

DISTRIBUTION SYSTEM EFFICIENCY AND VOLTAGE OPTIMIZATION

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- SCOPING STUDY
- DETAIL STUDY PROCESS
- THRESHOLD REVIEW
- ECONOMIC EVALUATION APPROACH
- RECOMMENDED PLAN
- TABLE OF ALTERNATIVE PLANS

2. SCOPING STUDY REVIEW

2.1 RESULTS

- Threshold assessment

- Represented Improvements

- SUMMARY TABLE (Link to Scoping Study Report -Table I)

2.2 RECOMMENDATIONS

- Information needed for a detail study

- Add kWh and Power Factor (PF) Metering

- Add Temporary Installations, ie: Power Plot Analyzers

- Field Verification of Conductor Sizes

- General Improvements

- System Mapping Improvements (GIS)

- Interface between Data and Engineering Model

- Begin Permanent meter Installations

3. EXISTING SYSTEM

3.1 OVERVIEW OF ELECTRIC SYSTEM STUDY AREA

- (insert map)

3.2 INTERIM SYSTEM IMPROVEMENTS

- System Mapping Improvements

- Substation and Feeder Locations (GIS)

- Field Verification of Conductor Sizes

- Verification of Distribution Transformer Size and Location

- Verification of Capacitor Bank Size and Location

- Verification of Regulator Size, Settings and Location

- System Metering

- Temporary Metering at substation/Feeder Locations, (Power Plot Analyzers)

- Installing Substation Metering of kW, kWh and kVAr

- Installing Substation Metering of kW, kWh and kVAr

- Develop Meter Data analysis capability

- Electric System Power Flow Analysis Capability

- Recommendations Not Met

3.3 (NAME) SUBSTATION DESCRIPTIONS

- Substation Transformer Size & Voltage
- Voltage Regulator Information
 - Type (LTC, 3 phase, etc.)
 - Voltage Setting & Bandwidth
 - LDC R&X Settings
- SCADA Control Methods
- Capacitor Banks
- Distribution Feeder (#____) Information
 - Voltage
 - Conductors (Size, Type & Spacing)
 - Regulator
 - Location
 - Size
 - Settings
 - Capacitor Installations
 - Size
 - Fixed or Switched
 - Load Information
 - Feeder Demands kW
 - kVAr
 - kWh
 - Load Balance (Amperes)
 - Transformer Connected kVA
 - Customers
 - Number (total)
 - Type of Customers
 - Residential (%total)
 - Electric Heat (EH) (%res.)
 - Air Conditioning (AC) (%res.)
 - EH/AC Zone
 - Commercial (%total)
 - Other industrial
- Voltage Optimization (VO) Factor
(from VO Protocol Tables).

3.4 DESIGNATED THRESHOLDS FOR EXISTING SYSTEM

ASSESSMENT OF EXISTING SYSTEM

(NAME X) SUBSTATION

- Power Factor (PF) Minimum/Average (meter)
- Load Balance (meter)
- Primary Voltage Drop Maximum (simulated)
- Secondary Voltage Drop Maximum (design)
- Minimum Primary Voltage (simulated)
- Maximum Primary Voltage (simulated)

FEEDER (X001), (X002), (X003), (X004)

...

SUMMARY OF COMPLIANCE OF EXISTING SYSTEM

(insert table)

3.5 EQUIPMENT COSTS (Labor & Material)

- Primary OH Conductors (\$/mi)
- Primary UG Conductors (\$/mi)
- Line Regulators (\$/219A)
- Shunt Capacitors (fixed, 300kVar)
- Shunt Capacitors (switched, 300kVar)
- Substation Primary Metering Installation (kW & kvah)
- Regulator Primary Metering Installation (kW & kvah)
- End-of-Line Volt Metering

3.6 ECONOMIC FACTORS

- Operation and Maintenance (O&M) (%)
- Purchased Equipment Interest Rate (%)
- Energy Cost Inflation Rate (%)
- Marginal Energy Costs (\$/kWh)
- Equipment Life (35 yrs)
- Project Life (15 yrs)
- Minimum Rate-of-Return (>4%)
- Minimum Benefit/Cost ratio (>1%)
- Maximum \$/MWh Saved (<\$ 0.035/kWh)

3.7 GROWTH RATES

- SHORT RANGE
- LONG RANGE
- TRENDS

3.8 EXISTING SYSTEM PARAMETERS

- (NAME X) SUBSTATION
 - Total kWh Delivered (metered)
 - Peak kW Demand (metered)
 - Total Line Loss (kWh) (simulated)
 - Total No-Load Loss (kWh) (simulated)
- FEEDER (X001), (X002), (X003), (X004)
 - Total kWh Delivered (metered)
 - Peak kW Demand (metered)
 - Total Line Loss (kWh) simulated
 - Total No-Load Loss (kWh) simulated

- (NAME X) SUBSTATION
- FEEDER (X001), (X002), (X003), (X004)

...
...

- (NAME X) SUBSTATION
- FEEDER (X001), (X002), (X003), (X004)

...
...

4. ALTERNATIVE PLAN DESCRIPTION

4.1 COMMON TO ALL PLANS

SUMMARY DESCRIPTION

Capacitor Installations
Voltage Regulators
System Metering Additions
Metering Data Collection & Translation Services
Re-conductoring
Phase Additions
Load Balancing
Voltage Control
 Pre VO
 Post VO
Feeder Modifications
System Mapping
System Engineering Analysis Model

MAP OF IMPROVEMENTS (insert construction drwg. for each substation)

4.2 PLAN A "title" (RECOMMENDED)

SUMMARY DESCRIPTION

Capacitor Installations
Voltage Regulators
System Metering Additions
Metering Data Collection & Translation Services
Re-conductoring
Phase Additions
Load Balancing
Voltage Control
 Pre VO
 Post VO
Feeder Modifications
System Mapping
System Engineering Analysis Model

MAP OF IMPROVEMENTS

(NAME X) Substation; Feeder (X____)

(insert construction drwg. for each feeder or substation)

Plan Equipment and facility O&M Costs

Total Investment Cost (L&M) (link)

Operation & Maintenance Cost (link)

SYSTEM THRESHOLDS ASSESSMENT

(INSERT TABLE)

PRE VO OPERATIONAL CHARACTERISTICS

Total kWh Delivered (metered)

Peak kW Demand (metered)

Line Loss (kWh)

Transformer No Load Loss

AVERAGE VOLTAGE CHART (insert)

(insert Pre VO table)

POST VO OPERATIONAL CHARACTERISTICS

- Total kWh Delivered (metered)
- Peak kW Demand (metered)
- Line Loss (kWh)
- Transformer No Load Loss
- AVERAGE VOLTAGE CHART (insert)
(insert Pre VO table)

ECONOMIC ANALYSIS

(insert table for plan a substations and feeders)

4.3 PLAN B “title”

SUMMARY DESCRIPTION

- Capacitor Installations
- Voltage Regulators
- System Metering Additions
- Metering Data Collection & Translation Services
- Re-conductoring
- Phase Additions
- Load Balancing
- Voltage Control
 - Pre VO
 - Post VO
- Feeder Modifications
- System Mapping
- System Engineering Analysis Model

MAP OF IMPROVEMENTS

- (NAME X) Substation; Feeder (X____)
(insert construction drwg. for each feeder or substation)

Plan Equipment and facility O&M Costs

- Total Investment Cost (L&M) (link)
- Operation & Maintenance Cost (link)

SYSTEM THRESHOLDS ASSESSMENT

(INSERT TABLE)

PRE VO OPERATIONAL CHARACTERISTICS

- Total kWh Delivered (metered)
- Peak kW Demand (metered)
- Line Loss (kWh)
- Transformer No Load Loss
- AVERAGE VOLTAGE CHART (insert)
(insert Pre VO table)

POST VO OPERATIONAL CHARACTERISTICS

- Total kWh Delivered (metered)
- Peak kW Demand (metered)
- Line Loss (kWh)
- Transformer No Load Loss
- AVERAGE VOLTAGE CHART (insert)
(insert Pre VO table)

ECONOMIC ANALYSIS

(insert table for plan b substations and feeders)

4.4 PLAN C “title”

SUMMARY DESCRIPTION

- Capacitor Installations
- Voltage Regulators
- System Metering Additions
- Metering Data Collection & Translation Services
- Re-conductoring
- Phase Additions
- Load Balancing
- Voltage Control
 - Pre VO
 - Post VO
- Feeder Modifications
- System Mapping
- System Engineering Analysis Model

MAP OF IMPROVEMENTS

(NAME X) Substation; Feeder (X____)
(insert construction drwg. for each feeder or substation)

Plan Equipment and facility O&M Costs

- Total Investment Cost (L&M) (link)
- Operation & Maintenance Cost (link)

SYSTEM THRESHOLDS ASSESSMENT

(INSERT TABLE)

PRE VO OPERATIONAL CHARACTERISTICS

- Total kWh Delivered (metered)
- Peak kW Demand (metered)
- Line Loss (kWh)
- Transformer No Load Loss
- AVERAGE VOLTAGE CHART (insert)
(insert Pre VO table)

POST VO OPERATIONAL CHARACTERISTICS

- Total kWh Delivered (metered)
- Peak kW Demand (metered)
- Line Loss (kWh)
- Transformer No Load Loss
- AVERAGE VOLTAGE CHART (insert)
(insert Pre VO table)

ECONOMIC ANALYSIS

(insert table for plan c substations and feeders)

5. COMPARISON OF ALTERNATIVE PLANS

5.1 ECONOMIC EVALUATION ANALYSIS METHODOLOGY

UTILITY CONSIDERATIONS

- Benefit/Cost Ratio min
- Value of Saved MWh max
- Rate of Return min
- Project Life Expectancy 15 yr

Equipment Life 35 yr
System Efficiency Goals
Electric System Reliability
Quality of Service

BPA SOCIETAL CONSIDERATIONS

Conservation as Generation
Total Resource Cost (TRC)
Environmental
Transmission Efficiency Contribution

5.2 SUMMARY OF ECONOMIC COMPARISON

(insert table of comparison of plan a, plan b, plan c)

5.3 RECOMMENDED PLAN

GENERAL

JUSTIFICATION

Benefit/Cost Ratio
Value of Saved MWh
Rate of Return
System Efficiency
Electric System Reliability
Quality of Service

6. CONSIDERATIONS FOR SYSTEM ADDITIONS AND MODIFICATIONS

Metering

At Operations Center
At Substation
At Regulator
At End-of-Line
At Customer

System Mapping & Engineering Model

GIS
Interface between Mapping, Data & Engineering Model
Other

Regulators

Capacitors (300 CKVA max.)

Fixed
Switched

Load Balancing

Between Phases
Between Feeders
Between Substations

Feeder Modifications

Re-conductoring
Additional Phases

Additional Substations

Distribution
Transmission
Higher Distribution Voltages
System Reliability
Safety
Environmental Impact
Distributed Generation
Planning guidelines
 Future Load Data
 Short Range Plans
 Long Range Plans

7. DATA ASSUMPTIONS

Transformer Loading
Homogeneous Customer Loads
System maps
 Accuracy & Detail
 Pole Locations
 Transformer Size & Location
 Conductor Size
Metering
 Substations
 Feeders
Engineering Model

8. ABBREVIATIONS and DEFINITIONS

<u>Abbreviation</u>	<u>Means (click on link for definition)</u>
VO	Voltage Optimization
M&V	Measurements & Verification
EUSE	Electric Utility System Efficiency
COTR	
PTR	
TSP	
CPP	
SI	System Investment
RTF	NWPCC Regional Technical Forum
EOL	Lowest voltage location
TRC	Total Resource Costs

9. APPENDIX – VOLTAGE OPTIMIZATION M&V PLAN

What to Measure:

- Seven Day Pre & Post Periods
- Show where to Measure Data
- Seven Day kW/hr; kvar/hr; V/hr (at Regulator & End-of-Line)
- Enter Data into Excel Spreadsheet to Perform Calculations
- Perform Threshold Assessments using excel
- Perform Annual Average Voltage Assessments
- Obtain Annual Peak (kW) from annual historical data
- Obtain Annual Energy (MWh) from annual historical data

- Obtain kVA connected from utility
- Obtain customer information from utility and determine VO Factor tables
- Calculate Verification of Annual Energy Saved