PO Box 53933
Phoenix, Arizona 85072-3999

01/26/2017

Subject: ***Secondary Arc Flash Calculations for Commercial and/or Industrial Installations at voltage levels 600V and less.***

To whom it may concern:

The following information is being provided at the Customer's request, in order to enable the Customer's electrical contractor to perform Arc Flash Calculations. Please keep in mind that the Arc Flash Calculations should be performed by a Registered Professional Electrical Engineer, in the State of Arizona.

The information APS is providing herein is generic (as opposed to specific) as it relates to a particular address or location, and (as set forth more fully below) the conditions at any particular address or location may be subject to change without notice. Therefore, APS cannot guarantee the accuracy of the information as it pertains to a specific location at any given time.

Additionally, APS highly recommends that, regardless of the results of any arc flash calculations, all work on or near Customer-owned electrical equipment be performed only after the electrical equipment has been de-energized.

Regarding maximum fault current values, APS provides maximum fault current values in the APS Electric Service Requirements Manual (ESRM) (www.aps.com/esrm) Section 800. For example, Table 800.2 in the ESRM represents maximum fault current values[1]. As noted in the ESRM, the maximum fault current values[1] are based on serving a Customer's Electric Service Entrance Section (SES) with transformation and service conductors rated at a minimum of 80% of its SES nameplate capacity. However, as noted in Section 800.5, transformer sizes could be larger if serving multiple SESs.

Regarding minimum fault current values, APS will not provide to secondary service customers the following: primary fault current data, actual transformer impedance nameplate information, and primary coordination information (such as upstream primary over-current protective device type, size and setting). However, APS is providing herein Attachment A which sets forth Distribution Transformer Impedance Ranges, and Attachment B which sets forth typical secondary conductor configurations. Actual transformer nameplate and approximate cable or conductor lengths between transformers and SESs will require a field survey. Customer shall coordinate with qualified APS Representative in order to obtain actual transformer nameplate. Based on this typical and current specific information, the Customer's electrical engineer should be able to perform calculations regarding a range of minimum fault current values. However, as previously indicated, the APS-provided information is typical not actual, as it relates to a specific location.

Please note that the APS electrical system is dynamic and subject to change without notice to the Customer. Therefore, due to its many variables, it is recommended that a range of impedances be considered when making arc flash calculations. The dynamics of the APS electrical system may include:

- The electric system that is feeding a specific location has the potential of being reconfigured at any time without advance notice to Customer, for system maintenance and/or load expansion.

- When a distribution transformer is replaced, the size is reassessed based on the expected loading, and the replacement transformer can have an impedance value anywhere in the range specified in Attachment A to this letter. In addition, a transformer upgrade may be performed to provide power to multiple services in accordance with Section 800.5 of the ESRM, and APS'S applicable Service Schedules.

[1] Fault current values from the APS ESRM are limited to fault current contributions from APS primary distribution system. They do not include contributions from customer owned equipment or from other customers served from the same transformer.

- The protective devices associated with the distribution transformer are intended to provide protection to the APS facilities only, and should not be relied upon to protect any Customer electrical equipment.

- Additionally, it may not be possible to obtain the actual length of a conductor, and therefore, the measurement may only be an approximation. Also, although APS typical secondary conductor configurations are provided in Attachment B to this letter, the actual current configurations may vary, depending on transformer sizes and SES loadings.

Consequently, APS reiterates that **APS highly recommends that all work on or near Customer-owned electrical equipment be performed only after the electrical equipment has been de-energized to eliminate Arc Flash Hazards.**

If you have any questions or concerns, please contact your APS Representative.

Regards,

Frankie Greco, P.E.
Sr. Electrical Engineer
APS ESRM Committee

APS Secondary Arc Flash Calculations for Commercial/Industrial Installations
Attachment A – Distribution Transformer Impedance Ranges

The impedance of APS' distribution transformers are required to be within the indicated range. Either the design or tested impedance of the transformer is recorded on the transformer nameplate. APS will not provide specific transformer nameplate information.

Each table below lists the full range of transformer sizes for each transformer type. If a replacement is required due to a transformer failure or to provide power to multiple services, a larger transformer could be installed with a different impedance range.

Table 1: Single Phase Pad-Mount
120/240V, 1θ Secondary Voltage

Transformer kVA	Impedance Range	
	Minimum	Maximum
100 & below	1.6%	2.7%
167	1.8%	3.0%

Table 2: Single Phase Overhead
120/240V, 1θ Secondary Voltage

Transformer kVA	Impedance Range	
	Minimum	Maximum
100 & below	1.6%	3.0%
167	1.8%	3.0%

Table 3: Three Phase Pad-Mount
120/208V, 3θ Secondary Voltage

Transformer kVA	Impedance Range	
	Minimum	Maximum
112.5 - 300	1.35%	3.00%
500	2.25%	3.00%
750-1000	5.35%	6.15%

Table 4: Three Phase Pad-Mount
277/480V, 3θ Secondary Voltage

Transformer kVA	Impedance Range	
	Minimum	Maximum
112.5 - 300	1.35%	3.00%
500	2.25%	3.00%
750-2500	5.35%	6.15%

Table 4: Three Phase Overhead
120/208V, 3θ Secondary Voltage

Transformer kVA	Impedance Range	
	Minimum	Maximum
3-25	1.6%	2.7%
3-50	1.6%	2.7%
3-75	1.6%	2.7%
3-100	1.6%	2.7%
3-167	1.8%	3.0%

Table 4: Three Phase Overhead
277/480V, 3θ Secondary Voltage

Transformer kVA	Impedance Range	
	Minimum	Maximum
3-25	1.6%	2.7%
3-50	1.6%	2.7%
3-75	1.6%	2.7%
3-100	1.6%	2.7%
3-167	1.8%	3.0%

APS Secondary Arc Flash Calculations for Commercial/Industrial Installations
Attachment B – Typical Underground Service Conductor Configurations

APS typical secondary conductor configurations are noted below. NOTE: field configuration may vary based on transformer size and SES loading. The following represents APS minimum configuration as per APS Schedule 3 requirements. Typically, the following represents serving the customer's SES at 60% of it's rating for 3-phase and 52% of 1-phase. Standard industry conductor is utilized, reference Section 9 of the NEC and/or the "Short Circuit Calculation" Section of the Cooper-Bussman SPD handbook for conductor characteristics (impedances).

	APS T&D DESIGN (UG)		
SES	SRVC @ 120/240V, 1θ	SRVC @ 120/208V, 3θ	SRVC @ 277/480V, 3θ
200	25kVA, 1-UA1/0AV[2] (2-1/0 Al + 1-#2 Al)[3]	112.5kVA, 1- UA750DDV[2] (3-750 Al + 1-500 Al)[3]	112.5kVA, 1-UA4/0DV[2] (3-4/0 Al + 1-2/0 Al)[3]
400	50kVA, 1-UA4/0EV[2] (4-4/0 Al + 1-4/0 Al)[3]	112.5kVA, 1-UA750DDV[2] (3-750 Al + 1-500 Al)[3]	225kVA, 2-UA4/0DV[2] (6-4/0 Al + 2-2/0 Al)[3]
600	75kVA, 2-UA4/0BV[2] (4-4/0 Al + 2-2/0 Al)[3]	150kVA, 1-UA750DDV[2] (3-750 Al + 1-500 Al)[3]	300kVA, 1-UA750DDV[2] (3-750 Al + 1-500 Al)[3]
800	100kVA, 2-UA4/0EV[2] (8-4/0 Al + 2-4/0 Al)[3]	225kVA, 2-UA750DDV[2] (6-750 Al + 2-500 Al)[3]	500kVA, 2-UA750DDV[2] (6-750 Al + 2-500 Al)[3]
1000		225kVA, 2-UA750DDV[2] (6-750 Al + 2-500 Al)[3]	500kVA, 2-UA750DDV[2] (6-750 Al + 2-500 Al)[3]
1200		300kVA, 3-UA750DDV[2] (9-750 Al + 3-500 Al)[3]	750kVA, 3-UA750DDV[2] (9-750 Al + 3-500 Al)[3]
1600		500kVA, 6-UA750DDV[2] (18-750 Al + 6-500 Al)[3]	1000kVA, 5-UA750DDV[2] (15-750 Al + 5-500 Al)[3]
2000		500kVA, 6-UA750DDV[2] (18-750 Al + 6-500 Al)[3]	1000kVA, 5-UA750DDV[2] (18-750 Al + 6-500 Al)[3]
2500		750kVA, 8-UC750DV[2] (24-750 Cu + 8-4/0 Cu)[3]	1500kVA, 6-UC750DV[2] (18-750 Cu + 6-4/0 Cu)[3]
3000		750kVA, 8-UC750DV[2] (24-750 Cu + 8-4/0 Cu)[3]	1500kVA, 6-UC750DV[2] (18-750 Cu + 6-4/0 Cu)[3]

[2] APS T&D Construction Standard Wire Code
[3] Cable Conductor Configuration showing Power Conductor Quantity /Type + Neutral Conductor Quantity/Type.