Calculating Power Factor on a Form 6 Meter

A form 6 meter is a non-Blondel metering configuration which is not covered under ANSI C12.20. This is a meter in which Active Power is calculated as:

P = Va x (Ia – Ib) + Vc x (Ic – Ib) where the mathematics is performed on an instantaneous basis. Equivalent to vectorial processing of a purely sinusoidal waveform.

At the meter only Va, Vc, Ia, Ib, and Ic are available for measurement.

The PowerMaster computes W, VA and VAR using the following methodology:

$$P_{sys} = \left(\vec{V}_a \bullet \left[\vec{I}_a - \vec{I}_b\right]\right) + + \left(\vec{V}_c \bullet \left[\vec{I}_c - \vec{I}_b\right]\right)$$

similarly VA would be computed as:

$$Q_{sys} = \left(\vec{V}_a \otimes \left[\vec{I}_a - \vec{I}_b\right]\right) + + \left(\vec{V}_c \otimes \left[\vec{I}_c - \vec{I}_b\right]\right)$$

and where

$$S_{sys} = \left(\left|\vec{V}_a\right| \times \left|\left[\vec{I}_a - \vec{I}_b\right]\right|\right) + + \left(\left|\vec{V}_c\right| \times \left|\left[\vec{I}_c - \vec{I}_b\right]\right|\right)$$

$PF_{sys} = \left[\sum_i P_i / S_i\right] / n$ here ***i*** refers to the stator of the meter and ***n*** is the number of stators

Apparently the meter you are using does something quite different. It appears to be synthesizing Vb based on Va and Vc and then performing the power factor calculation as though it were a form 9S meter. Mathematically this is equivalent to:

$$P_{sys} = \left(\vec{V}_a \bullet \vec{I}_a\right) + \left(-\left[\vec{V}_a + \vec{V}_c\right] \bullet \vec{I}_b\right) + \left(\vec{V}_c \bullet \vec{I}_c\right)$$

similarly VA would be computed as:

$$Q_{sys} = \left(\vec{V}_a \otimes \vec{I}_a\right) + \left(-\left[\vec{V}_a + \vec{V}_c\right] \otimes \vec{I}_b\right) + \left(\vec{V}_c \otimes \vec{I}_c\right)$$

and where

$$S_{sys} = \left(\left|\vec{V}_a\right| \times \left|\vec{I}_a\right|\right) + \left(\left|-\left[\vec{V}_a + \vec{V}_c\right]\right| \times \left|\vec{I}_b\right|\right) + \left(\left|\vec{V}_c\right| \times \left|\vec{I}_c\right|\right)$$

$$\vec{V}_b = -\left(\vec{V}_a + \vec{V}_c\right)$$

and finally power factor would be;

$$PF_{sys} = \left[\left(\vec{V}_a \bullet \vec{I}_a\right) / \left(\left|\vec{V}_a\right| \times \left|\vec{I}_a\right|\right) + \left(-\left[\vec{V}_a + \vec{V}_c\right] \bullet \vec{I}_b\right) / \left(\left|-\left[\vec{V}_a + V_c\right]\right| \times \left|\vec{I}_b\right|\right) + \left(\vec{V}_c \bullet \vec{I}_c\right) / \left(\left|\vec{V}_c\right| \times \left|\vec{I}_c\right|\right)\right] / 3$$

The equation for PF above is of the form

PFsys = (PFa + PFb + PFc)/3

which is how we calculate system power factor. Some meters calculate

PFsys = (Pa + Pb + Pc)/(Sa + Sb + Sc) = Psys / Ssys

We will contact Itron to verify the actual computation being performed.

In the case under consideration, when we measure W, VA or VAR we get:

Stator	Watts	VA	VAR	PF
Va x (Ia – Ib)	29.5751	30.7601	-8.4447	0.961
Vc x (Ic – Ib)	15.3979	25.2203	19.9741	0.611

Here the PF is calculated based on the normal P/S for each stator.