TVA Distributor Retail Rates and Comprehensive Services Program Power Factor Case Studies

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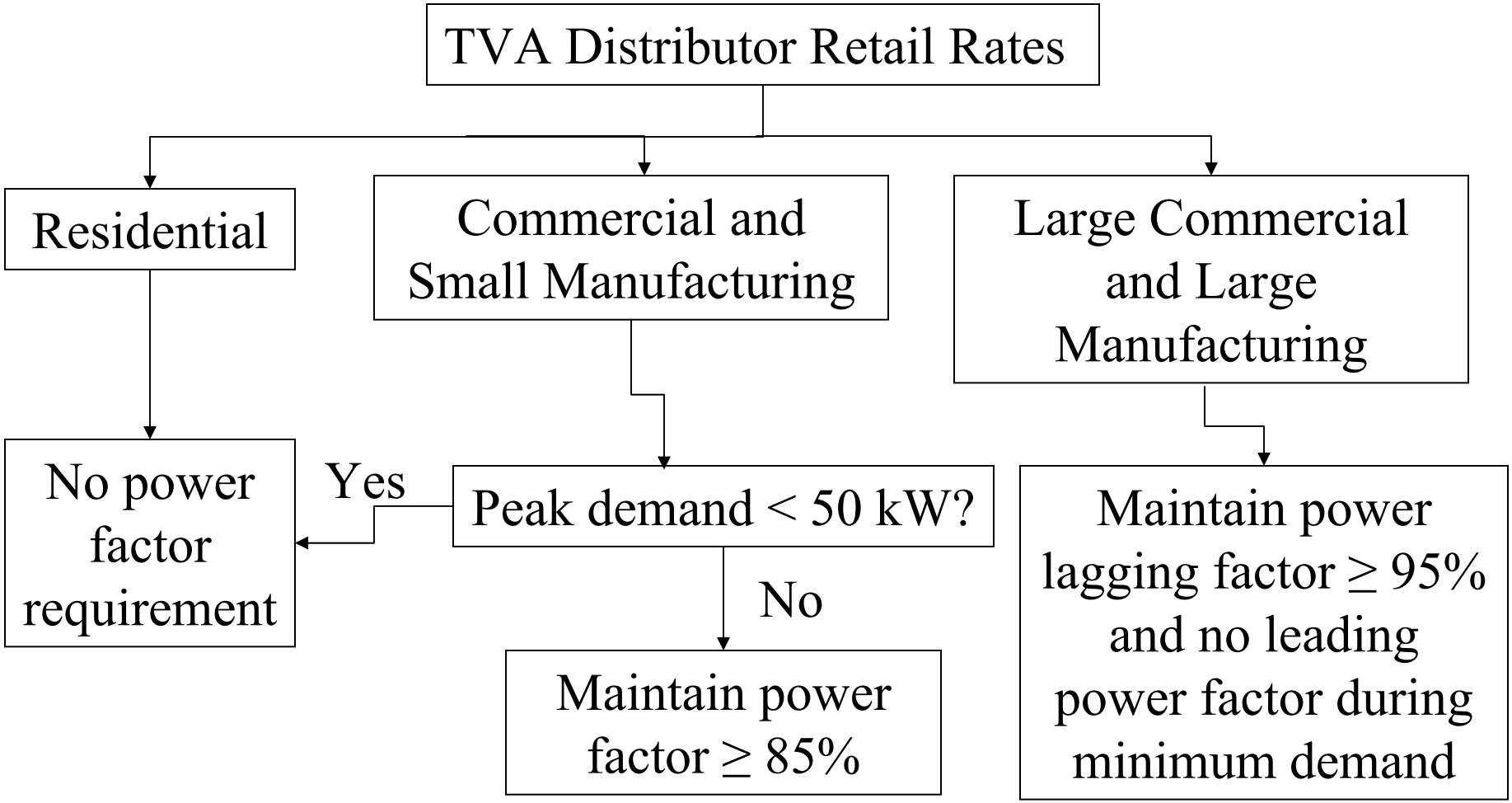
TVA Comprehensive Services – Power Factor Studies/Recommendations

TVA works with local power distributors to help end-use customer answer the following questions:

- What are the excess costs associated with power factor?
- How much capacitance to install for power factor correction?
- How should the capacitors be controlled?
- What type of capacitor bank should be installed?

TVA Distributor Retail Rates and Power Factor Requirements in a Nutshell



TVA Distributor Retail Rates Commercial and Small Manufacturing

- GSA-1 Less than 50 kW or 15,000 kWh
- GSA-2 50 – 1,000 kW or more than 15,000 kWh
- GSA-3 1,001 to 5,000 kW

GSA-1 – Peak demand < 50 and kWh < 15,000

- Customer charge
- Energy charge for all kWh used in monthly billing period.
- No demand charge
- Covers services ranging from backyard garage to offices, small retail and service shops, temporary services.

GSA-2 – Peak demand 50 kW to 1,000 kW or Energy Usage > 15,000 kWh

- Customer charge.
- Energy charge for all kWh used in monthly billing period.
- Demand charge based on peak kW demand minus 50 kW.
- Billing Demand is based on highest usage in 30 minute interval in billing month
- Billed demand based on the higher of the peak kW demand or 85 % of the peak kVA demand.
- Power factor < 85 % at time of maximum demand results in excess billing demand cost.

GSA-3 – Demand 1000 kW to 5,000 kW

- Customer charge.
- Energy charge for all kWh used in monthly billing period.
- Demand charge on all kW.
- First 1,000 kW at slightly less cost per kW than that above 1,000 kW.
- Billed demand based on the higher of the maximum kW demand or 85 % of the maximum kVA demand.
- Power factor < 85 % at time of maximum demand results in excess billing demand cost.
- Additional demand charge for each kW, if any, of the amount by which billed demand exceeds 2,500 kW or contract demand.

Example GSA-2 Billed Demand Calculation with Power Factor Less than 85 %

Small industrial customer with 200 kW in active power demand at 70 % power factor. Typical examples could include sawmill and loads with DC motors such as small printing presses. Hypothetical rate of $14 per kW of billed demand.

- Actual demand = 200 kW.
- Maximum apparent power demand = 200 / 0.7 = 285.7 kVA.
- 85 % of 285.7 kVA = 242.85.
- Billed Demand = Higher of either 200 or 242.85 = 242.85.
- Billed Demand Charge = (242.85 – 50) x $14 = $2,699.90
- Excess costs = (242.85 – 200) x demand rate of $14 = $599.90

Billed demand increased by 28.6 % because of power factor!

Percent Increase in Billed Demand Charge at Various Power Factors for GSA-2 Customers

	Active Power Demand Demand in kW				
PF	**75**	**100**	**250**	**500**	**1000**
0.85	0.0%	0.0%	0.0%	0.0%	0.0%
0.8	18.8%	12.5%	7.8%	6.9%	6.6%
0.7	64.3%	42.9%	26.8%	23.8%	22.6%
0.6	125.0%	83.3%	52.1%	46.3%	43.9%
0.5	210.0%	140.0%	87.5%	77.8%	73.7%

Special cases can result when actual kW < 50 with power factor below 85%. In these cases, power factor may mean the difference in incurring a demand charge altogether.

GSA-2 Case Study 1

- Plastics manufacturer - injection molding.
- Peak demand ranged from 700 to 800 kW.
- Average PF each month of 81 %.
- Plant already had some fixed capacitor banks – some of which had failed.
- Reactive compensation needed from month to month ranged from 50 to 100 kVAr.
- Annual excess costs due to power factor approximately $6,000.
- Excess costs were ~ 5 % of billed demand costs and ~ 2 % of utility expenses overall.
- Recommended replacement of some of the failed capacitors.

Energy Savings Vs. Power Factor

GSA-2 Case Study 2

- Agricultural facility
- Retrofitted incandescent lamps with non-pf-corrected magnetic CFLs
- >$100,000/yr energy savings
- >$30,000/yr demand savings
- New opportunity – power factor correction
- ~$40,000/yr in excess costs due to power factor
- Eliminated excess charges by installing capacitor banks (detuned).

GSA-2 Case Study 3

- Small sawmill.
- 480 VAC service.
- No power factor correction installed.
- Power factor < 30 %!!!! (Not because of metering error!).
- Actual kW demand was less than 50 kW.

Case study #3 cont'd

Mo/Yr	KWh	KW	KVAR	KVA	Billed Demand (kW)	Energy Charge + Customer Charge	Billed Demand Charge	Total Bill
Jun-04	5,280	33.92	115.60	120.47	102.40	$449.98	$703.77	$1,153.75
May-04	6,720	35.68	125.70	130.67	111.07	$561.72	$820.12	$1,381.84
Apr-04	5,760	36.32	124.70	129.88	110.40	$487.23	$811.16	$1,298.39
Mar-04	5,760	38.08	122.20	128.00	108.80	$487.23	$789.64	$1,276.86
Feb-04	6,080	33.92	114.60	119.51	101.59	$512.06	$692.82	$1,204.88
Jan-04	5,120	34.08	117.80	122.63	104.24	$437.56	$728.39	$1,165.95
Dec-03	5,920	33.92	117.70	122.49	104.12	$499.64	$726.79	$1,226.43
Nov-03	5,600	33.60	114.80	119.62	101.67	$474.81	$693.98	$1,168.79
Oct-03	3,520	31.68	116.40	120.63	102.54	$313.40	$705.60	$1,019.00
Sep-03	3,520	28.32	109.60	113.20	96.22	$313.40	$586.99	$900.39
Aug-03	4,000	30.56	106.20	110.51	93.93	$350.65	$557.95	$908.60
Jul-03	3,840	30.88	109.80	114.06	96.95	$338.23	$596.27	$934.51
					Totals>>	$5,226	$8,413	$13,639

Over 60 % of Electric Cost was Due to Power Factor!!!!

Case study #3 cont'd

- Customer installed standard 100-kVAr automatically-switched capacitor bank.
- If capacitor bank was not switched, significant excess costs would still be realized in this case!!
- Simple payback of about 9 months.

TVA Distributor Large Commercial and Large Manufacturing Rate Classifications

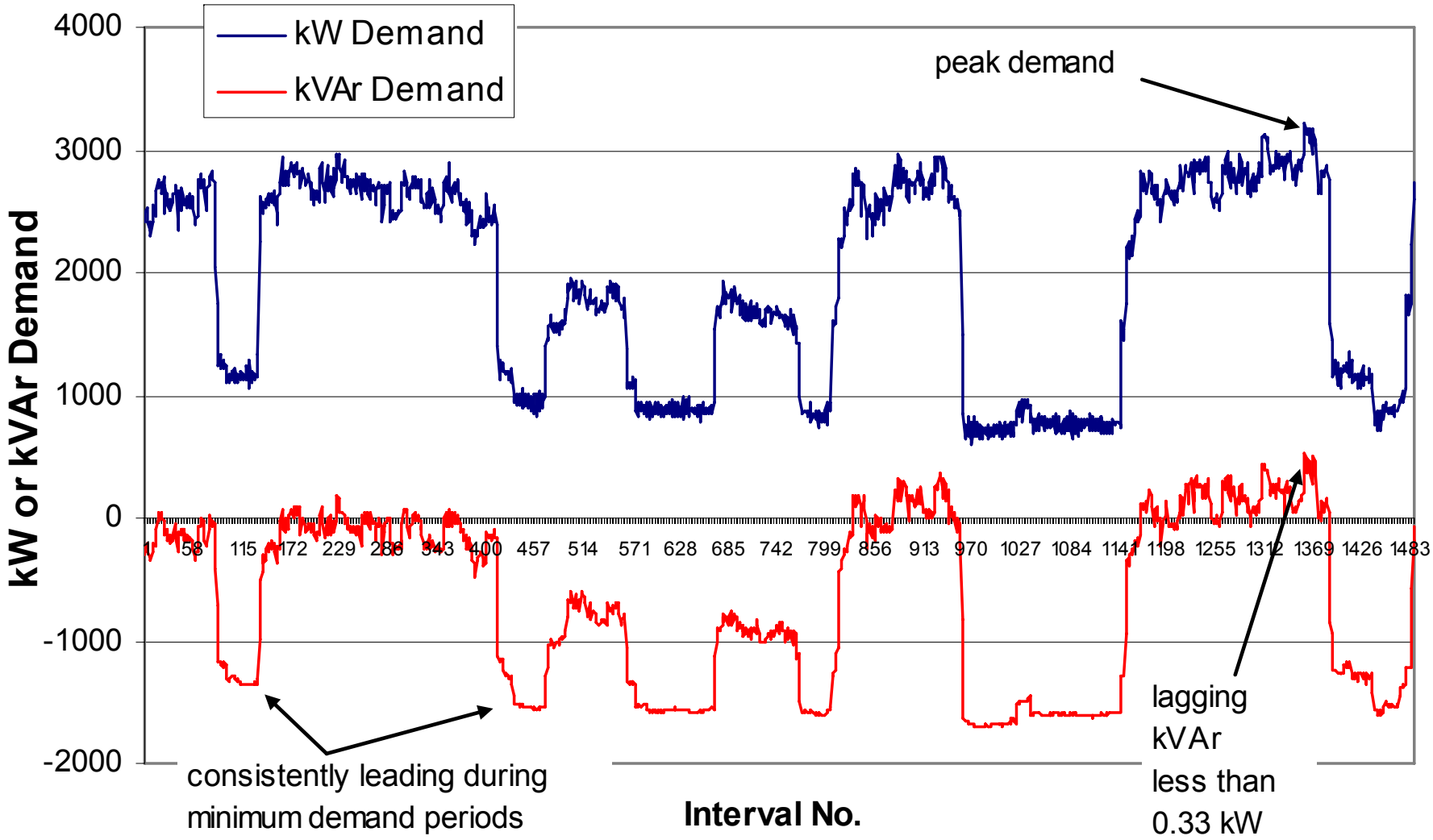
- Large Commercial – GSB, GSC, GSD
  - Peak metered demand 5,001 kW and up
- Large Manufacturing – MSB-1 and MSB-2
  - Depends on NAICS classification
  - Contract demand between 5,000 and 15,000 kW
  - MSB-1 = peak metered demand up to 5,000 kW
  - MSB-2 = peak metered demand from 5,000 to 15,000 kW
- Large Manufacturing – MSC, MSD
  - MSC = Peak metered demand 15,000 to 25,000 kW
  - MSD = Peak metered demand greater than 25,000 kW

All have a "reactive demand" charge provision in contract.

TVA Distributor Large Commercial and Large Manufacturing Rates

- Essentially a 95% power factor requirement.
- Direct $1.46 per kVAr charge for lagging reactive power demand if lagging at the time of peak demand and lagging kVAr exceeds 0.33 x kW demand (works out to 94.96 % pf).
- Direct $1.14 per kVAr charge for leading reactive power demand if leading by any amount at the time of minimum demand (excluding any minimum demands < 25 percent of maximum demand.

Case Study #3 – Large Mfr.



Before Installing Capacitors for Power Factor Correction…

- Customers should contact their local power distributor for a billing history review and explanation of their rate structure.
- Be sure of power factor requirement – 85 % or 95 %.
- Consider the impact of any equipment or operational changes to be made in the near future.
- Consider how the capacitors should be controlled. Having too much capacitance online can result in excess operating costs.
- Remember, local power distributor will often provide service to help determine the right amount, type, and optimal control of capacitors for power factor correction.