TRUCKEE DONNER
Public Utility District

2019 ELECTRIC SYSTEM MASTER PLAN

Prepared For:

Truckee Donner Public Utility District
11570 Donner Pass Road
Truckee, California 96161

Prepared By:

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"Engineering with Distinction"

ENGINEER'S CERTIFICATION
2019 Electric System Master Plan
Truckee Donner Public Utility District
11570 Donner Pass Road
Truckee, California 96161

Upon completion of construction of the facilities proposed herein, the system will provide adequate and dependable service to approximately 13,923 customers and 57 MW of non-coincidental load, as projected in the analysis.

The recommended system improvements included in this report are in general agreement with the Truckee Donner Public Utility District Planning Criteria.

I certify that this report was prepared by me or under my direct supervision and that I am a duly registered Professional Engineer.

Name Richard L. McComish, P.E.

December 2019
Date

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Reg. No.

REGISTERED PROFESSIONAL ENGINEER
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ELECTRICAL
STATE OF CALIFORNIA

1.0 OVERVIEW & PURPOSE

1.1 Overview

This report contains an analysis of the present system and the 2019 Electric System Master Plan for Truckee Donner Public Utility District (the District or TDPUD). The Executive Summary, Section 2, contains the required information for the District's management to include in long-range financial forecasts and a summary of the recommended plan. The Planning and Sectionalizing Criteria is described in Sections 3 and 4 respectively, while Section 5 provides a review of historical trends and load forecasts. Section 4 includes the philosophy used by the Engineer to provide proper coordination between the protective devices in the District's system. Section 5 of this report examines performance of the existing distribution system for voltage drop, voltage and current imbalance, line loading, equipment capacity, power factor and losses with present peak, projected 5 and 15 year peak conditions.

1.2 Purpose

The main purpose of this report is to provide Truckee Donner Public Utility District with an orderly plan for carrying out construction, protective coordination and other needed improvements. Complementary to this purpose is the study's goal of planning and completing improvements in the most economic manner possible.

A second major purpose of this report is to provide the most up-to-date forecast possible of financial requirements for the next 15 years. These cost estimates provide the utility with the data necessary for completion of their annual business work plans and budgets and serve as a basis for long-term financial forecasts.

Service reliability and quality of service are the very essence of operational goals in any electric utility. The function of system planning is to evaluate the existing and projected system configuration, voltage levels and load balance in a manner that endeavors to increase the quality of service. In a continuing effort and in order to serve its intended purpose, planning must change dynamically as governing conditions change. This plan provides the Owners' and Engineers' current philosophy on those specific improvements which will best meet the present needs of the system.

In addition to the Master Plan construction recommendations, a detailed sectionalizing study was completed to provide the best possible protection for the utility and consumers. This evaluation of the system takes into consideration the following items:

- Increased fault levels due to system improvements
- Loading of equipment
- Reliability

Taking into account each of the above items, the system was evaluated to ensure that all devices met maximum interrupt rating, while not exceeding their continuous current ratings, and that devices would pick up minimum fault currents based on a 40 ohm ground resistance. Proper coordination between devices was also evaluated in an attempt to eliminate simultaneous operation. As a result of this evaluation, the sectionalizing study provides recommendations which will enable the District to provide a high level of reliability to its customers.

2.0 EXECUTIVE SUMMARY

This report presents the results of a Master Plan prepared by Electrical Consultants, Inc. (ECI) for Truckee Donner Public Utility District (the District). This study evaluates the District's distribution system which provides electric service in Northeastern California.

Based upon the planning criteria identified in *Section 3.0* and pertinent historical trends and load forecasts identified in *Section 5.0*, distribution system performance was evaluated in order to identify criteria violations for voltage drop, voltage and current imbalance, line and equipment loading, as well as power factor and losses.

System performance was evaluated by first performing load flows for peak loading conditions. A thorough review of the existing system performance with the present, transition (5 year) and long range (15 year) loading was performed. The peak model is represented by the existing system maps located in the Appendix, which include voltage loading levels through the District's distribution system. Results of the load flow analysis are summarized in *Section 6.0* along with recommendations for system improvement.

After load growth was implemented in the model, protective device settings were updated to reflect the existing system. Changes are recommended where minimum pick up levels are above minimum fault current levels within the protection zones. Other recommendations provided within this report provide increased coordination intervals and new sectionalizing points. Most of the improvements are considered minor in nature and would bring the District's system reliability to a higher level.

All feeders on the District's system utilize an electronic recloser for feeder protection. All of these controls, with the exception of Glenshire, have high current trip (HCT) and high current lock out (HCL) enabled on the controls. Ideally, the use of HCT and HCL will trip and lock out a recloser for a fault on the main underground feeder. Setting changes are recommended to many of the reclosers to increase the trip levels on the HCT and HCL to allow down line faults to be cleared by tap fuses while the feeder recloser only lock out for a close in fault on the underground.

All recommendations were designed to be in general concurrence with planning criteria and to ensure that no adverse impacts to the integrity of the District's system were imposed. The mechanical condition of the District's plant, along with reliability of service to members, was also factored into the recommendations for system improvement. Single contingency outages were investigated through analysis of load flow and voltage drop studies to address system requirements during such operating conditions.

2.1 Existing System Performance

Figure 2-2-1 displays the District's system kW demands since 1991 and projected 15 year usage based upon historic load data and least squares statistical regression technique. The non-coincidental peak load that was utilized for the load flow analysis was 47 MW for existing system loads. In consideration of potential growth over the 15 year study period, 53 MW was utilized for projected 5 year growth and 57 MW was utilized for projected 15 year growth.

Analysis of existing systems shows no substations have voltage less than 116.0 volts. This means that in its current shape, there are very few improvements that will be required during the next 15 years.

ANSI C84.1-2011 sets normal voltage levels for equipment on a distribution system. Minimum service voltage set by this standard is 114.0 volts under normal operating conditions. Service voltage is defined as the connected point between the customer and the utility, which is considered the meter. Analysis of the District's system consisted of voltage drop on the primary line and did not account for voltage drop from the transformer to the meter. A minimum voltage of 118.0 volts on the primary line allows for a 4.0 volt drop through the transformer and secondary wire to the meter. Refer to *Section 3.0, System Planning Criteria,* for voltage criteria used for system planning and other criteria.

Conductor loading over 80% was noted for the existing system in the Donner Lake service area. At the projected fifteen (15) year loads, additional conductor overloading was also noted in the Donner Lake service area on Feeder 1.

A single contingency load transfer of each substation was performed with existing as well as projected 5 and 15 year loads. This single contingency assumes a loss of substation service transferring feeders to adjacent service areas. Complete load transfer of all substations be accomplished under peak loading conditions. The balance of the substations could be transferred to adjacent substations; however, voltage levels fell below planning criteria, where transformer and conductor overloading was also noted during these load transfers.

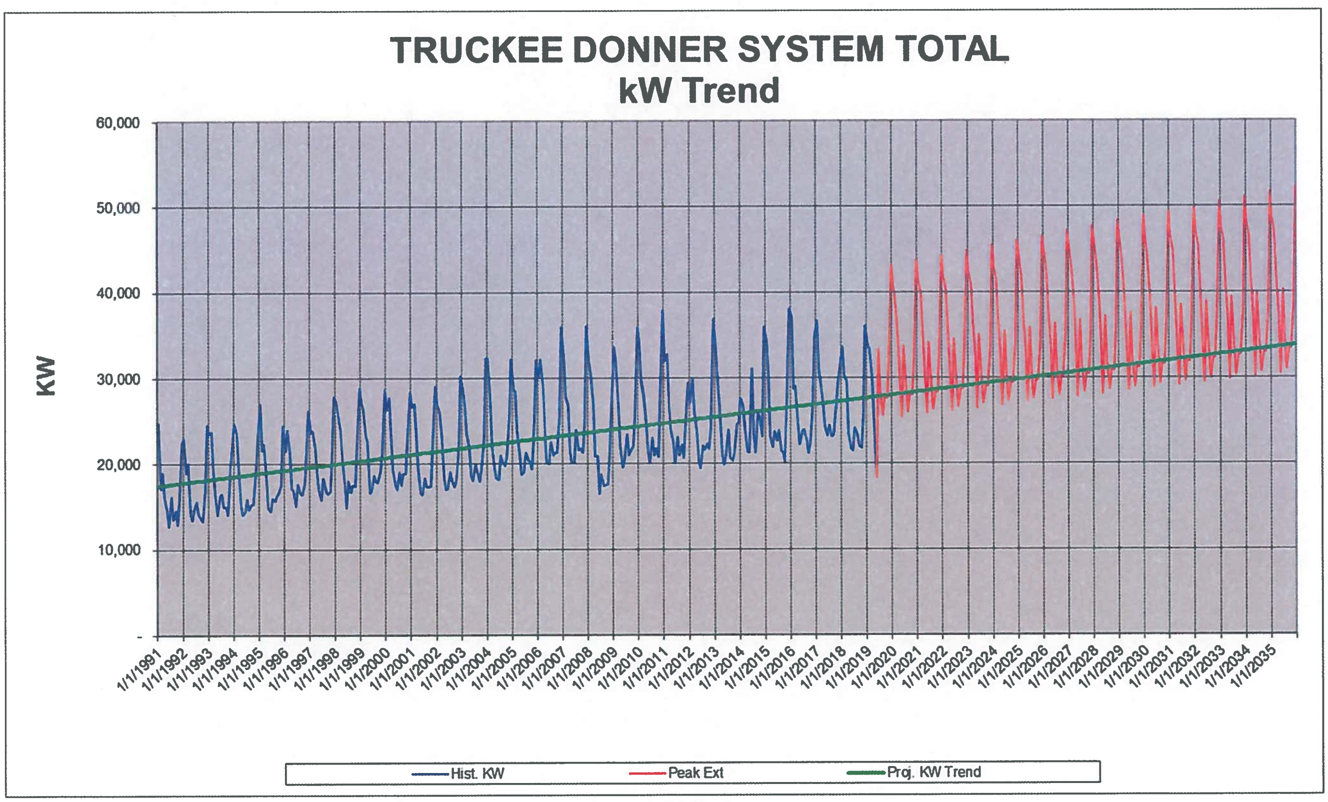

Figure 2-2-1

2.2 Recommended System

Improvements were recommended for the Electric System Master Plan which would first improve voltage levels under peak loading conditions for both existing and projected 15 year loads. Phase balancing was also recommended for the existing system to not only improve voltage levels but to reduce losses.

Single phase taps with greater than 30 amps of load should be considered for rebuild to three-phase to allow for more effective phase balancing throughout the system. It was recommended to use minimum standard conductor size of 2/0 AWG ACSR for these rebuilds, however, local demographics may warrant the use of smaller conductors, such as 2 AWG ACSR, in areas of anticipated low growth.

The following is an overview of the major projects recommended for the District's service area:

- Rebuilding of the three-phase line from Davos Dr. and Northwood Blvd. at the substation to Fjord Rd. and Northwood Blvd. This project is required to improve voltage during transfer to Donner Lake to above 114.0 V. It will also improve loading, as the existing conductor is over 100% loading during contingency.

- The District is interested in installing a photovoltaic system on the District headquarters building in 2020. Not only would the District be reducing its own carbon footprint, all of the District's customers would benefit with a lower District complex electric bill. Additionally, all generation would count towards the District's renewable portfolio requirements.

- The District has completed 4 phases of optical communication line installation. Four additional phases are expected to be required for connection to all remaining District facilities. At completion, there will be a redundant network to all facilities, with 2 distinct physical paths from each facility back to the main office.

- Upgrading the Truckee Substation transformers to either a set of three (3) 8.3 MVA single-phase transformers or a 25 MVA three-phase transformer in order to provide load transfer capability between Martis Valley and Truckee substations when Martis Valley is cleared at 15-year loading levels.

- The District will replace all T-link expulsion fuses with ELF current limiting fuses in Tahoe Donner by 2022.

- The District is aware of the new Solar Generation initiative affecting all future residential construction starting in 2020. The full effects of this initiative are unknown, but the additional Solar Generation will support system voltage levels. Additional analysis will be necessary when this project is implemented to address power factor correction and Solar Generation design.

TDPUD's standard fuse manufacturer and type are Kearney Type T fuses. The Kearney fuse has a relatively quick clearing time on a majority of the fuse sizes. It is recommended that all taps off of the main three-phase line be fused, so as not to have an outage on a short tap, resulting in a feeder recloser going to lock-out. For each feeder on the system, there is a fuse coordination table listed, showing maximum T fuse size to be used with up-line reclosers. On longer taps, it is recommended that the tap be fused and additional fuses down-line be used to increase coordination. This will not only improve reliability, but also aid in locating faults.

It is important to fuse the single-phase taps off from the main three-phase line to improve reliability. This is especially true on short taps where a two or three span tap with a fault would result in the feeder seeing the blink or having an outage.

2.3 Contingency Analysis

Using the recommended model as a basis, contingency analysis was performed. Currently there is load transfer capability between all of the substations for individual feeders.

There are a large number of existing possible contingency options between substations, which allows for a wide array of possible load transfers. All possible contingency options between feeders of different substations were analyzed and projects were provided in order to make load transfer possible in the case of a total substation outage.

2.4 Cost Summary

Table 2-4-1 through *Table 2-4-4* show recommended and contingency project costs by substation and priority year.

2.5 Project Prioritization

The first aspect to consider when determining a project's priority is whether the project is for the normal system improvement or for a contingency improvement. Normal system improvements would have first priority over a contingency improvement. The next consideration would be voltage levels of the system and at what year those voltage levels fall below planning criteria. Projects required to correct voltage for a transition period or long range period would have a lower priority than those needed to correct the existing system. The next item to consider would be the number of customers being served in the area requiring the project. An area with a high number of projects, although it may not have as low of voltage as other areas, would have a higher priority.

The last item to consider would be budget constraints in completing the project. Some systems may require a number of projects to correct existing system voltages requiring a large portion of the overall projects be completed within the first few years of the plan. However, this may not be feasible and would require that the projects be spread over a number of years, even though they are required as soon as possible. In these cases, the best approach is to try to complete projects that provide the most for your money. For example, completing a number of three-phase projects to allow phase balancing, improving voltage in a number of areas versus one major line rebuild.

Although the plan may prioritize projects, it is best to spread them over the planning period. Projects may need to be prioritized due to events of construction that may occur at an earlier time frame. For example, a project may be slated for year five, however, the county has just informed the District that it is going to rebuild a road in that area and that the line would need to be rebuilt, resulting in this project construction being moved up by three years. Another example may be that a subdivision did not develop as planned and that project may be moved back until such time that the subdivision is constructed.