Transmission Loss Study

Western Area Lower Colorado Losses for the Desert Southwest Transmission System

Desert Southwest Region

Rocky Mountain Region Operations Engineering

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Executive Summary

This 2015 Western Area Lower Colorado (WALC) system loss study focuses on determining a loss percentage for the combined projects within the WALC Balancing Authority (BA). The previous WALC BA loss study (completed in 2003) showed that the loss percentage for the totality of all projects in the WALC BA was 3%. This 2015 WALC system loss study shows that the loss percentage for all combined projects in the WALC BA remains at 3%.

To acquire the loss percentage for the entire WALC BA, a 36-month time window (ranging from July 2011 to June 2014) of historical loss data was observed. This data was compartmentalized into 12-month timeframes and the average loss for each of these 12-month timeframes was examined to determine what the total average loss amount would be over the 36-month time period. The total average loss amount for the 36-month period was then divided by the total net generation and interchange for the same 36-month period.

Since the losses on the Mead Phoenix Project (MPP) transmission components are collected separately according to the MPP contract and MSI, the total average losses for MPP were exempted from the total average losses of the remaining WALC BA projects. When the difference between these numbers was divided by total net generation and interchange in the WALC BA, the loss percentage was shown to be 3%.

I. Introduction:

The purpose of this study is to review the loss rate for the Western Area Lower Colorado Balancing Authority. The WALC BA includes the transmission lines and transformers associated with the Parker-Davis Project, the Central Arizona Project, the Pacific Northwest/Pacific Southwest Intertie Project, the Boulder Canyon Project, the Colorado River Basin Salinity Control Project, and the Colorado River Front Work and Levee System Project. The WALC BA excludes the Colorado River Storage Project (CRSP) Southern Division and the MPP transmission components. The WALC BA, its' tie lines, and customer base is illustrated in Maps A, B, and C in Appendix 1.

This paper is an exposition of the methods employed to calculate the system loss rate. The primary method that was implemented to determine the combined system loss rate was the use of real-time loss data from the "Losses" function that is included in WALC's Supervisory Control and Data Acquisition (SCADA) software. These data were represented as hourly average losses in the WALC BA over a 36-month timeframe; specifically from July 1, 2011, to June 30, 2014. This method presented the most accurate representation of the loss data.

II. Results:

1. Using actual real-time loss data, a combined loss rate of 3% is obtained for the WALC BA excluding the CRSP Southern Division and the MPP. This loss rate is calculated by recording hourly average energy values for losses and the energy flow contributing to those losses (generation within the BA).

2. To ensure that existing agreements were acknowledged in the calculation of the loss percentage, a separate set of computations were done for the Mead-Phoenix Project (MPP) transmission components. This was done by taking the 36-month timeframe of loss data specifically for the MPP components and dividing it by the total flows within the MPP for the same 36-month period. The loss percentage for

MPP was determined to be approximately 1.2%, which validated the contractual values established between WALC and MPP customers. This contract assesses the loss percentage on MPP between 0.5% and 2.5%. The MPP losses are assessed separately based on scheduled amounts according to the MPP Metering and Scheduling Instructions (MSI) document. In order to not double-count these losses in the overall WALC BA-based analysis, the MPP losses are deducted.

3. WALC assesses the combined system loss rate for those transmission customers that utilize WALC's share of the MPP; however, there was not an accurate method to use to consider a portion of the MPP transmission components in the study. Therefore, all MPP transmission components were removed.

4. The combined system loss rate is defined as the total of all line and transformer losses plus motoring as a percentage of total actual generation in addition to the net power flowing into the WALC BA.

5. The observed losses within the WALC BA show a correlation with events that included either the gain or loss of load or the gain or loss of generation within the WALC BA. This correlation is shown below in Appendix 2, Table D.

6. The single largest hourly loss figure observed in the study period was 74.98 MW. The lowest figure observed was 20.09 MW. The average system loss over the 36-month period was 51.47 MW.

III. Recommendations:

The transmission losses rate of 3% should be applied for the WALC-BA. This ensures a sufficient collection of energy from the transmission customers within the WALC-BA.

IV. Recordkeeping and Analysis:

The purpose of loss collection is to assure that energy is provided or returned in payback to the BA to provide for transmission energy losses sufficient to maintain a balance of the generation, loads, and losses.

With the continuously increasing cost of energy, accurately quantifying system losses, good recordkeeping, as well as tracking and loss collections are necessary to preserve Federal hydropower benefits for our preference customers, in addition to helping keep our rates down and minimizing required power purchases.

Study results suggest that the current transmission loss rate should be 3%. This loss rate is for use in transmission loss accounting for physical and financial loss returns to account for actual system losses within the WALC BA. At this time, based on actual recorded loss data, a transmission loss rate of 3% is adequate to compensate the BA requirements and preserve preference customer benefits.

V. Methodology

The primary method for determining losses uses the actual hourly meter data for line flows at both line ends. Line losses are calculated by subtracting the respective meter readings. This calculation is done via the “Losses” function included within WALC SCADA software.

To compute the final loss rate given the loss data from the “Losses” function, the following equation was implemented:

Percentage Loss Rate = [Energy Losses calculated for every hour of the observed period/{Energy from WALC generation including Hoover, Parker-Davis, South Point and Griffith generation + Net Interchange}] x 100

This method was applied over the course of a 36-month period, from July 1, 2011, to June 30, 2014. To verify the validity of the data, study cases from WALC’s Transmission Security Management (TSM) software were used and validated against recorded data. The validation was performed by verifying

recorded generation within the TSM study case and subtracting the generation from the recorded data at the loads. The difference between these numbers represented the loss in megawatts. These calculations were seen to approximate what was produced by “Losses” function, thereby ensuring that the data was legitimate.

Moreover, the recorded loss data were also compared to a series of events (addition or loss of generation and/or load within the WALC BA) that occurred over the period studied. This comparison demonstrated an identifiable correlation between addition or loss of generation and/or load to the overall losses within the WALC BA. A correlation between the events and loss data was observed and is shown in the Appendix 2, Table D.

VI. Conclusion:

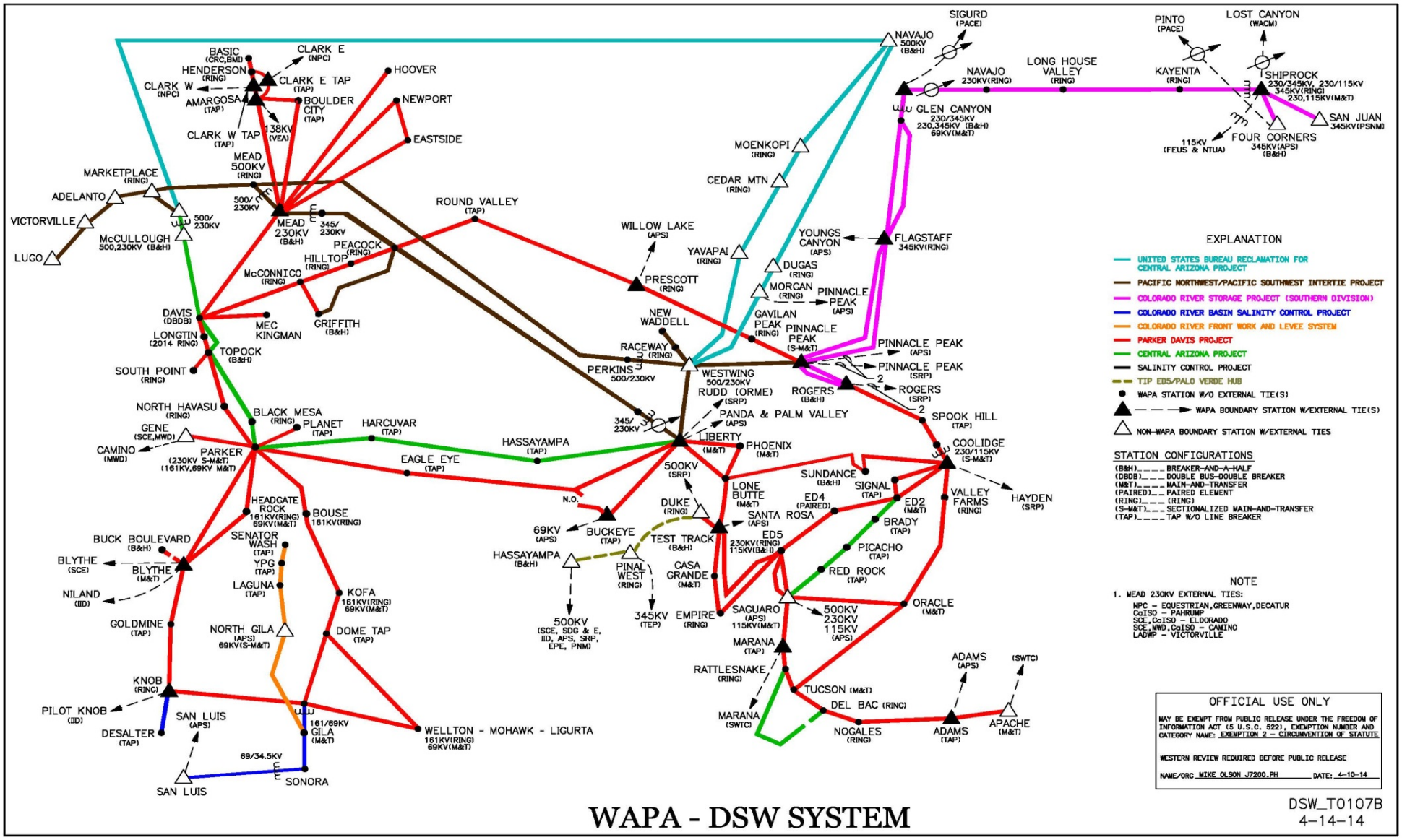
Using collected real-time data to determine the transmission loss rate for the WALC BA is the optimal method to determine the loss percentage for the WALC system. The collected real-time data ensures the most accurate portrayal of events and flows within the WALC BA as recorded by the automated measurement systems in position at WALC substations and transformers. Using these data focuses the study to the reliability-side of how the WALC BA is functioning and yields the most accurate transmission loss rate.

Another method investigated was the use of Power Flow software to observed losses in an idealized state. This method yielded loss ratings that were inconsistent to the observed losses from real-time data. Specifically, the idealized losses were very high with this simulation. As a result, this method was not implemented in the final calculation of the transmission loss rate for the WALC BA.

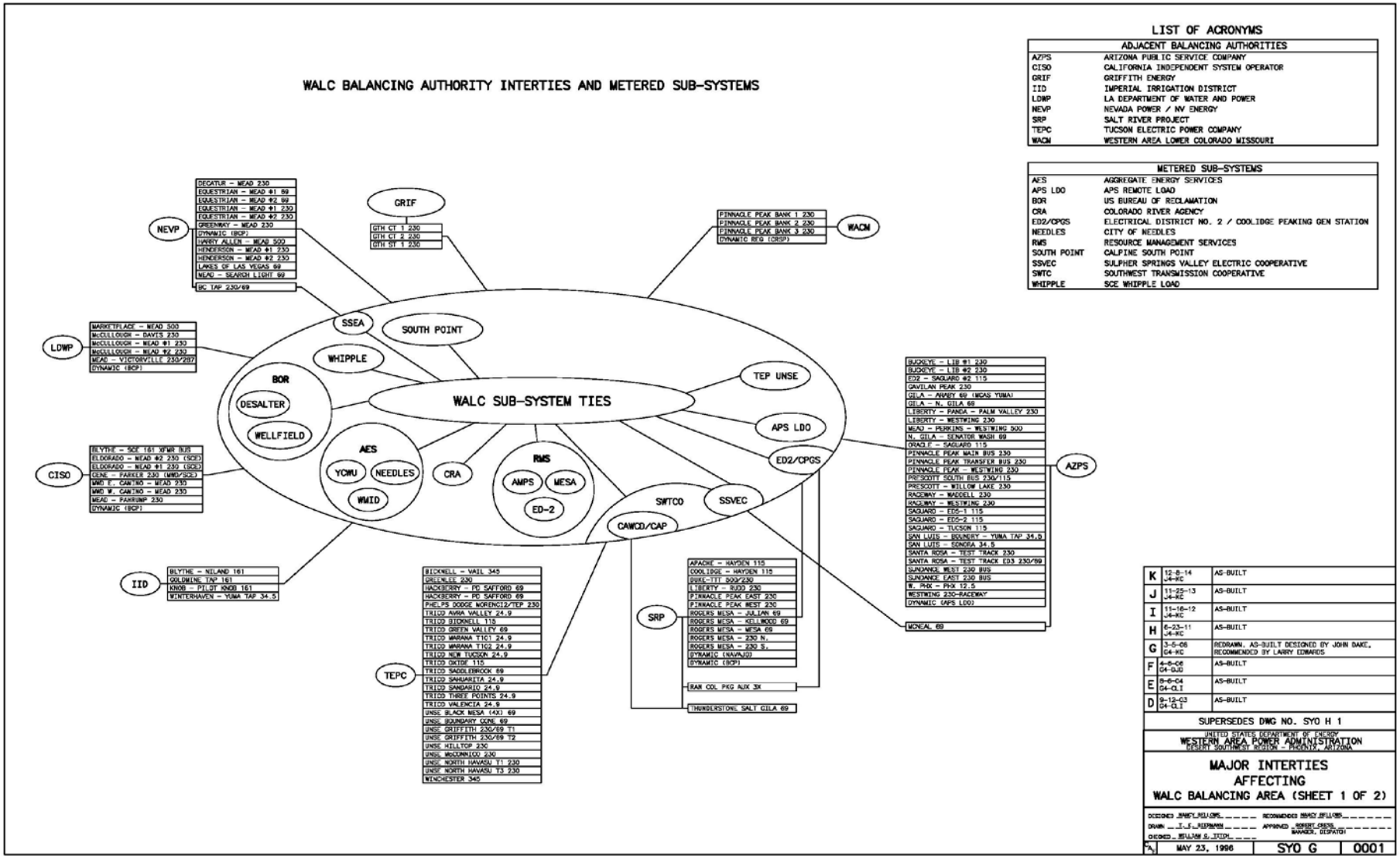
The 36-month period of loss data was used because it was considered to be a sufficient enough amount of data to get an accurate computation for the actual transmission loss rate in the WALC BA. It is suggested that loss data be monitored for events of addition or loss of generation and load within the WALC BA and that the transmission loss rate be studied and recalculated every 36 months. This ensures that the rate remains relatively stable for customers and that WALC has documentation to reinforce its implementation of a particular transmission loss rate.

Appendix 1 – Maps of Study Area

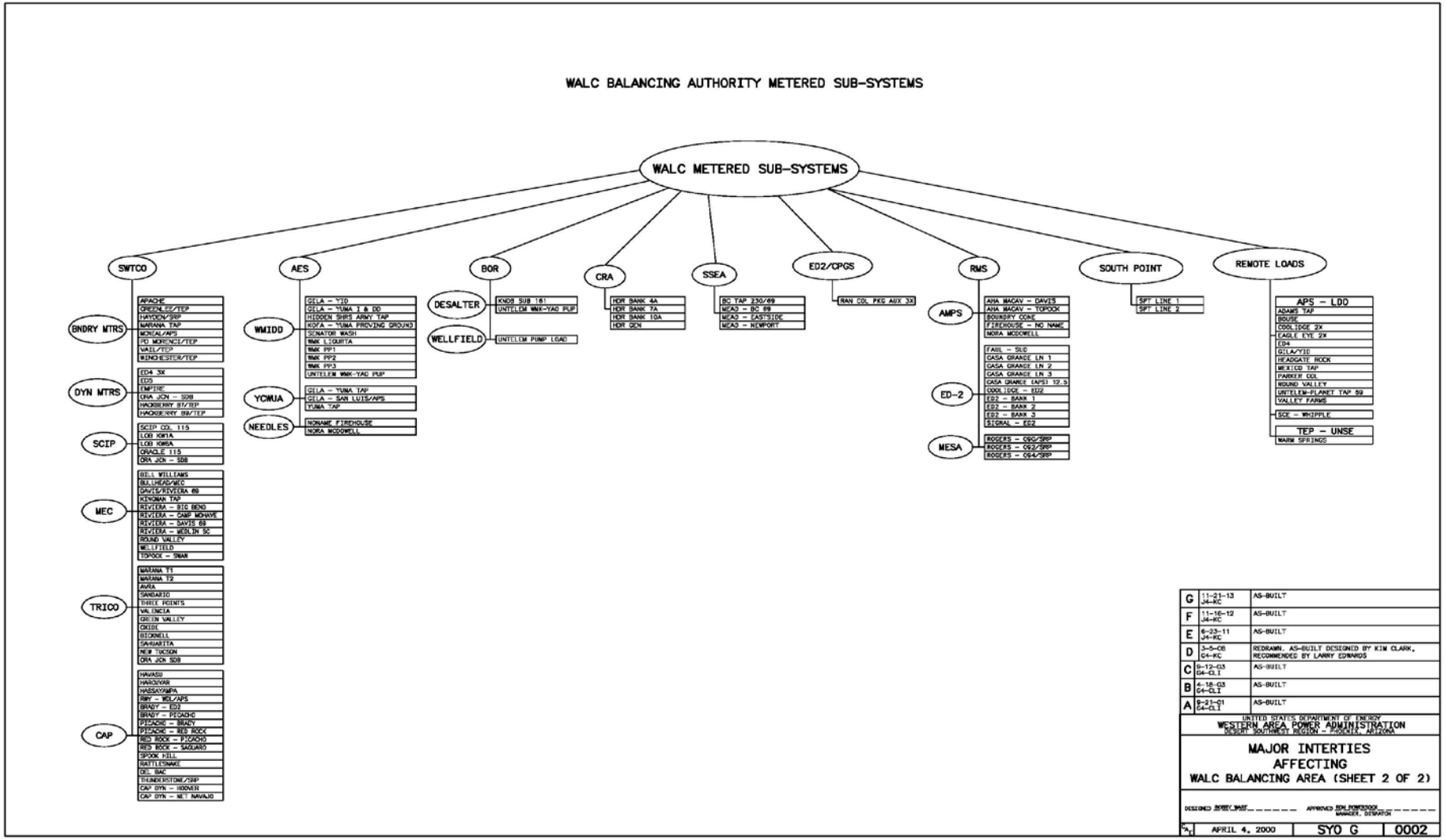
Map A – Graphical Representation of WALC BA



Map B – Metered Tie Lines in WALC BA



Map C – Customers Impacted within WALC BA



Appendix 2 – Tables of Data Computations

Table A – Average Losses Over 36-Month Period

Time Period	Average Losses (in MW)
July 1, 2011 – June 30, 2012	59.88
July 1, 2012 – June 30, 2013	53.26
July 1, 2013 – June 30, 2014	43.99
Total (July 1, 2011 – June 30, 2014)	52.38

Table B – Average Losses for MPP Over 36-Month Period

Time Period	Average Losses (in MW)
July 1, 2011 – June 30, 2012	14.37
July 1, 2012 – June 30, 2013	13.67
July 1, 2013 – June 30, 2014	14.06
Total (July 1, 2011 – June 30, 2014)	14.03

Table C – Average Generation Over 36-Month Period

Time Period	Average Generation (in MW)
July 1, 2011 – June 30, 2012	1472.97
July 1, 2012 – June 30, 2013	1152.54
July 1, 2013 – June 30, 2014	1112.67
Total (July 1, 2011 – June 30, 2014)	1246.06

Table D – Loss Percentage Per Year and Total Loss Percentage Over 36-Month Period

Time Period	Loss Percentage
July 1, 2011 – June 30, 2012	3.09
July 1, 2012 – June 30, 2013	3.44
July 1, 2013 – June 30, 2014	2.69
Total (July 1, 2011 – June 30, 2014)	3.07

Table E – Percentage Change to Losses Based Upon Event in WALC BA During 36-Month Period

Event	Load Change	Percentage Change to Losses	Actual Load Change (in MW)	Projects Impacted
CAP Loads Moved from SRP BA to WALC BA	Increase	0.68% Decrease	Summer/Winter 130-490 Increase	Boulder Canyon
CRSP Facilities Leave WALC BA	Decrease	13.91% Decrease	Summer 166.735-445.729, Winter 305.715-601.112 Decrease	None
MEC Move from WALC BA to SWTC Pseudo BA	Decrease	6.67% Increase	Summer 43.793-95.094, Winter 38.964-49.208 Decrease	None
SSEA and City of Boulder City Moved from NVE BA to WALC BA	Increase	7.43% Decrease	Summer 67.625-96.6, Winter 52.717-66.792 Increase	Boulder Canyon

SSVEC moved from being in WALC BA to SWTC Pseudo BA	Decrease	11.82% Decrease	Summer 66.915-104.329, Winter 53.777-67.926 Decrease	None

Note: The numbers shown in Table D above reflect increases and/or decreases in the total losses within the WALC-BA per event (ie. If a current event shows a decrease of 3% in total losses and a prior event shows a decrease of 5% in total losses, then the final loss calculation would be as follows: Final Losses = Total Losses – [(Total Losses x .05) + (Total Losses – (Total Losses x .05)) x .03] .