Transformer Design Guidance

Reference to LANL Engineering Standards Manual (ESM) Chapter 7—Electrical,
Section D5010, Electrical Service & Distribution

1.0 Scope

This guidance is for separately derived systems, also typically referred to as "lighting transformers."

2.0 Background

Transformers have specific design requirements, and not all of these requirements (e.g., NFPA 70) are captured in software analysis packages like SKM or ETAP.

3.0 Common issues found in transformer designs

A. The "grounding" conductor that runs between the transformer and the first means of overcurrent protection is called a Supply Side Bonding Jumper (SSBJ) and is covered in NEC 250.102(C). This conductor is sized per NEC T250.102(C)(1). Some analysis software sizes this conductor per NEC T250.122, but this usually results in too small of a conductor.

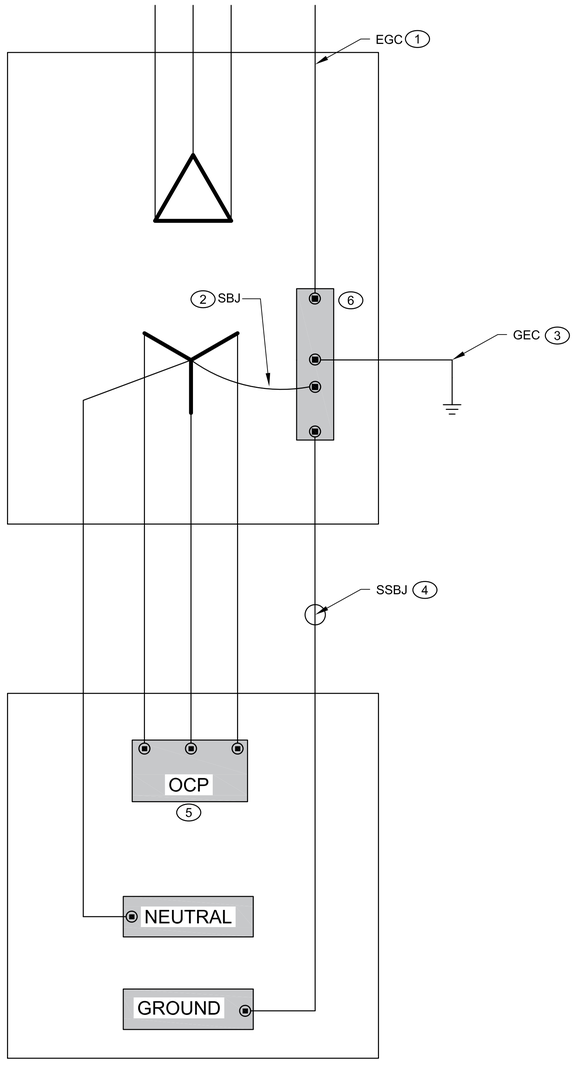
B. The transformer secondary conductors must be sized to carry at least as large a current as the overcurrent protection that they feed. This is covered in NEC 240.21(C); the next-size-up rule does not apply to transformers.

4.0 Other considerations -- refer to attached detail (schematic and table)

A. The neutral on the secondary side is not included in the detail. The neutral can be sized per NEC 220.61. This allows the neutral to be sized to carry the imbalance. If the neutral is also part of the effective ground-fault current path, the neutral must also be at least as large as the value in NEC T250.102(C)(1).

B. In the graphic detail, the System Bonding Jumper (SBJ) is in the transformer. This is a requirement of the LANL ESM. Having the SBJ here allows transformers to feed multiple panels and results in more consistent installations. Also, having the SBJ here means that the neutral between the transformer and the first means of overcurrent protection is not a part of the effective ground-fault current path.

C. In the table, some of the transformer sizes have multiple entries for overcurrent protection (OCP) sizes. The primary of a 75 kVA transformer, for example, shows that OCP of 100, 115, or 125 can be used. A 100 Amp OCP might be chosen if that is all that is available. Whichever OCP is chosen determines the sizes of the associated conductors. On some of the larger devices, multiple choices of conductor sizes are possible. For example, if 400 amp OCP is chosen on the secondary side, either single 600 kcmil conductors or parallel 3/0 conductors can be used.



PRIMARY

	KVA Rating	480 volt FLA	480 volt FLA *1.25	480 volt ocp	480 volt ungrounded conductor	480 volt EGC
	15	18	22.5	25	10	10
	30	36	45	45	8	10
(7)	45	54	67.5	60	6	10
				70	4	8
	75	90	112.5	100	3	8
				110	2	6
				125	1	6
	112.5	135	168.75	175	2/0	6
	150	180	225	225	4/0	4
(7)	225	270	337.5	350	1 X 500 2 X 2/0	1 X 3 2 X 3

SECONDARY

KVA Rating	208/120 volt FLA	208/120 volt FLA *1.25	208/120 volt typical ocp	208/120 volt ungrounded conductor	208/120 volt SSBJ		Grounding Electrode Conductor
15	41.7	52.1	60	6	8		8
30	83.3	104.1	100	3	8		8
45	125	156.3	125	1	6		6
			150	1/0	6		6
75	208.3	260.4	225	4/0	2		2
112.5	312.5	390.6	300	1 X 350 2 X 1/0	1 X 2 2X 6		2
			350	1 X 500 2 X 2/0	1 X 1/0 2 X 4		1/0 2
			400	1 X 600 2 X 3/0	1 X 1/0 2 X 4		1/0 2
150	416.7	520.9	400	1 X 600 2 X 3/0	1 X 1/0 2 X 4		1/0 2
			450	2 X 4/0 3 X 1/0	2 X 2 3 X 6		1/0 2
			500	2 X 250 3 X 2/0	2 X 2 3 X 4		1/0
225	625	781.3	600	2 x 350 3 X 3/0 4 X 1/0	2 X 2 3 X 4 4 X 6		2 1/0 1/0
			700	2 x 500 3 X 250 4 X 2/0	2 X 1/0 3 X 2 4 X 4		2/0 2/0 1/0
			800	2 x 600 3 X 300 4 X 3/0 5 X 2/0	2 X 1/0 3 X 2 4 X 4 5 X 4		2/0

GENERAL NOTES:

1. TRANSFORMERS MAY HAVE MULTIPLE CHOICES FOR OVERCURRENT PROTECTION, WITH CORRESPONDING SIZES FOR CONDUCTORS. THIS IS A DESIGN CHOICE. FOR EXAMPLE, A 45 KVA TRANSFORMER PRIMARY IS USUALLY PROTECTED BY A 70 AMPERE OVERCURRENT DEVICE BUT A 60 AMPERE DEVICE MAY BE ALL THAT IS AVAILABLE. THIS IS ACCEPTABLE.

KEYED NOTES:

(1) EQUIPMENT GROUNDING CONDUCTOR. NEC 250.118.

(2) SYSTEM BONDING JUMPER. NEC 250.30(A)(1). 250.28, T250.102(C)(1).

(3) GROUNDING ELECTRODE CONDUCTOR. NEC 250.66 AND TABLE 250.66.

(4) SUPPLY SIDE BONDING JUMPER. NEC 250.102(C).

(5) OVER CURRENT PROTECTION.

(6) INSTALL TERMINAL BAR FOR GROUNDING CONDUCTORS IN ACCORDANCE WITH NEC 450.10 IF NOT SUPPLIED BY THE EQUIPMENT MANUFACTURER.

(7) THESE TRANSFORMERS HAVE MULTIPLE CHOICES OF OCP FOR BOTH THE PRIMARY AND SECONDARY. A PARTICULAR CHOICE ON THE PRIMARY SIDE IS NOT MEANT TO CORRESPOND TO A CHOICE ON THE SECONDARY.