit currents which includes transformer short circuit current and sub-transient or reactive discharge current. Again, the intent of the calculation is to select a fuse with the appropriate interrupt rating and the guide is appropriate for Cooper Industries' products. The examples provided in the guide show implemented products with interrupt ratings that are well beyond the guides calculated interrupt rating value.
    - Sub-transient/reactive energy, in simple terms, is stored energy in the systems components that rapidly discharges during a short circuit. The reason protective devices allow for in-rush current when a system is initially charged is the same reason sub-transient or reactive discharge is included in system fault current calculations.

- The interrupt rating of a fuse has a different purpose than the ampere rating of a fuse. The interrupt rating is to ensure that the fuse can safely function given a system fault at a given location (e.g. it includes transformer short circuit current plus sub-transient discharge current so that an arcing doesn't bypass the component) while the ampere rating is selected to protect an associated device which in this case is the transformer; derivatively it protects the system.
- KCPL's claim that *the CT current **was not** near the magnitude of [prospective short circuit current], therefore the event **was not** a bolted fault* is inaccurate. The short circuit that occurred was a bolted fault to the degree that the secondary lateral conductors could sustain. If the secondary lateral conductors were more robust, the coordinated damage curves of KCPL's system show that the transformer would've been the next component to fail, not the transformer fuse. The secondary lateral conductors and then the transformer are protecting the automatic disconnecting device. Transformers and conductors are not allowable automatic disconnecting devices per the NESC, as previously explained to the commission.
- The only current expected in the Phase C CT data (at the feeder) for this event is the current transferring through the transformer. The feeder CT is not configured at the appropriate resolution to record sub-transient or reactive discharge, but more importantly, it is not located at the correct location to record the maximum system fault current of the secondary (again, transformer short circuit current plus sub-transient/reactive discharge).
- See Attachment A to compare a Cooper Industry's fuse specification with the example that includes its use. The commission and staff should be able to conclude that even though the guide discusses types of fuses, it is not a guide that instructs the selection of ampere rating.

KCPL References to the Premier Edition Handbook of the NESC:

- Even though KCPL's references to the intentions of the NESC authors via the Handbook comes across as a strong argument, KCPL omitted the Premier Handbook's discussion on KCC staff selected NESC language as to how Part 1 applies to utilization equipment and conductors regardless of whether it's located in a substation or overhead/underground. On page 86, which is a continuation of a discussion of Part 1 scope and which was omitted in KCPL's response, the hand book includes:

> Electric supply stations owned by, and installed in, an industrial establishment where the facilities are under the control of, and accessible only to, properly qualified persons continue to be covered by the 1971 Code and later editions. Examples given in the 1971 Code are paper and steel industries. Clear keys to determining whether the NEC or the NESC is applicable to an industrial installation are (1) does the "electric supply station" have an electricity generation or a delivery function (as opposed to solely a utilization wiring function); and (2) is the facility under the exclusive control of, and accessible only to, qualified persons? If the answer to these questions is "yes," the NESC applies.
>
> The definition of *generating station* was added in the 1993 Code to make more explicit the type of facility included in the scope of Part 1. In deliberating the 1995 proposal to add the definition, it was explicitly stated that telecommunications central stations were covered by codes other than the NESC. In 1997, the definition of *supply station* was added; *supply station* now includes the subcategories of *generating stations* and *substations*. A generation station includes all facilities, including auxiliary equipment, that are required for the conversion of some form of energy to electric energy. Substations include areas where electricity is switched or transformed, but does not include generation.
>
> It is important to observe the distinction between the requirements of the code for station equipment and for utilization equipment, even when the former is of the same nature as the latter. A somewhat less general use of guards and less complete isolation is allowable with station equipment that is accessible only to qualified persons than is allowable with electrical utilization equipment that is accessible to unqualified persons, as is often the case in workshops, mercantile establishments, and other similar places that are covered by the NEC.
>
> Part 1 is intended to apply to utilization of conductors and equipment by a utility in the exercise of its function as a utility (but not for office buildings, etc., to which the NEC applies).
>
> The addition of grounding requirements for systems over 750 V to Part 1 in the 1993 Code signals the inclusion of HVDC terminals in the scope of Part 1. DC station clearances were added in Table 124-1 in the 2002 Code equal to the clearances for ac circuits having the same crest voltage to ground.

- The NESC standard recognizes that utilization equipment/conductors should be more protected where unqualified persons can interact or come into contact with the system compared to where only qualified persons are intended to interact with the system.
- KCPL's claim that *"Staff's expansive application of the scope of Part 1 to encompass overhead facilities, like those in question in this docket, is inappropriate and contrary to the NESC drafters'* ***intent****"* is clearly false because the drafters directly re-explain in the handbook that *Part 1 is* ***intended*** *to apply to utilization of conductors and equipment by a utility in the exercise of its function as a utility (but not [] to which the NEC applies).*

- Rule 153, "Short circuit protection of power transformers", is discussed by the premier handbook as follows:

> **Rule 153.** *(Rule 153 of the 1941 Code and prior editions was deleted in the 1971 Code; see Rules 124 and 127. Rule 153 of the 1971 Code was moved to Rule 152 in the 1981 Code. Rule Number 153 was unused from 1981 until the 1997 Code added requirements for short circuit protection of power transformers.)*
>
> If a power transformer suffers a high-magnitude internal fault, the results can be catastrophic for the transformer and/or upstream facilities, if the faulted transformer is not promptly removed from the system. Such protection is especially critical for generator step-up transformers and station auxiliary transformers, in which case the generator electric field and mechanical energy source must be disconnected. These protection requirements apply to power transformers, but are not required for transformers used specifically for control, protection, or metering.
>
> The rule intentionally allows single-phase protection where that is appropriate.

  - The context of the NESC and this rule is that it is a performance requirement. The internal fault language is intended to communicate that if transformer current is high in magnitude (not to exclude external shorts if they are similar to an internal fault) an automatic disconnecting device is required to promptly remove the transformer from the system – "promptly" contextually means before other utilization components automatically disconnect due to overcurrent.
    - From page 4 of the Premier NESC Handbook:

> **010. Purpose**
>
> A. The purpose of the NESC is the practical safeguarding of persons and utility facilities during the installation, operation, and maintenance of electric supply and communication facilities, under specified conditions.
>
> *NOTE:* NESC rules are globally recognized and intended to provide a practical standard of safe practices that can be adopted by public utilities, private utilities, state or local utility commissions or public service commissions, or other boards or bodies having control over safe practices employed in the design, installation, operation, and maintenance of electric supply, communication, street and area lighting, signal, or railroad utility facilities.
>
> B. NESC rules contain the basic provisions, under specified conditions, that are considered necessary for the safeguarding of:
>
> 1. The public,
> 2. Utility workers (employees and contractors), and
> 3. Utility facilities.
>
> C. This Code is not intended as a design specification or as an instruction manual.

    - From page 1 of the Premier NESC Handbook:

> Rule 010 also states that the Code is not a design specification or an instruction manual. The NESC is a performance standard. It does not specify materials to be used for certain installations, nor does it provide instructions on how to meet the Code requirements. The Code recognizes that design specifications and work methods vary from utility to utility depending on many factors such as location, typical climate conditions, terrain, etc. The most common example of this rule is that the Code requires clearances above ground over which the overhead lines pass, but the Code does not require the use of a certain type of structure to support the overhead lines. Metal lattice-type towers, wood, concrete, fiberglass, or metal poles may be used as long as the structure meets the Code's strength requirement and is high enough to provide the required clearance.

- The transformer in question is not for control, protection or metering.
- *"If a power transformer suffers a high-magnitude internal fault, the results can be catastrophic for the transformer and/or upstream facilities if the fault is not promptly removed,"* or in other words, safety and reliability of the system can be affected, therefore this is an operational requirement.

- Rule 171, "Application of Circuit breakers, reclosers, switches and fuses", is discussed by the Premier NESC Handbook as follows:

> **171. Application**
>
> Circuit breakers, circuit switchers, reclosers, switches, and fuses should be utilized with due regard to their assigned ratings of voltage and continuous and momentary currents. Devices that are intended to interrupt fault current shall be capable of safely interrupting the maximum short-circuit current they are intended to interrupt, and for the circumstances under which they are designed to operate. The interrupting capacity should be reviewed prior to each significant system change.
>
> **Rule 171.** *(This rule was formed in the 1971 Code from the NOTE of Rule 107A of the 1941 Code and prior editions; former Rule 171 was deleted; see Rule 111.)*
> Circuit-interruption devices serve various purposes. Both safety and reliability are served by careful choice of devices to match the system capacity and other requirements of its intended service. The stated intention that device capacity should be reviewed whenever significant system changes are considered was added in the 1981 Code.
> Switches are not included in the rule requirement for adequate fault-current-interrupting capability because a switch should not be used to interrupt *fault* current. However, the use of circuit switchers was allowed in the 1997 Code so long as they are matched in capability with the overall protective scheme requirements for fault current interruption duty.

- Switches, such as a manual disconnect, are clarified to not be an interrupting device.
- It is stated that both safety and reliability are served by careful choice of devices to match the system capacity and other requirements of its intended service. This is an operational requirement that compliments Rule 153.

Mr. Troy B. Little's Affidavit:

- It is important to observe that Troy B. Little has positioned himself as a qualified electrical engineer for the "The Littich Complaint" and concludes that his opinions are provided to a reasonable degree of engineering certainty. Effectively, Mr. Little has formally asserted a professional title and then renders engineering services and engineering interpretations to KCPL in a jurisdiction where he is not registered; a potential violation of K.S.A 74-7001 which the Board of Technical Professionals could review. The inclusion of Mr. Little in this most recent response raises concern that KCPL does not employ a Kansas licensed engineer to weigh in on this issue and provide the engineering methodology of their fusing table.

- Regardless, limited response to Mr. Little's Affidavit can be provided because the contents of his affidavit do not provide much substance to respond to; it more or less reads as a combination of partial interpretation and a wave of the hand:
    - There is no disagreement that some aspects of Part 1 do not apply to Part 2, but Mr. Little failed to address the KCC staff quoted NESC language as to how Part 1 rules apply to Part 2.
    - Mr. Little does not address other critical issues with KCPL's system such as the soundness of the fusing table (with regard to how it coordinates) or KCPL's adherence to tree trimming clearance requirements.
    - Mr. Little claims to support a high impedance fault conclusion but he does not support it with case examples of CT currents caused by a tree limb versus a shorted secondary. The tree limb scenario, as KCPL described it, is very observable to bystanders. It would also produce evidence where a tree limb is clearly burned by an energized wire for a period of time. The accounts provided by witnesses to the event never included a tree limb hanging in the lateral as KCPL describes, the Fire Investigator who arrived on scene that day never recorded that kind of evidence, and the discovered photos from KCPL's investigation do not show any tree limb with the appropriate damage.
- See Attachment B for an example high impedance tree limb event. No evidence similar to Attachment B was recorded by any party for the May 21st, 2015 event.

The cost of having to implement the 10A fuses:

- KCPL stated some general opposition to the cost of KCC staff recommendations but didn't specifically state that the cost of replacing transformer fuses and repairing secondary conductors were the reason why it opposed KCC staff recommendations. They instead stated that those two reasons were not warranted by a single event which, per previous responses to the commission, KCPL has forfeited knowledge or experience in claiming that the event is isolated.

- The fuse in question is approximately a $10 fuse according to their manufacturer's website. Re-stringing a burnt-down conductor would obviously be more expensive than having the proper fuse to prevent that damage. But to actually avoid outages, KCPL would then have to do the tree maintenance they are required to do (regardless of the fuse size) which is a greater cost but still does not compare to the customer damages in this case.

Considerations for NFRIS Event Analysis:

- In KCC Staff's second report, the staff acknowledged that KCPL does not maintain records of abnormal operating events but stated that they assumed this type of event would account for a small percentage of the outages KPCL experiences. The context of the staff assumption were for the condition where safety to customers and the system is clearly in question. The staff's assumption is agreeable only to the degree that the randomness of this uncoordinated and unmaintained system can produce. The scenario where significant damage is observed may be relatively low but that does not remove that the scenario occurs more often than it should, nor does it exclude that the system frequently operates abnormally because it's not maintained properly.
- The commission will have to develop some method of weighing events that were indicators to KCPL that maintenance was required even though major damages were not observed. These types of event will be very numerous in the NFIRS records.

Considerations for the KCPL Surge Arresting Device and Program:

- Even though the weather head is considered to be the point of service, the meter is considered to be NESC territory. Surge arrestors for customer meters however are NEC territory.
  - The NESC doesn't explicitly allow the surge arrestor for the customer meter.

  - For a surge arrestor to operate correctly, a very short path and low impedance to ground is required. It would be very unusual for a utility to claim responsibility for a ground rod installed locally at the box.
  - The NEC clearly provides requirements for surge arrestors.
- There is admittedly no correct answer for KCPL on whether or not the meter box surge arrestor is designed for the sustained short circuit scenario on the secondary.
  - If the surge arrestor isn't designed for the secondary short circuit scenario that includes the oversized transformer fuse, it would possibly make the surge arrestor non-compliant with NEC 280.4-A3 and simultaneously a product that does not perform as KCPL advertises.
  - If the surge arrestor does prevent all home damage from the scenario in question, since the transformer fuse is not sized to be compliant with the NESC, the KCPL system has a unique capability of causing fires that KCPL in turn sells fire insurance/prevention for.
- Other than the terms and conditions, very little is known about the design of KCPL's surge arrestor product. KCPL has repeatedly relied upon the notion of surge protection and customer obligations to their own wiring as the reason KCPL is not at fault. This has been done with complete disregard to their own obligations.
- It is my strong belief that KCPL's surge arrestor product warrants further review, if not by the commission, at least by other Kansas consumer and insurance protection entities.

Conclusion

A ruling that KCPL is in violation and for further proceedings is warranted and nothing provided by KCPL satisfies staff's request to show cause to prevent further proceedings and requirements.

Respectfully submitted,

Jamie Kathleen Littich
5748 Walmer Street
Mission, KS 66202
jamiekw73@gmail.com

Single-Phase Short Circuits

Line-to-Line Fault @ 240V — Fault X_1

One-Line Diagram

Available Utility
Infinite Assumption

75KVA, 1Ø Transformer,
1.22%X, .68%R
1.40%Z
120/240V

Negligible Distance

400A Switch

LPN-RK-400SP Fuse

25' - 500kcmil

Magnetic Conduit

Fault X_1

Step 1. $I_{f.l.} = \frac{75 \times 1000}{240} = 312.5A$

Step 2. $\text{Multiplier} = \frac{100}{1.40} = 71.43$

Step 3. $I_{S.C.} = 312.5 \times 71.43 = 22,322A$

Step 4. $f = \frac{2 \times 25 \times 22,322}{22,185 \times 240} = .2096$

Step 5. $M = \frac{1}{1 + .2096} = .8267$

Step 6. $I_{S.C.\ L\text{-}L\ (X_1)} = 22,322 \times .8267 = 18,453A$

Line-to-Neutral Fault @ 120V — Fault X_1

One-Line Diagram

Available Utility
Infinite Assumption

75KVA, 1Ø Transformer,
1.22% X, .68%R,
1.40%Z
120/240V

Negligible Distance

400A Switch

LPN-RK-400SP Fuse

25' - 500kcmil

Magnetic Conduit

Fault X_1

Step 1. $I_{f.l.} = \frac{75 \times 1000}{240} = 312.5A$

Step 2. $\text{Multiplier} = \frac{100}{1.40} = 71.43$

Step 3. $I_{S.C.\ (L\text{-}L)} = 312.5 \times 71.43 = 22,322A$

$I_{S.C.\ (L\text{-}N)} = 22,322 \times 1.5 = 33,483A$

Step 4. $f = \frac{2^* \times 25 \times 22,322 \times 1.5}{22,185 \times 120} = .6288$

Step 5. $M = \frac{1}{1 + .6288} = .6139$

Step 6. $I_{S.C.\ L\text{-}N\ (X_1)} = 33,483 \times .6139 = 20,555A$

*Assumes the neutral conductor and the line conductor are the same size.

Attachment A

COOPER
Bussmann

Low-Peak® Dual-Element, Time-Delay Fuses
Indicating & Non-indicating Class RK1 – 250 Volt 70-600 Amps
LPN-RK_SPI & LPN-RK_SP Series

Catalog Symbol: LPN-RK_SP (non-indicating version)
LPN-RK_SPI (indicating version)

Ratings:

Volts – 250Vac/dc (70-600A)
IR – Vac: 300kA RMS Sym.
– Vdc: 100kA

IR = INTERRUPT RATING

Agency Information:

CE, UL Listed–Special Purpose*, Guide JFHR, File E56412
CSA Certified, (200kA IR) Class 1422-02, File 53787,
Class RK1 per CSA C22.2 No. 248.12

* Meets all performance requirements of UL Standard 248-12 for Class RK1 fuses.

Catalog Numbers - Non-indicating versions

LPN-RK-70SP	LPN-RK-150SP	LPN-RK-350SP
LPN-RK-80SP	LPN-RK-175SP	LPN-RK-400SP
LPN-RK-90SP	LPN-RK-200SP	LPN-RK-450SP
LPN-RK-100SP	LPN-RK-225SP	LPN-RK-500SP
LPN-RK-110SP	LPN-RK-250SP	LPN-RK-600SP
LPN-RK-125SP	LPN-RK-300SP	—

Catalog Numbers - Indicating versions

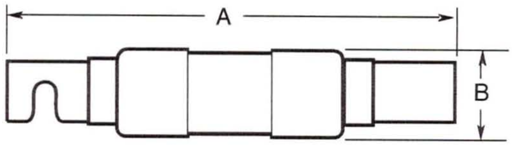
LPN-RK-70SPI	LPN-RK-150SPI	LPN-RK-350SPI
LPN-RK-80SPI	LPN-RK-175SPI	LPN-RK-400SPI
LPN-RK-90SPI	LPN-RK-200SPI	LPN-RK-450SPI
LPN-RK-100SPI	LPN-RK-225SPI	LPN-RK-500SPI
LPN-RK-110SPI	LPN-RK-250SPI	LPN-RK-600SPI
LPN-RK-125SPI	LPN-RK-300SPI	—

Carton Quantity and Weight

Ampere Ratings	Carton Qty.	Weight** Lbs.	Weight** Kg.
70–100	5	1.9	0.9
110–200	1	0.9	0.4
225–400	1	2.0	0.9
450–600	1	3.0	1.4

**Weight per carton.

Dimensions - in



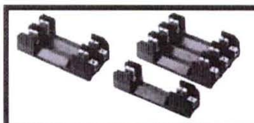
Amp Ratings	"A"	"B"
70-100	5.88 (± 0.062)	1.10 (± 0.020)
110-200	7.13 (± 0.062)	1.61 (± 0.020)
225-400	8.63 (± 0.094)	2.36 (± 0.020)
450-600	10.38 (± 0.094)	2.88 (± 0.020)

Features:

- Current-limiting for maximum short-circuit protection.
- Type 2 "No Damage" protection for IEC and NEMA starters when properly sized.
- High in-rush current motor protection.
- Time-delay that permits 130% FLA sizing for back-up motor protection.
- Provides protection against single-phase motor damage.
- Low watt loss power consumption.
- Electrically isolated end caps.
- 250Vdc, UL Listed, CSA Certified.

Applications:

- Branch distribution
- Motors
- Transformers
- Solenoids
- General purpose circuits



Recommended fuseblocks for Class R 250V fuses
See Data Sheet: 1110

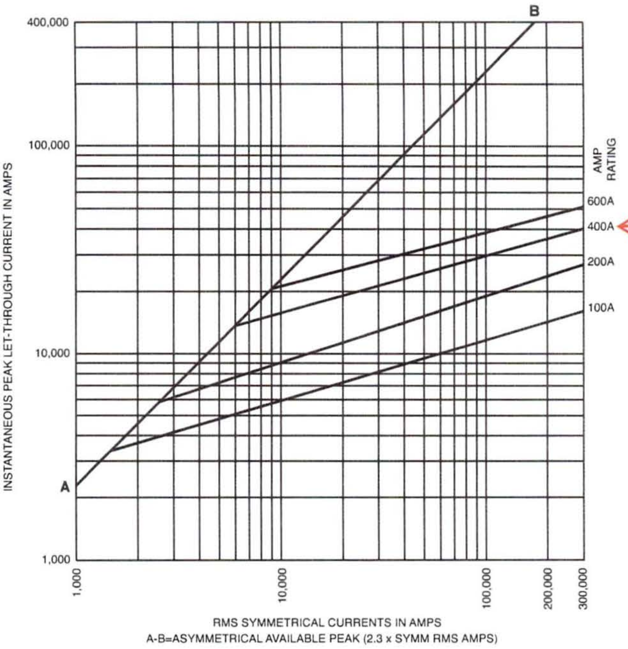
Fuse Reducers For Class R Fuses

Equipment Fuse Clips	Desired Fuse (Case) Size	Catalog Number (Pairs) 600V
200A	100A	No. 2621-R***
400A	100A	No. 2641-R
	200A	No. 642-R
600A	100A	No. 2661-R
	200A	No. 2662-R
	400A	No. 2664-R****

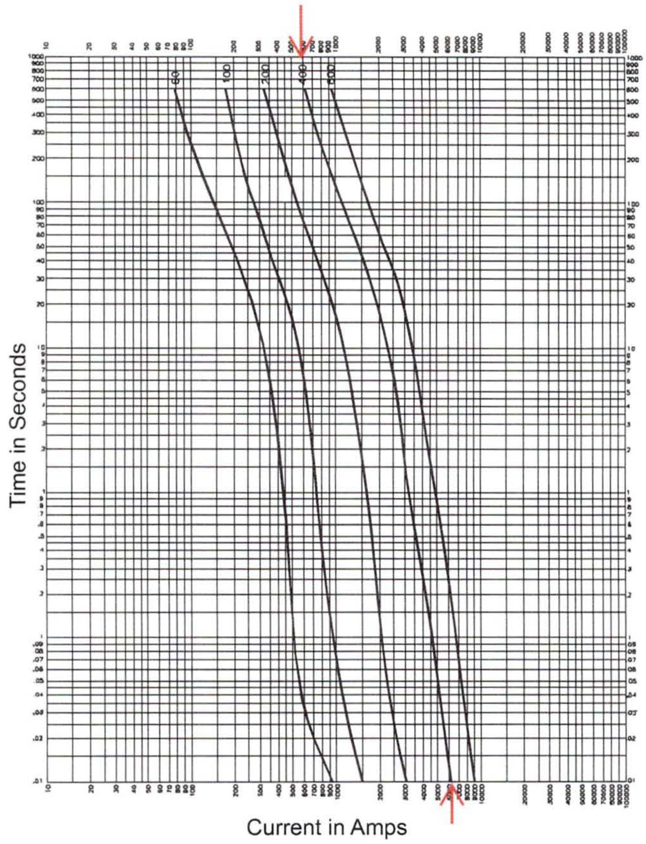
***Reducer 2621-R does not apply to 70 through 100 amp Low-Peak fuses.
****Single reducer only (pair not required).
For additional information on Class R fuse reducers, see Data Sheet 1118.

Attachment A

Current Limitation Curves



Time-Current Characteristic Curves–Average Melt



Note: 60 Amp fuse curve is ferrule style and included to show only relative performance. For actual 60 amp time-current curve performance, see Data Sheet 1003.

Current-Limiting Effects

Prosp. S.C.C.	Let-Through Current (Apparent RMS Symmetrical) Versus Fuse Rating			
	100A	**200A**	**400A**	**600A**
5,000	2,100	3,150	5,000	5,000
10,000	2,600	3,950	6,900	9,250
15,000	2,950	4,500	7,650	10,250
20,000	3,200	4,900	8,350	11,050
25,000	3,350	5,300	8,850	11,750
30,000	3,550	5,600	9,300	12,250
35,000	3,750	5,850	9,700	12,800
40,000	3,900	6,150	10,050	13,250
50,000	4,150	6,600	10,700	14,050
60,000	4,400	7,000	11,250	14,750
80,000	4,750	7,650	12,200	15,850
100,000	5,050	8,250	12,950	16,800
150,000	5,700	9,400	14,500	18,650
200,000	6,200	10,300	15,700	20,100
250,000	6,600	11,050	16,700	21,250
300,000	7,000	11,750	17,550	22,350

*Values derived from curve data

COOPER Bussmann

Attachment A

Photo provided from location 399 Echo St., Shell Knob, MO 65747 on August 12th, 2016 at approximately 8:15 PM after a severe storm pass through the area. (Not a KCPL area)

This species of sycamore does not exist near 58th & Walmer.


This is what a high impedance fault through a tree limb looks like. The energized wire cleared a hole in the limb until the line failed which triggered the arresting device.
Attachment B


More evidence of burning.
Attachment B