Correction to the Discussion of "Practical Definitions for Powers in Systems with Nonsinusoidal Waveforms and Unbalanced Loads: A Discussion"

The paper "Practical Definitions for Powers in Systems with Nonsinusoidal Waveforms and Unbalanced Loads: A Discussion" (95 WM 040-6 PWRD) by the IEEE Working Group on Nonsinusoidal Situations: Effects on Meter Performance and Definitions of Power and its accompanying discussion were published in the January 1996 issue of the IEEE TRANSACTIONS ON POWER DELIVERY (vol. 11, no. 1, pp. 79–101). The following should have been included in the section of the discussion by Robert J. Schneider of the Public Service Company of Colorado:

THE FOLLOWING ILLUSTRATIONS SHOW TRANSFORMER BANK I^2 WHEN APPLYING 1000 WATTS OF TOTAL RESISTIVE LOAD, IN VARIOUS COMBINATIONS, TO A 120 / 208 v "Y' AND A 240v DELTA TRANSFORMER BANK.

LOSS FACTORS ARE CALCULATED USING TWO METHODS:

$$\text{A) TRANSFORMER BANK LOSS FACTOR} = \frac{\text{ACTUAL BANK } I^2}{\text{BALANCED BANK } I^2}$$

$$\text{B) LOSS FACTOR} = \frac{1}{\text{PF}^2} \qquad \text{PF} = \frac{\text{WATTS}}{\text{VOLTAMPERES}}$$

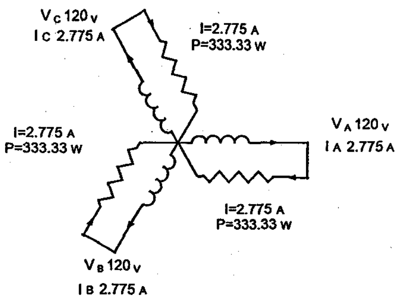
VOLTAMPERES ARE CALCULATED USING THE FOLLOWING THREE METHODS:

A) VECTORAL: $V = \sqrt{\text{WATTS}^2 + \text{VARS}^2}$

B) ARITHMETIC: $A = V_{AN\,(RMS)} \times I_{A\,(RMS)} + V_{BN\,(RMS)} \times I_{B\,(RMS)} + V_{CN\,(RMS)} \times I_{C\,(RMS)}$

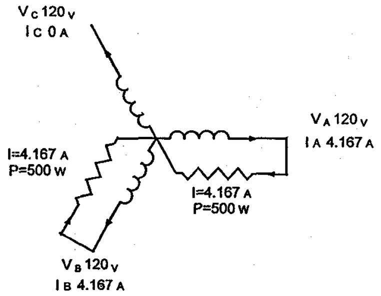
C) SYSTEM APPARENT: $S = 3 \bullet V_e \bullet I_e$

NOTE THAT THE LOSS FACTORS ARE THE SAME FOR LINE TO LINE CONNECTED RESISTORS WHETHER APPLIED TO A WYE OR DELTA BANK



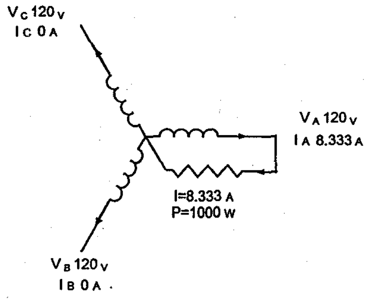
BANK	$I^2 = 3 \times 2.775^2 = 23.1$	LOSS FACTOR
BALANCED	$I^2 = 3 \times 2.775^2 = 23.1$	23.1 / 23.1 = **1.0**

SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1000	1.0	1.0
S = 1000	1.0	**1.0**



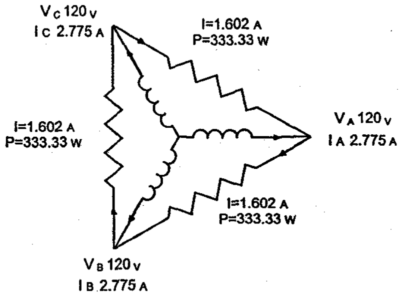
Bank	$I^2 = 2 \times 4.167^2 = 34.7$	LOSS FACTOR
Balanced	$I^2 = 3 \times 2.775^2 = 23.1$	34.7 / 23.1 = **1.5**

SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1000	1.0	1.0
S = 1224.8	0.816	**1.5**



Bank	$I^2 = 1 \times 8.333^2 = 69.4$	LOSS FACTOR
Balanced	$I^2 = 3 \times 2.775^2 = 23.1$	69.4 / 23.1 = **3.0**

SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1000	1.0	1.0
S = 1732	0.577	**3.0**



BANK	$I^2 = 3 \times 2.775^2 = 23.1$	LOSS FACTOR
BALANCED	$I^2 = 3 \times 2.775^2 = 23.1$	23.1 / 23.1 = **1.0**

SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1000	1.0	1.0
S = 1000	1.0	**1.0**

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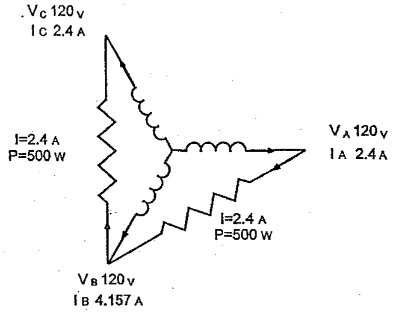
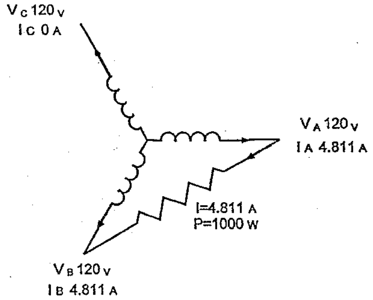


BANK $I^2 = 2 \times 2.4^2 + 1 \times 4.157^2 = 28.8$ LOSS FACTOR

BALANCED $I^2 = 3 \times 2.775^2 = 23.1$ 28.8 / 23.1 = **1.25**

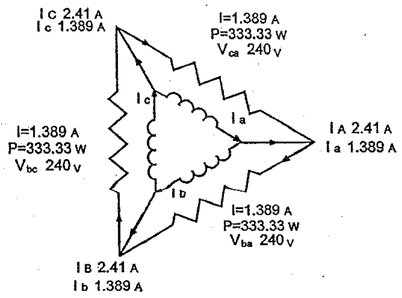
SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1075	0.93	1.16
S = 1115.4	0.896	**1.25**



BANK $I^2 = 2 \times 4.811^2 = 46.3$ LOSS FACTOR

BALANCED $I^2 = 3 \times 2.775^2 = 23.1$ 46.3 / 23.1 = **2.0**

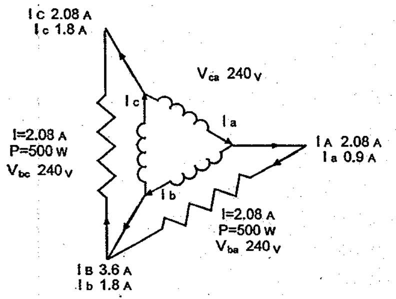
SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1154.6	0.866	1.33
S = 1414	0.707	**2.0**



BANK $I^2 = 3 \times 1.389^2 = 5.79$ LOSS FACTOR

BALANCED $I^2 = 3 \times 1.389^2 = 5.79$ 5.79 / 5.79 = **1.0**

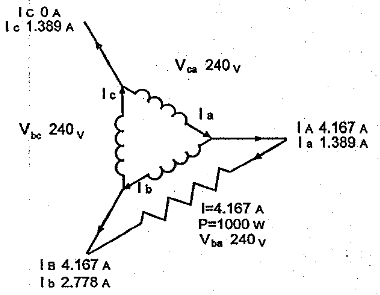
SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1000	1.0	1.0
S = 1000	1.0	**1.0**



BANK $I^2 = 1 \times 0.9^2 + 2 \times 1.8^2 = 7.29$ LOSS FACTOR

BALANCED $I^2 = 3 \times 1.389^2 = 5.79$ 7.29 / 5.79 = **1.26**

SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1075.23	0.93	1.16
S = 1115.7	0.896	**1.24**



BANK $I^2 = 1 \times 2.778^2 + 2 \times 1.389^2 = 11.58$ LOSS FACTOR

BALANCED $I^2 = 3 \times 1.389^2 = 5.79$ 11.58 / 5.79 = **2.0**

SYSTEM VOLTAMPERES	PF	LOSS FACTOR
V = 1000	1.0	1.0
A = 1154.8	0.866	1.33
S = 1413.3	0.707	**2.0**