BONNEVILLE POWER ADMINISTRATION

Western WA Roundtable

Utility Distribution Sector Update

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In the BPA Implementation Manual listed under

Section 11: Utility Distribution Sector

- Technically complex
- Large energy savings
- Most energy savings occur within the customer premise

1. Voltage Optimization

BPA developed the Simplified Voltage Optimization Measurement & Verification Protocol (available in the IM Document Library) to assist utilities with implementing VO projects. In developing the project M&V plan, the customer has the option to use a custom M&V plan or the Simplified Protocol. The Simplified Protocol requires analytics from load flow studies and is based on RTF guidelines and focuses on residential and small commercial end-use loads, and requires that specific system stability thresholds be met prior to lowering service voltages.

- Simple to calculate energy savings
- Technical support from BPA
- Measures are commonly executed by utilities (red arrows)
- All energy savings occur on the distribution system

2. Electrical Distribution System Improvements

SI may include the following measures:

- Power transformer replacement;
- Service conductor replacement;
- Higher distribution primary voltage (including insulator additions and replacement);
- Transformer load management (replacement of improperly sized transformers for loss improvements);
- Balancing loads and phases;
- Adding parallel feeders;
- Operation improvement (recognition and phase balancing);
- Power factor improvement to reduce line losses;
- Volt-Amperes-Reactive (Reactive Power) Management;
- Fixed and switched capacitors; and
- Service distribution transformer:
  - Replacing an existing or proposed transformer with a higher-efficiency transformer;
  - Multiple transformers versus a single transformer based on system analysis; and
  - Voltage management.

Summary of Custom Projects reported to BPA in the past 5 years

Transformer upgrades/ Re-conductoring

- $0.35/kWh EEI incentive
- 25 projects since 2014
- Potential incentives ranging from $3,500 to $210,000
- Energy savings in the range of 10,000 to 600,000 kWh/year

Voltage Optimization/ Conservation Voltage Reduction

- $0.25/kWh EEI incentive
- 8 projects since 2014 (some with multiple phases)
- Potential incentives ranging from $40,000 to $550,000
- Energy savings ranging from 150,000 to 2,200,000 kWh/year

Example of re-conductor energy savings calculation

Section load inputs: annual average and peak, re-conductor length

Existing system configuration and materials

Proposed system configuration and materials

Annual energy savings

Utility

Project Name: Project A
Prepared by:
Data Provided by:
Date:

Project Scope: Re-conductor 1.298 miles of existing 2-phase, 7.2 kV phase to 3-phase.
Reconductor phase conductor from: #6 HD CU, neutral 397 ACSR to 477 AAC, neutral 477 AAC

M&V Methodology: Verification shall consist of a visual inspection of the total length of completed line by Utility staff and shall confim the installation of 477AAC conductor.
A memo shall be written of such inspection and shall be kept on file at the utility.

Color Codes
- Manually Entered Input Data
- Hand Entered Number from Distribution Guidebooks
- Check Calc in the Cell to ensure either a 1-Phase or 3-Phase Assumption
- Calculated value

Assumptions:

#	Item	Value	Unit	Note
	BASELINE LOADS			
1	Annual Peak Power at the **Beginning** of the subject Section	1,299	kW	
2	Annual Peak Power at the **End** of the subject Section	-	kW	
3	Power Factor at Beginning of section	100.0%	PF	
4	Power Factor at End of section	100.0%	PF	
5	Annual Peak Power at the **Beginning** of the subject Section	1,299	kVA	
6	Annual Peak Power at the **End** of the subject Section	-	kVA	
7	Calculate Ratio of (power-end) / (power-beginning)	-		
8	Calculate **Distribution Factor** to be applied to peak at the start of the section	0.58		from Nonogram, REA Manual 60-9. May 1960 - See on 2nd page
	POST LOADS			
9	Annual Peak Power at the **Beginning** of the subject Section	1,299	kW	**<< Default assumption is that loads don't change. If there is major reconfiguration, enter new loads**
10	Annual Peak Power at the **End** of the subject Section	-	kW	
11	Power Factor at Beginning of section	100%	PF	
12	Power Factor at End of section	100%	PF	
13	Annual Peak Power at the **Beginning** of the subject Section	1,299	kVA	
14	Annual Peak Power at the **End** of the subject Section	-	kVA	
15	Calculate Ratio of (power-end) / (power-beginning)	-		
16	Calculate **Distribution Factor** to be applied to peak at the start of the section	0.58		from Nonogram, REA Manual 60-9. May 1960 - See on 2nd page
17	Annual Load Factor	50%		**<<< this can be calculated dividing the annual avg kW (total annual kWh / 8760 hr) by the annual hourly peak kW for the substation**
18	Annual Loss Factor (use: 0.8*(LF^2) + 0.2*(LF))	0.300		
19	Road Miles of Conductor Being Upgraded	1.298	miles	

Existing System

#	Item	Value	Unit	Neutral	Unit / Note
20	Phases:	2			
21	Neutral:	1			
22	Voltage	7.2	kV Phase to Neutral	Neutral:	
23	Conductor: Phase	#6 HD CU		397 ACSR	
24	Resistance per Length	2.210	Ohms / mile at 25C	0.231	Ohms / mile at 25C
25	Phase Conductor Resistance	2.869	Ohms		
26	Neutral Conductor Resistance	0.300	Ohms		
27	Phase Conductor Current A	90	Amps		
28	Phase Conductor Current B	0	Amps		
29	Phase Conductor Current C	90	Amps		
30	Neutral Conductor Current	14	Amps	if specific data is not available assume	15% neutral current of phase current
	Annual Energy Losses	**70,876**	**kWh/year**		

Proposed System

#	Item	Value	Unit	Neutral	Unit / Note
31	Phases:	3			
32	Neutral:	1			
33	Voltage	7.2	kV Phase to Neutral	Neutral:	
34	Phase Conductor	477 AAC		477 AAC	
35	Resistance per Length	0.197	Ohms / mile at 25C	0.197	Ohms / mile at 25C
36	Phase Conductors Resistance	0.255	Ohms		
37	Neutral Conductor Resistance	0.255	Ohms		
38	Phase Conductor Current A	60	Amps	<<< Check Calculation for correct use of single or Three phase	
39	Phase Conductor Current B	60	Amps		
40	Phase Conductor Current C	60	Amps		
41	Neutral Conductor Current	9	Amps	if specific data is not available assume	15% neutral current of phase current
	Annual Energy Losses	**4,234**	**kWh/year**		
	Annual Energy Savings	**66,642**	**kWh/year**		

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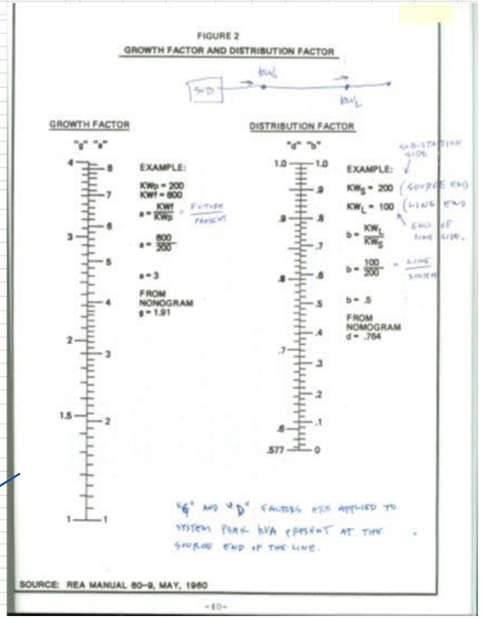

Distribution Factor

Example of transformer energy savings calculation

Nameplate and Load inputs: annual average and peak

Existing system losses

Proposed system losses

Annual energy savings

	A	B	C	D
1	Transformer Loss Savings Calculation :	Blue cell is manual data entry		
2		Project Proposal:		
3		Estimated Figures		
4		TX1		
5	NamePlate Power of the TX	2,000	kVA	
6	Peak Annual (Hourly) Power through the TX	1,800	kVA	
7	Average (Hourly) Power through the TX	1,500	kVA	
8	Load Factor (Avg / Peak)	0.8333		
9	Loss Factor [0.85(LF)^2 + 0.15(LF)]	0.7153		
10	Annual Energized Hours	8,760	Hours/Year	
12	BASELINE			
13	No Load Loss at Name Plate	3.200	kW	
14	Load Loss at Name Plate Rated Power	18.700	kW	
15	Peak Load-Loss	15.147	kW	
16	Annual No-Load (core) Energy Losses	28,032	kWh/year	
17	Annual Load (winding) Energy Losses	94,909	kWh/year	
18	Total Annual Energy Losses	122,941	kWh/year	
20	Purchase Cost of TX (includes sales tax)	$ 36,542		
22	PROPOSED			
23	No Load Loss at Name Plate	2.180	kW	
24	Load Loss at Name Plate Rated Power	12.029	kW	
25	Peak Load-Loss	9.743	kW	
26	Annual No-Load (core) Energy Losses	19,097	kWh/year	
27	Annual Load (winding) Energy Losses	61,051	kWh/year	
28	Total Annual Energy Losses	80,148	kWh/year	
30	Purchase Cost of TX (includes sales tax)	$ 42,834		
32	Annual Energy Savings : Site Savings	42,793	kWh/Year	
33	Incremental Project Cost:	$ 6,293		
35	Annual Utility Cost Savings (Energy & Demand	$ 1,441		
36	Simple Payback - NO BPA Incentive	4.4		
38	BPA Incentive Based on Energy (bus bar) :	$ 16,334		
39	BPA Incentive Based on Project Cost :	$ 4,405		
41	BPA Incentive LESSER of the TWO:	$ 4,405		
42	Simple Payback with BPA Incentive	1.3		
44	Energy Savings: at Bus Bar	46,668	kWh/Year	
45	BPA Incentive :	$ 4,405		

Update for New Transformer – Reconductor Calculator

Was intended to be ready for use on Oct 1, 2019

Deployment is postponed, new target use date is April 1, 2020

What is it?

- New streamlined process for these two measures, an alternative to custom project submittal
- Works similarly to the Lighting calculator
- Project cost files can be attached to the calculator (all in 1 file)
- More automated data entry fields
- Can handle up to 6 transformer and 6 reconductor measures in 1 file

BPA Technical Support Team is Growing

Current team:

Tony Koch, Nathan Kelly, and David Bell

Both Nathan and David are degreed Electrical Engineers

David, recently hired, brings 20+ years of CVR deployment experience

- Can bring operational expertise to utility engineering staff
- This is a new offering from BPA in the area of CVR
- We seek to engage on the topic of CVR with more utilities in the coming years. This is currently a measure with very little uptake regionally

Distribution Transformer Efficiency Study

- This is a BPA effort to address incremental efficiency (above DOE-2016)
- Working closely with WSU Energy Program staff
- Sought and received input from 16 BPA customers utilities
  - (some are in the room today)
- Phase 1 report scheduled to be completed in Dec 2019
- A webinar will be scheduled in Jan / Feb 2020 to share findings
- Initial findings: Amorphous core can bring additional savings to NW

- Phase 2 work will be done in 2020
  - (address if BPA incentive can be offered)

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