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November 1, 2019

Daniel P. Wolf
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101-2147

RE: In the Matter of the Distribution System Planning for Otter Tail Power Company
Docket No. E017/CI-18-253
Integrated Distribution Plan

Dear Mr. Wolf,

Otter Tail Power Company (Otter Tail) respectfully submits its first Integrated Distribution Plan (IDP), developed by using input from internal departments as well as external stakeholder review as outlined in the requirements of the above referenced docket. It is understood the IDP will evolve over time, but it is the Company's intention that the information included within this first IDP provides a broader understanding into the challenges and opportunities for Otter Tail and its customers as well as how investments are determined into the distribution system.

Please note that Otter Tail has marked certain portions of Appendix A of this filing with the caption **NOT PUBLIC DOCUMENT – NOT FOR PUBLIC DISCLOSURE**, according to Minn. Stat. § 13.37, subd. 1(b). This statute protects certain "government data," as that term is defined at Minn. Stat. § 13.02, subd. 7, from being disclosed by an administrative agency to the public. The information being supplied in these schedules is considered to be a "compilation" of data that (1) was supplied by Otter Tail, (2) is the subject of reasonable efforts by Otter Tail to maintain its secrecy, and (3) derives independent economic value, actual or potential, from not being generally known to or accessible to the public. Specifically, the marked portions of Appendix A reflect load data that if not protected, could possibly be connected to specific customers. The nature of this data does not permit sufficient aggregation or anonymization. Otter Tail believes it is obligated to maintain this information as confidential in accordance with the Commission's January 19, 2017 Order in Docket No. E, G-999/CI-12-1244.

If you have any questions regarding this filing, please contact me at 218-739-8565 or at mriewer@otpco.com.

Sincerely,

/s/ MICHAEL RIEWER
Michael Riewer
Manager, Special Projects

kaw
Enclosures
By electronic filing
c: Service List

Integrated Distribution Plan

Docket No. E-017/CI-18-253
Otter Tail Power Company

Contents

APPENDICES

1 Preface

Otter Tail Power Company ("Otter Tail" or "Company") respectfully files this Integrated Distribution Plan with the Minnesota Public Utilities Commission ("Commission") in connection with docket no. E-017/CI-18-253.

Within this report, Otter Tail provides its first Integrated Distribution Plan ("IDP"), developed by using input from internal departments as well as external stakeholder review as outlined in the requirements of docket no. E-017/CI-18-253. It is understood this IDP will evolve over time, but it is the Company's intention that the information included within this first IDP provides a broader understanding into the challenges and opportunities for Otter Tail and its customers as well as how investments are determined into the distribution system. Since 1909 Otter Tail has touched the lives of its customers by providing reliable electricity and energy services. And Otter Tail will continue to focus on its customer's energy needs through all planning processes—including the Integrated Distribution Plan—with a balanced approach to environmental, economic, and community stewardship. Over the past 100 years Otter Tail's distribution planning process has evolved to meet the Company's mission and the needs of its customers and the Company will continue to evolve to meet future needs.

Otter Tail's Mission

To produce and deliver electricity as reliably, economically, and environmentally responsibly as possible to the balanced benefit of customers, shareholders, and employees and to improve the quality of life in the areas in which we do business.

1.A Multi-State Jurisdiction Complexity

Otter Tail serves customers in three states: Minnesota, North Dakota, and South Dakota. From a demographics and economic standpoint, the small, rural towns served both east and west of the Red River are very similar. In Minnesota the Company provides electricity and energy services to 155 communities with an average population of approximately 630. Though distribution systems typically do not have multi-state impacts, the general processes and budgets for the Company are applied on a system-wide basis, including rate making, which spans all three states. For example, rate making is completed based on system-wide spends and allocated pro-rata to each state based on usage. Throughout this report, the Company provides state-specific information whenever possible. However, there are cases in the IDP only system-wide total information is feasible. Whenever information is provided in the IDP, it is marked as either Minnesota-specific or system-wide.

2 Background

In March 2016 the Commission released the *Staff Report on Grid Modernization* (2016 Staff Report).[1] The 2016 Staff Report outlined a phased process and potential options for the Commission to pursue an investigation into the state's grid modernization efforts. At that time Commissioners supported distribution system planning as the most reasonable and actionable way for the Commission to assist in the forthcoming grid evolution. Commissioners agreed with the creation of a comprehensive, coordinated, transparent, and integrated distribution system planning process in Minnesota and supported the staff's proposed principles to guide further work[2]:

- Maintain and enhance the safety, security, reliability, and resilience of the electricity grid, at fair and reasonable costs, consistent with the state's energy policies.
- Enable greater customer engagement, empowerment, and options for energy services.
- Move toward the creation of efficient, cost-effective, accessible grid platforms for new products, new services, and opportunities for adoption of new distributed technologies.
- Ensure optimized utilization of electricity grid assets and resources to minimize total system costs.

In August 2016 the Commission received an *Integrated Distribution System Planning* report, completed by ICF International based on funding provided by the Department of Energy.[3] Following release of this report, the Commission held a workshop on October 24, 2016, seeking stakeholder input and discussion on a Minnesota-based distribution system planning framework.[4]

In April 2017 the Commission issued a questionnaire to utilities and stakeholders seeking to understand (1) how utilities currently plan their distribution system, (2) the status of each utility's current-year plan, and (3) how utilities and stakeholders recommend current distribution system planning processes could be improved.

Through September 2017 the Commission received in-depth responses on each utility's planning process, current plans, and utility and stakeholder input on potential topics and process considerations for distribution system planning. It was realized in early 2018 that due to utility differences in geography, territory, size, and status in grid modernization efforts, among several other factors, it was reasonable to set requirements individually by utility in order to collect information from each utility.

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[1] Docket No. E999/CI-15-556.

[2] MN PUC Staff Report on Grid Modernization, March 2016.

[3] Integrated Distribution Planning Report, August 2016 (ICF Report).

[4] MN PUC Grid Modernization: Distribution Planning Workshop Slides, Oct. 24, 2016.

In April 2018 Commission staff established individual dockets and publicly released proposed utility-specific filing requirements for Commission review, seeking Commission input and authorization to release the Draft-IDP for utility and stakeholder comment. The Commission directed staff to meet with each utility to discuss and clarify the filing requirements and following those meetings, authorized the release of the utility-specific draft integrated distribution plan filing requirements (Draft-IDP) for each utility.[5] Staff met with utilities throughout April and May 2018 to answer questions and/or provide clarity and released each utility's Draft-IDP for comment in June 2018.[6]

By September 7, 2018, comments were received on Minnesota Power (MP), Otter Tail Power Company (OTP), and Dakota Electric Association (DEA) Draft-IDPs on their own filing requirements, and from the Citizens Utility Board of Minnesota (CUB), Minnesota Department of Commerce- Division of Energy Resources (DOC DER), Fresh Energy (FE), and the Office of the Attorney General – Residential Utilities Division (OAG-RUD) on filing requirements for all utilities.

On December 6, 2018 the Commission adopted the staff's recommendations for each utility's IDP. This ruling required Otter Tail to file its first IDP on November 1, 2019. Within this first integrated distribution plan report, Otter Tail provides responses or explanations for each requirement of the IDP.

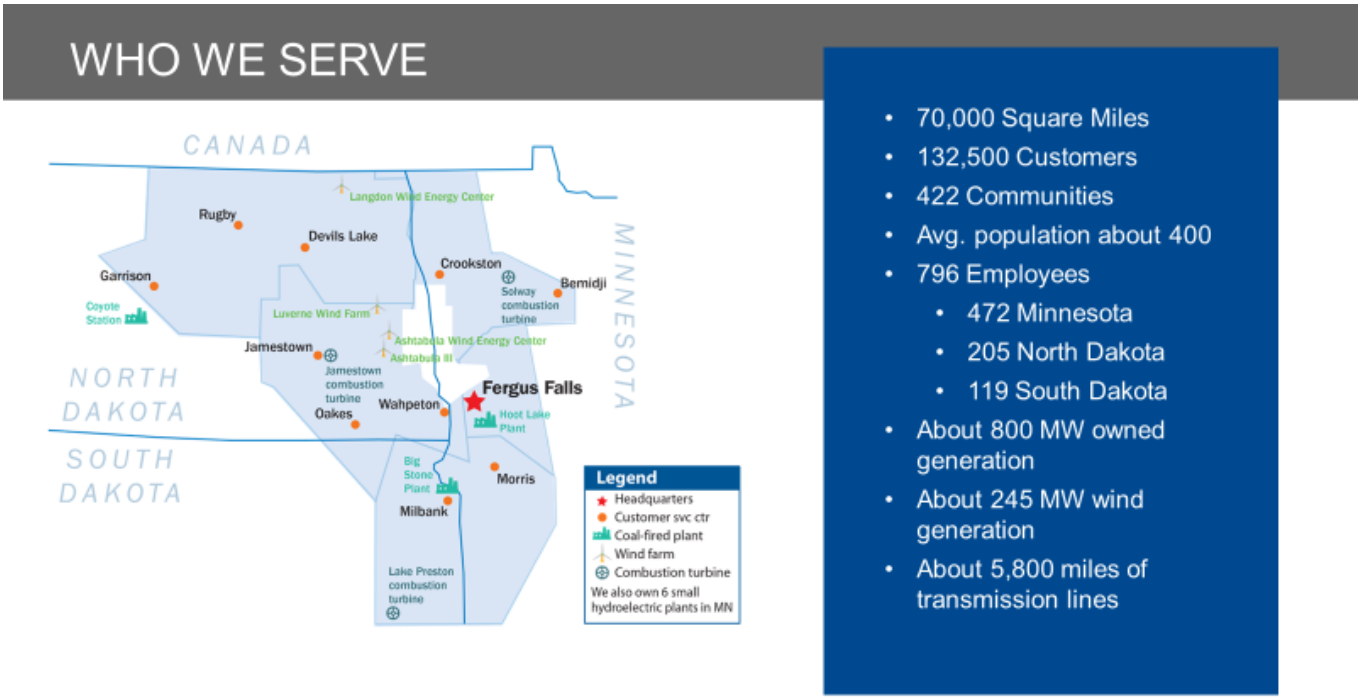
As mentioned in the preface, it is understood this IDP will evolve over time, but it is intended that the information included within this first IDP provides a broader understanding into the challenges and opportunities for Otter Tail and its customers and how investments into the distribution system are determined.

[5] April 19 Agenda Meeting Minutes, Docket Nos. 18-251 (Xcel Energy), 18-253 (Otter Tail Power), 18-254 (Minnesota Power), 18-255 (Dakota Electric Association).
[6] The June 2019 Xcel Draft-IDP Filing Requirements is included to this briefing paper as a relevant document.

3 Distribution Planning Overview

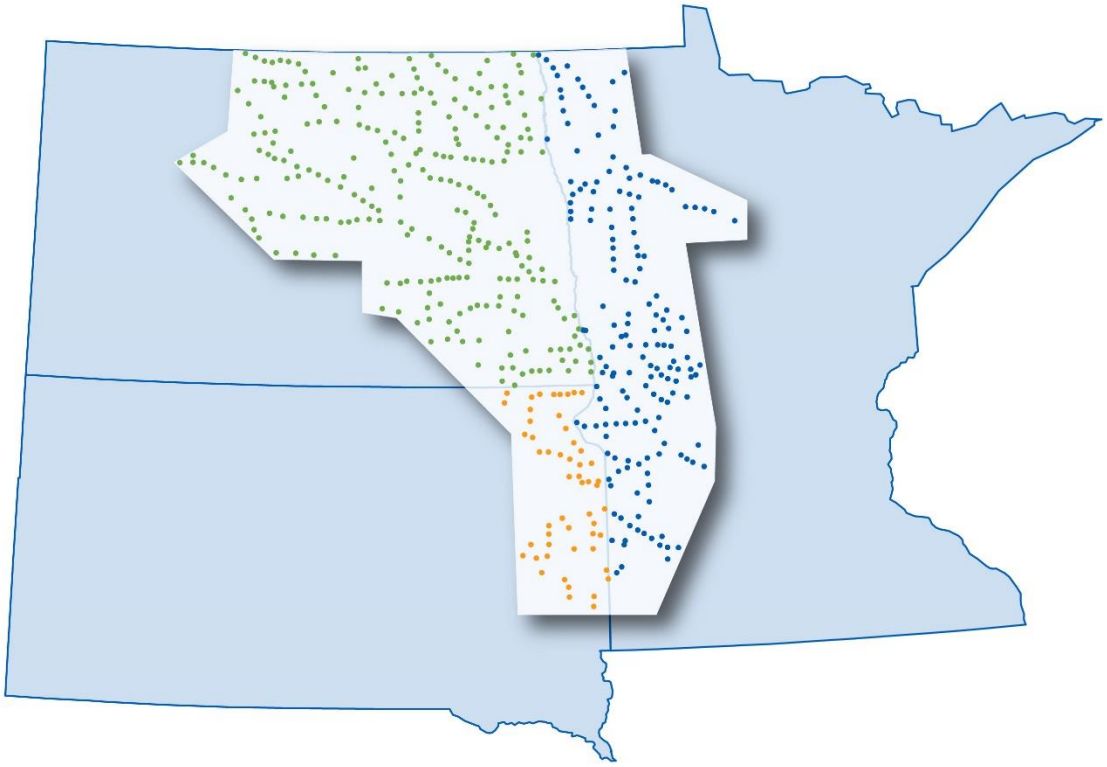
Otter Tail provides electricity to 422 communities across rural areas in western Minnesota, northeastern South Dakota, and the eastern two-thirds of North Dakota. The average population of the communities served is approximately 400, and over one-half of the communities served have populations of fewer than 200. Only three of Otter Tail's communities have populations exceeding 10,000: Fergus Falls, Minnesota (pop. 13,138), Bemidji, Minnesota (pop. 13,431), and Jamestown, North Dakota (pop. 15,427). The Company operates nine local Customer Service Centers (CSC) throughout the service territory, of which four are within Minnesota. Otter Tail is committed to utilizing proactive efforts to communicate, investigate, and resolve reliability issues across the Company's approximately 70,000 square-mile service territory. In total, the Company's service area is roughly the size of North Dakota. This information is also summarized in Figure A below. Considering Otter Tail's total load across the service territory and the number of distribution substations that exist, Otter Tail's average distribution substation demand is around 1.7 MWs. Consequently, Otter Tail's average distribution substation transformer size is around 3.3 MWs.

Figure A – Who We Serve



The following Figure B shows each of the communities served across the Company's three-state service area.

Figure B – Otter Tail Communities



Customer experience (including service reliability) and satisfaction are among the Company's top priorities. Otter Tail scored higher than average when compared to the Company's peer group in several power quality and reliability metrics in the 2018 J.D. Power Electric Utility Residential Customer Satisfaction study. Promptly restoring power after an outage, supplying electricity during extreme temperatures, and avoiding lengthy outages are areas rated high by customers. Areas needing improvement per the 2018 J.D. Power study are related to enhancing customer communications during outages and reducing the number of brief interruptions.

Otter Tail serves 155 communities in Minnesota. Of these, only two have a population of more 10,000 (Bemidji and Fergus Falls). Figure C below shows the actual population trends for Otter Tail's Minnesota service area and Figure D below shows the median age trends in Otter Tail's Minnesota service area per census data. As can be noted by both figures, many of the small communities Otter Tail serves are increasing in age and decreasing in population. These trends are important factors to consider in the distribution planning processes.

Figure C – Population Growth Trends

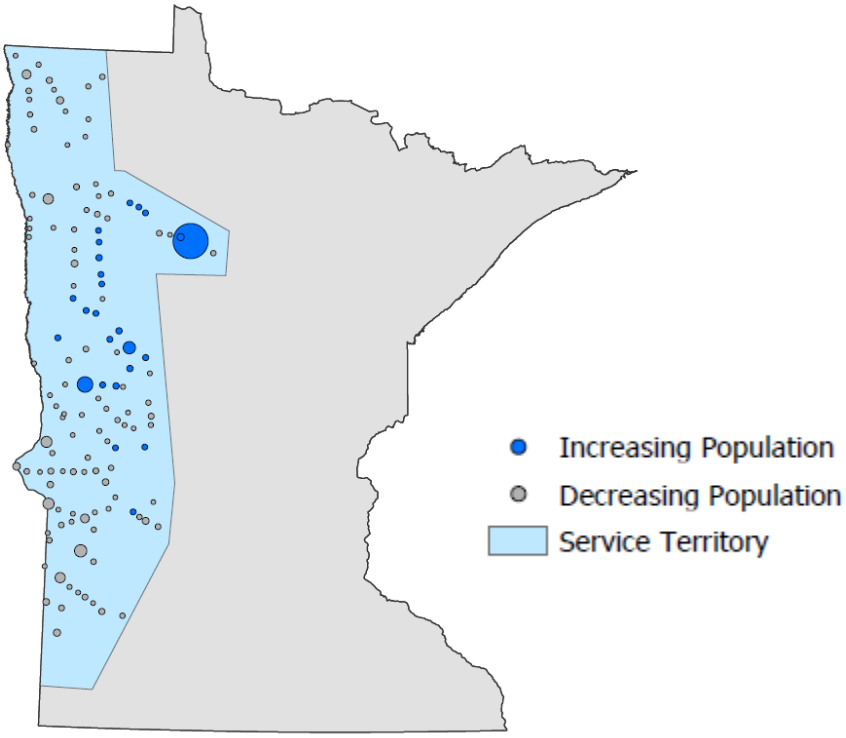
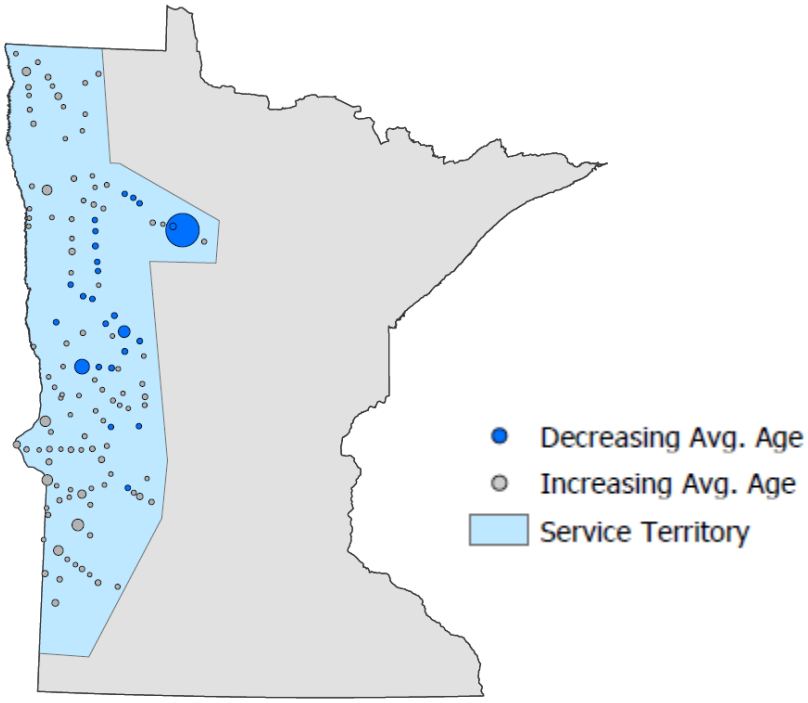


Figure D – Population Median Age Trends



These figures highlight only some of the unique challenge Otter Tail faces in planning the distribution system. The distribution system from one area of the system to the next can be very unique and different, such as when considering demand and energy growth. For example, over the past 10 years within the Minnesota distribution system, less than 20% of the substations are currently growing in demand and above 75% of their existing capacity. Most of the substations in the territory are either not growing or well within the system limits. This number changes from 20% in the winter months (Otter Tail's current system peak) to less than 10% in the summer months. That said, load may shift from one area of a distribution feeder to another in the form of spot loads over the course of time. These load changes may also warrant closer attention from engineers even though the overall substation loading may not have changed.

The information above highlights how system planning at Otter Tail can be unique as the demand growth and demographics of Otter Tail's communities may be much different than other areas of the state. Figures E and F below show the demand (based on metered substations) and energy trends for the Company's Minnesota distribution system. From the graphs below, it can be observed that the past five years of Minnesota distribution system demand and energy growth has been minimal. However, load changes and new load is only one factor for distribution planning. Otter Tail also considers reliability, performance and age assessments of assets alongside any outside forces, such as road moves during distribution system planning.

Figure E – MN Distribution System Demand Growth Trends (kW)

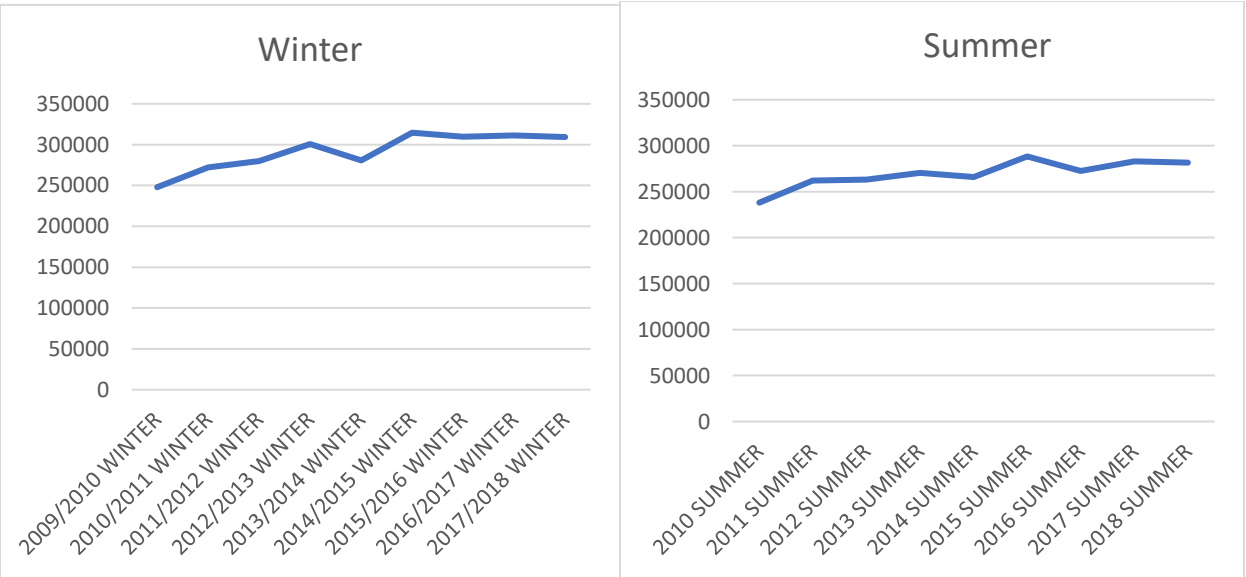
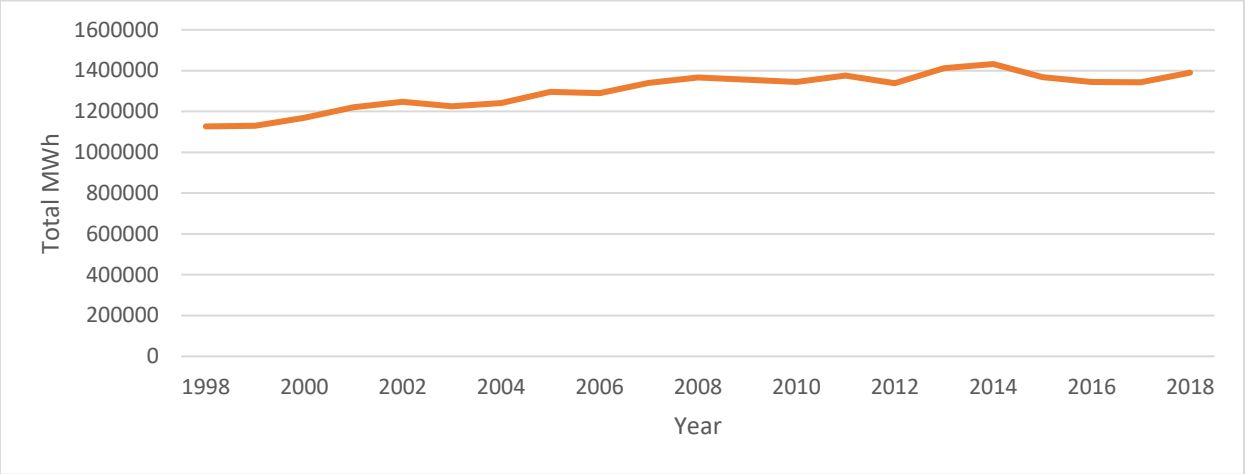


Figure F – MN Distribution System Energy Growth Trends



Otter Tail has one primary distribution studies engineer with others within the organization who can perform similar tasks as needed. This role is primarily responsible for reviewing and analyzing areas of the system which are seeing demand growth or other operational constraints that require study. In addition, Otter Tail has one principal area engineer and five additional senior area engineers. These roles are dispersed throughout the Company's service territory to ensure adequate review of assets in the field. They are responsible for identifying high value projects in their respective areas that meet the goals of improving reliability and system efficiency and reducing risk. Reducing risk includes things such as capacity concerns, compliance, and safety. Overall these roles reside within the asset management department, which works very closely with Otter Tail's customer service department (representing field employees, including linemen, and customer relations personnel) in identifying high-value projects. This close working relationship keeps the engineering and asset management group in touch with the needs on the distribution system. The customer service department is also aware of new and/or growing customers, aging and failing facilities, and suggestions for overall system improvement. In addition to the information coming from the field, the Area Engineers review distributions studies, metering reports, and reliability reports to develop, scope, and estimate projects to grow and maintain a reliable distribution system. Otter Tail recently reorganized the asset management department, including a renewed emphasis on reliability and data analytics within the planning process.

In addition to the specific projects identified each year, Otter Tail also maintains budgets for ongoing programs to maintain the Company's electrical system's health. These programs include things such as; tree trimming, transformer and regulator change outs, pole replacements, recloser change outs, and underground cable replacements.

The last important item to note in planning and forecasting spends on the system is related to material standards. Otter Tail maintains construction and material standards to help manage costs, safety, and reliability, though building of the electrical system is lumpy in nature. Otter

Tail has standard designs and material used to keep costs down while increasing consistency and efficiency. For example, feeder standards are either 200 amp or 600 amp, which help maintain efficient installation as well as replacement of assets.

3.A System Tools

As the system is planned for, various tools are used to aid in the process. For studies, Synergi Electric (V6.0.0) by DNV-GL is the modeling software used. The software is used to complete load flow and system performance analysis. Today, most studies are looking at near-term challenges associated with a new customer or an existing customer expansion. However, the distribution study area is striving to be continually more proactive in identifying longer-term challenges in applicable areas.

Another critical tool leveraged for system planning is the Company's Geographic Information System (GIS), which is also used for many operational applications discussed elsewhere in this report. Environmental System Research Institute's (ESRI) GIS houses both transmission and distribution assets. Otter Tail's Delivery Engineering and GIS departments create, as a cooperative effort, distribution models for use in Synergi Electric. The process starts with review and quality analysis/quality control of the system data within GIS. Assets, attributes, and system connectivity is necessary to create a model. Once the proper information is collected, processed, and memorialized in GIS, a file transfer takes place to an interface program called MiddleLink. MiddleLink aligns the data sets between GIS and Synergi Electric, allowing the creation of an electrical system model so that studies can be performed.

The electric system model contains all the known detail about the electrical system's equipment, conductors, and facility attributes. The attributes include voltage and current ratings, size, length, height, class, material type, phasing, and a geospatial location for the asset. The model gives an accurate geospatial view of the electrical system.

One of the last steps in modeling is to leverage actual system metering data. Otter Tail capture's this via load/meter historian systems (i.e., eDNA and Progress) which is then loaded into the electrical model as the most current system loading information. Finally, system source strength is added to the electrical model from the system protection department's software called Aspen One-liner. Engineering review takes place at every step along the way to ensure the data is accurate and of sufficient quality.

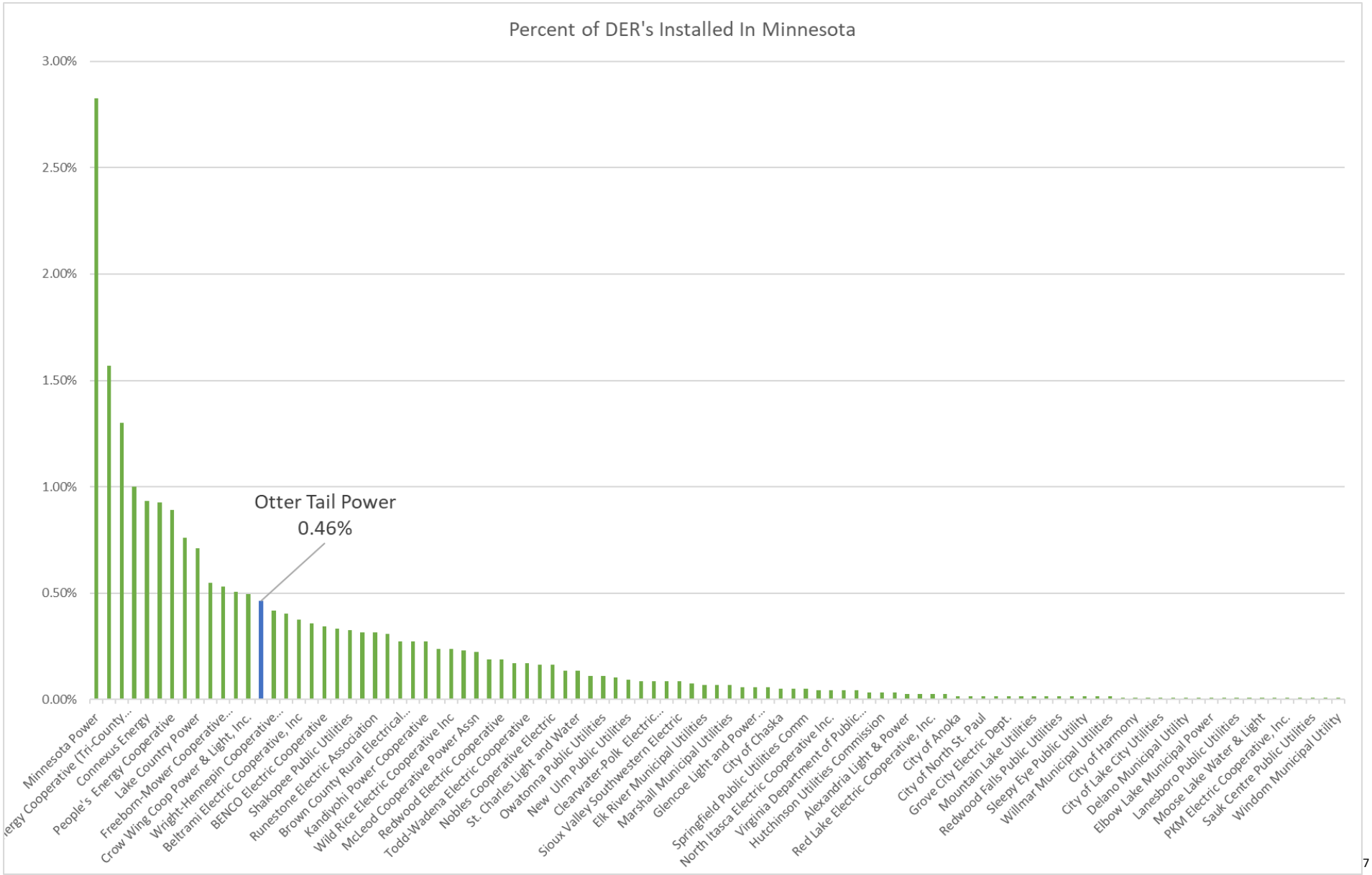
Outside of the modeling perspective, Otter Tail develops and designs distribution projects within a tool called Work Order Estimating or WOE. This system was developed over 30 years ago on an IBM mainframe. The system allows users to design a project and determine estimated costs as well as a list of materials. The system is connected to the company's financial and inventory systems as well. In 2019, we will be replacing this legacy system with a "staking" system from GeoDigital. In addition to being able to provide estimates and a material

list, this new tool will include more modern-day features and will carry a heavy spatial component through an interconnection to GIS as well.

3.B IEEE 1547-2018 impacts

IEEE 1547-2018 offers additional potential capabilities for the installation and operation of DER. With the implementation of this new standard, the view in which the study engineer looks at the system will evolve. Otter Tail is involved in the Distributed Generation Working Group, which is developing the Technical Interconnection and Interoperability Requirements. Otter Tail plans to use this group, along with the experience gained through interconnections to the Company's distribution system, to better understand the model and the potential operating characteristics these units have on the distribution system in regard to both planning and operations. Otter Tail is also developing a Technical Standards Manual that will address technical items because of the characteristics of the electrical system in and around the Company's communities.

The current level of DER penetration at Otter Tail, along with the current activity in the interconnection queue, does not yet rise to a level of concern for when more detailed studies would be required. Per the 2018 Minnesota Public Utilities DG Data, Otter Tail has less than a half of a percent of the DER's installed in the state (see graph below) and less than 0.14 percent of the DER MW installed in Minnesota interconnected to the electrical system.



[7]

[7] The graph excludes Xcel as they have the majority of DER installations. https://mn.gov/puc/assets/DG%20in%20Minnesota%202018%205-13-19_tcm14-384375.pdf.

4 Distribution Operations Overview

Day to day distribution operations at Otter Tail are handled through a few key areas of the organization that span asset management and customer service. As discussed in section 3, the asset management area of the company is primarily responsible for capturing stakeholder input and planning and engineering the distribution system improvements. Otter Tail then has nine customer service centers throughout the three states in which we serve where area line crews and customer service representatives reside, along with a few other staff. As mentioned in the preface, four of these customer service centers are located in Minnesota (Bemidji, Crookston, Fergus Falls, and Morris). At Otter Tail, there are approximately 60 linemen equipped with trucks who are capable of completing any of the Company's distribution construction needs. These roles are primarily assigned to capital projects throughout the year. In addition, approximately 110 service representatives are equipped with lighter duty trucks or pickups with utility bodies. These service representatives are equipped to handle some capital work but spend more time on operational and maintenance items including meter-related activity, collections, start/stop service requests, area and streetlight maintenance, and general customer inquiries. Both the linemen and service representatives roles are capable of outage and emergency response. Lastly, about 40 customer service representatives are the primary contacts for customers to inquire about outages, bill concerns, and other utility offerings. These roles are also described in the MN SQRS annual filing.

Otter Tail recently deployed a new Customer Information System (CIS). This system is where short-cycle service orders are generated, including the operational and maintenance items describe above. One unique process for Otter Tail is the way in which these orders are dispatched. In some utilities, work is centrally dispatched by a distribution desk to the appropriate personnel. At Otter Tail, however, there is generally only one service representative available to complete the order due to the rural nature of the Company's service territory. Because of this, Otter Tail does not use a distribution desk but rather routes orders based on geographic location. Longer-term or capital work is dispatched and coordinated between both asset management and customer service teams based on priority and availability.

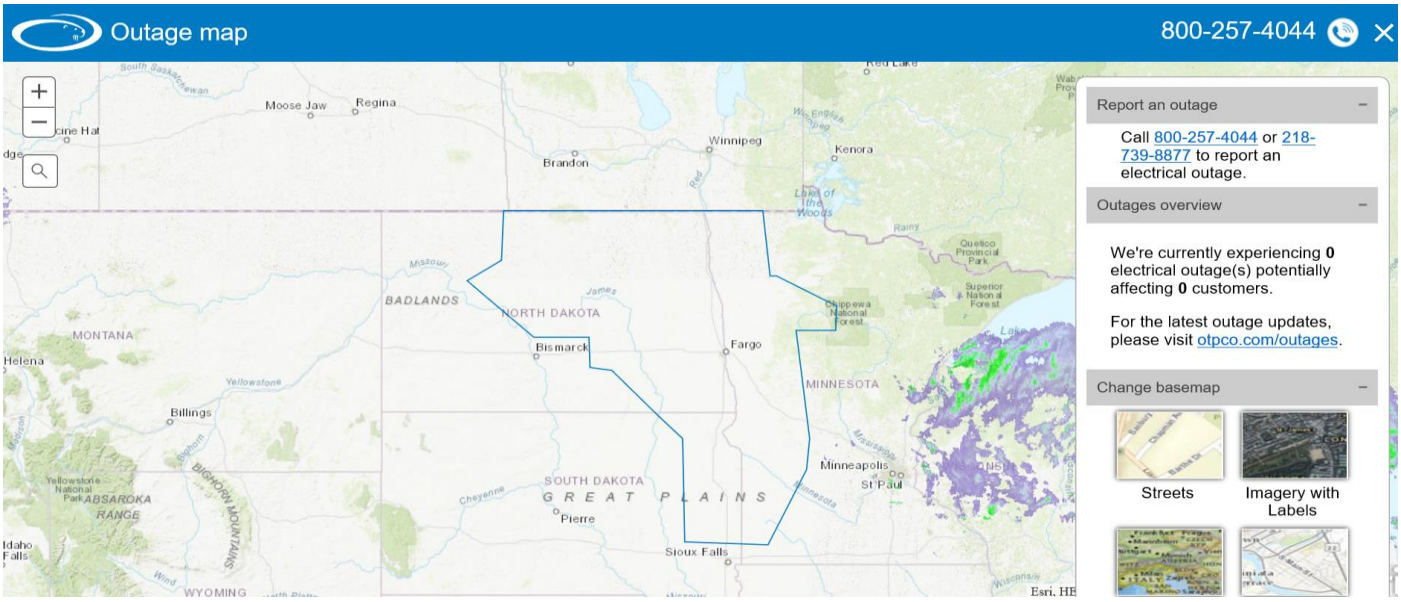
Perhaps another unique characteristic of Otter Tail's distribution operation relates to the Company's outage processes. Otter Tail coordinates responses to both business hours and after-hours outages without the use of a centralized distribution desk nor a formal outage management system. Switching orders and outage restoration efforts on the distribution system are all handled at the local level—in other words, at the customer service centers. There are about 25 employees who rotate through an on-call role for after-hours outage dispatch and response. These roles are split up within three geographic regions of the Company and are responsible for receiving after-hours outage concerns and dispatching field personnel. In

addition, Otter Tail's System Operations department, where on-shift power system operators reside, are also available to take outage calls after hours. Otter Tail's customer service representatives typically answer customer calls during business hours and a 3rd party answering service takes calls after hours. In either situation, customer inquiries related to outages are directed to appropriate field employees.

Currently, Otter Tail does not utilize an integrated voice response system for outage inquiries. Communications regarding outages to customers is done through the Company's online outage map, (https://www.otpco.com/outagemap/index.html), as shown in Graphic A, as well as through social media and direct customer contacts. Though Otter Tail does not have a formal Outage Management System, outage awareness and management is done through a combination of tools. These tools include bell-weather deployed ITRON AMI meters, GIS mapping tools and dashboards, and various Microsoft Office products developed including an online Personnel Dispatch Tool.

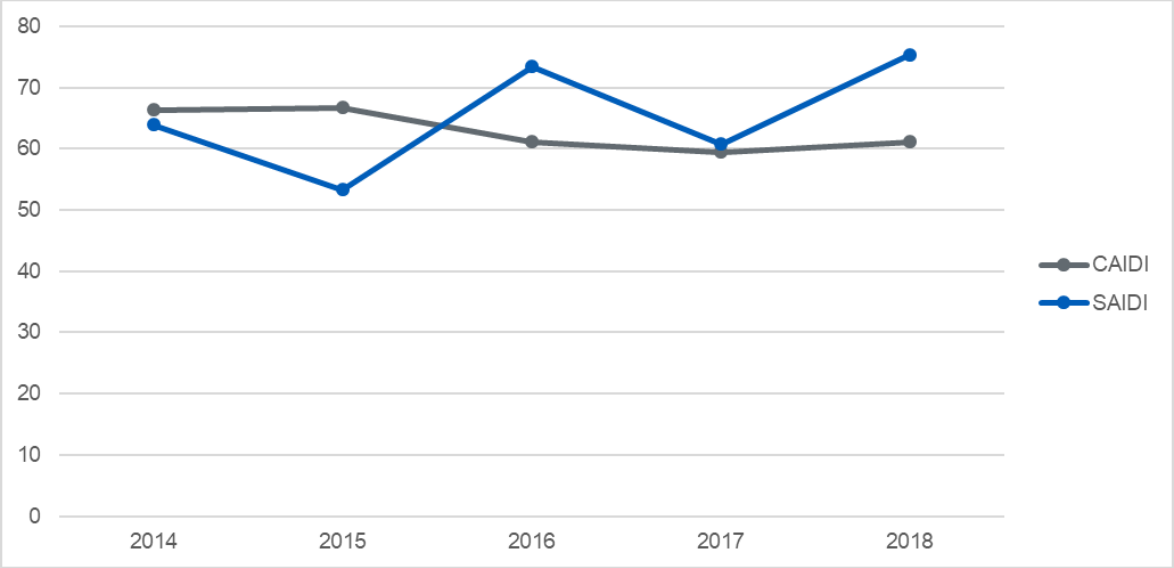
The processes of distribution operations reflect Otter Tail's mission statement in the sense that it is resourceful and serves customers reliably and efficiently. That said, these processes are under review for potential improvements, as will later be discussed in Section 8: Grid Modernization.

Graphic A – Otter Tail Power Outage Map



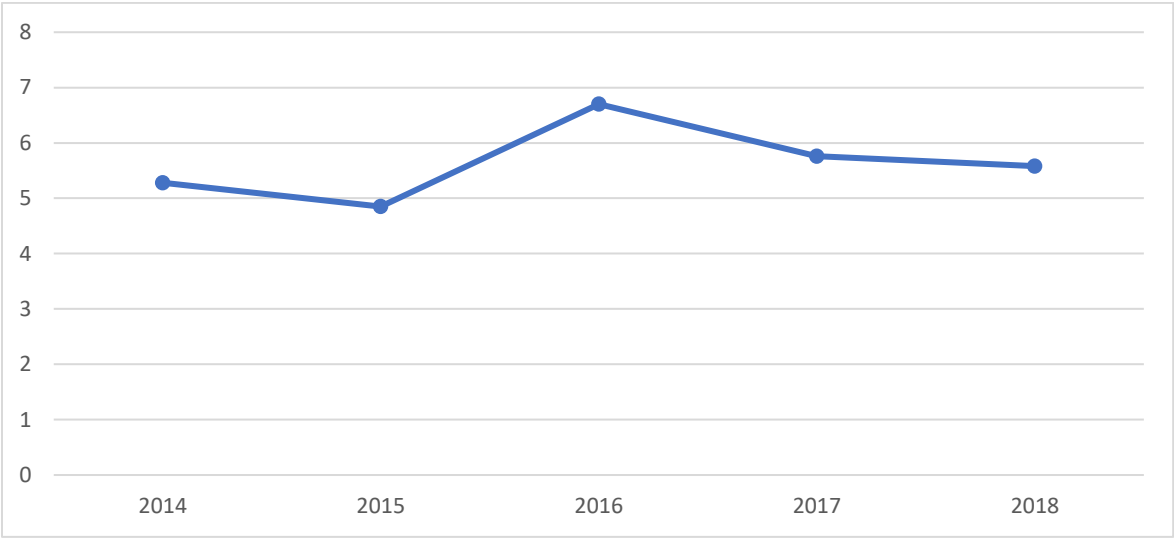
Otter Tail's reliability performance is well described within the Minnesota Safety, Reliability, and Service Quality report found within docket number E017-M-19-260. In summary, Figure G below shows the past five years of Customer Average Interruption Duration Index (CAIDI) and System Average Interruption Duration Index (SAIDI) performance.

Figure G - Historic Minnesota SAIDI and CAIDI



In addition, a summary of the momentary average interruption frequency index (MAIFI) over the past five years is provided in Figure H. MAIFI is an indication of the average number of momentary interruptions the average customer received over the course of a year, for a particular region. Otter Tail views MAIFI as a leading indicator for future SAIDI and thus tracks and analyzes line sections with excessive momentary interruptions to focus on for future capital improvements or possible vegetation management needs.

Figure H – Minnesota Historic MAIFI



The data for reliability calculations are gathered by the Interruption Monitoring System, (IMS). Otter Tail saw a slight reduction in MAIFI in 2018 when compared to 2017, though when reviewing customer comments and feedback regarding reliability, it has been noted that the

largest opportunity for improvement to meet customer expectations is by improving MAIFI. This expectation has been factored into future infrastructure planning decisions.

5 System Details

Otter Tail has limited visibility of distribution facilities throughout system on a real-time basis. Otter Tail has 565 distribution substations, with 11 of those substations having control and monitoring within Otter Tail's System Operations Energy Management System utilized by the power system operators. Otter Tail's Energy Management System is primarily used to monitor and control the transmission system (transmission system - 41.6kV and higher). However, distribution facilities located within a transmission substation are included when possible. Table 1 below shows a summary of the Substation and Feeder statistics.

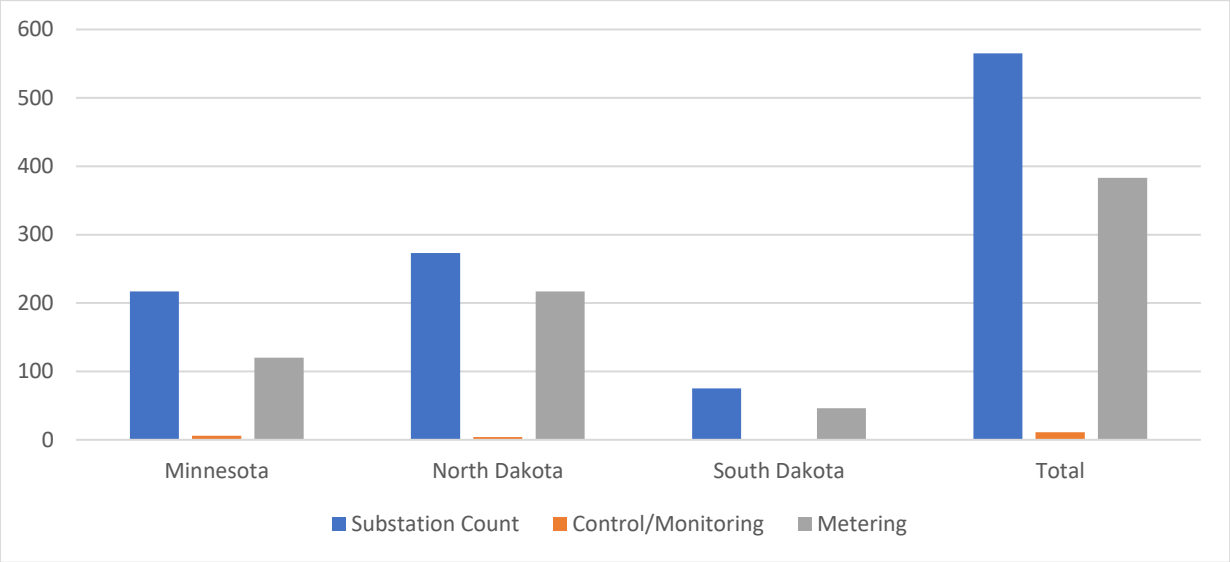
Table 1 – Substation and Feeder Statistics

Distribution Substation	Minnesota	North Dakota	South Dakota	Total
Substation Count	217	273	75	565
Control/Monitoring	6	4	1	11
Metering	120	217	46	383
Substation/Transformer Capacity (MVA)	710	780	170	1,660
Max Substation Load (MVA)[8]	425	550	105	1,080

Distribution Feeder	Minnesota	North Dakota	South Dakota	Total
Feeder Count	282	352	90	724
Control/Monitoring	24	9	4	37

[8] Max substation demand as observed by each metered substation delivery point. Values represent a system non-coincident peak but coincident to the substation meter.

Graphic B – Distribution Substation Visibility



As can be seen from Table 1 and Graphic B, Otter Tail currently meters 383 of 565 distribution substations. However, this metering covers more than 90 percent of Otter Tail's delivered energy. It is estimated that the cost of adding metering capabilities to substations where metering doesn't currently exist to be between $5,000 and $10,000 depending on the site. In total, this means full metering capability to all substations would range from $900,000 to $1,800,000. To date, metering at the remaining substations has not been cost justifiable to serve the needs of customers and will continued to be evaluated on a case-by-case basis as needs evolve. It should also be pointed out the metering referenced in this section relates to distribution substation metering. Otter Tail does meter all customer accounts.

Table 2 below provides more insight, derived from GIS, regarding asset counts for the distribution system at Otter Tail. Primary distribution lines are the main lines from substations to the high side of service transformers. Secondary distribution lines are the lines used for streetlight circuits and the lines from the low side of service transformers to individual customer service lines owned by Otter Tail. Distribution poles are used to attach the primary and secondary distribution lines for overhead circuits and service transformers are used to transform the voltage from primary to secondary levels.

Table 2 – Distribution System Asset Statistics

Primary Distribution Line (miles)	Minnesota	North Dakota	South Dakota	Total
Overhead	2,037	1,902	475	4,414
Underground	669	586	103	1,358
Total	2,706	2,488	578	**5,772**

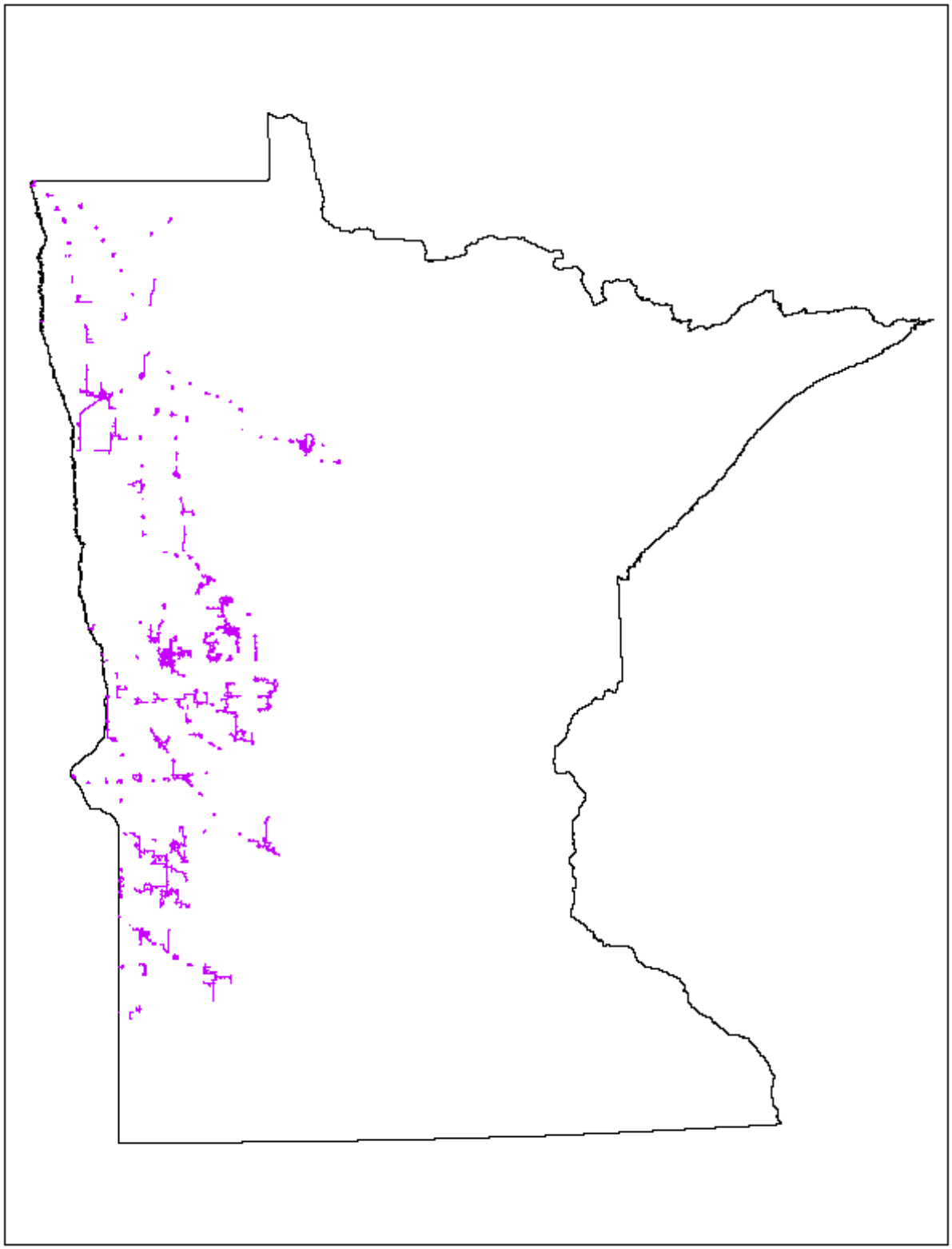
Secondary Distribution Line (miles)	Minnesota	North Dakota	South Dakota	Total
Overhead	951	1,008	240	2,199
Underground	192	217	36	445
Total	1,143	1,225	276	**2,644**

Distribution Poles	Minnesota	North Dakota	South Dakota	Total
Total	79,972	81,278	17,958	**179,208**

Service Transformers	Minnesota	North Dakota	South Dakota	Total
Overhead	12,250	10,544	2,678	25,472
Pad-mount	5,703	4,687	810	11,200
Total	17,953	15,231	3,488	**36,672**

To help visualize the Otter Tail assets within a map, Figure I below was exported from the Company's GIS. It's easy to see the rural areas throughout the west and north central regions of the state where we provide service.

Figure I – Map of Otter Tail's Minnesota Distribution System from GIS



Lastly, nearly all of Otter Tail's billing meters are manually read today. Outside of some industrial meters and the Interruption Monitoring System cellular AMI meters, the remainder are read either by Otter Tail employees or a 3rd party through handheld devices. Table 3 below summarizes Otter Tail's meter counts in Minnesota. These meters are used to bill just over 62,000 Otter Tail customers in Minnesota.

Table 3 – Minnesota Service Territory Metering

	Manually Read	AMR	AMI	Total
Minnesota Meters	84,363	244	491	85,098

5.A Load Forecast Including Electrical Vehicles, Load Control, Energy Efficiency and Storage

The distribution system must be designed to withstand system peaks and possible scenarios which may arise on the system in emergency conditions. Because of this, the system must be planned to peak demand levels. In addition, as DER is added to the system and reaches higher penetration levels, minimum demand levels will also need to be studied for system impacts. That said, the Company continuously works to improve system utilization through various rates, demand programs, and system configurations.

The process for developing demand forecast begins with taking the latest economic demand forecast from the Company's last Integrated Resource Plan (IRP). While this gives a general sense of system-wide demand growth, it does not show potential growth or decline in specific locations or communities. In the last IRP, the demand growth was shown to be nearly flat across the system. However, because distribution system planning is much more localized than transmission or resource planning, community specific growth patterns are used where necessary. This means there are areas of the system that do see demand growth and that growth must be accounted for in the distribution plan. In general, the following areas of Otter Tail's Minnesota system have experienced the most demand and growth activity over the past few years listed in alphabetical order:

- Bemidji
- Fergus Falls
- Morris
- Pelican Rapids
- Perham

Not surprisingly, most of these areas appear within Figures A and B in Section 3 and those that do not appear in those figures are driven by increasing commercial and industrial loads. As DER penetration increases, we will also need to be aware of areas of the system that are decreasing in demand or where DER is masking potential load. There are numerous smaller communities across Otter Tail's service territory in Minnesota that are decreasing in demand. Areas of the system with noted demand growth are studied more frequently and proactively than other areas of the system to ensure the system is adequate for the increasing load.

Otter Tail's baseline system wide demand growth is expected to be around 0.92 percent over the next 15 years. This percentage is based on the Company's most recent demand forecast, created in January of 2018, which is projecting a downward trend despite the Company's last Integrated Resource Plan filing (Docket No. E017/RP- 16-386), which projected a demand growth of 1.25 percent over the same time period. The decline in the demand growth factor is consistent with the trends seen in the Company's sales forecast and is caused namely by slower economic growth and an increase in energy efficiency programs.

In addition, Otter Tail expects to continue to see energy efficiency projects impacting energy sales and consequently, coincident demand. In recent years, Otter Tail has achieved remarkably high energy savings from partnering with customers and implementing projects through the Conservation Improvement Program (CIP). While the Company did achieve 2.75 percent energy savings in 2016, 3.01 percent in 2017, and a record-setting 4.21 percent in 2018, the Company is cautiously optimistic as to where future energy savings will come from. Most short-term payback projects have now been completed by customers, leaving less opportunity for simpler energy savings projects looking forward. CIP projects will likely become more complex, necessitate more spending, and require a longer payback for customers. These factors, paired with changing lighting and energy code standards, may significantly impact energy and demand savings from CIP projects in the future.

In 2017 the Minnesota Department of Commerce's Division of Energy Resources (Department) hired a consultant to perform a Demand-Side Management (DSM) potential study focused on energy efficiency potential. This study performed an in-depth assessment across the entire state to identify what potential for electric energy efficiency exists throughout the state. The Department released results from the study in December 2018. The results of the study indicate investor owned utilities should be able to average a level of 1.9 percent annual energy savings from 2020-2029.

In Otter Tail's latest approved Integrated Resource Plan, docket no. E017-RP-16-386, the Company included 1.6 percent annual energy savings from 2017-2031. The 1.6 percent energy savings goal was based on Otter Tail's proprietary 2016 energy efficiency potential study. The study showed 1.6 percent energy savings was the most cost-effective level of energy savings Otter Tail should target. While Otter Tail has consistently exceeded both

1.6 and 1.9 percent energy saving levels in Minnesota, there is still uncertainty of future achievement levels considering upcoming changes to equipment standards, advanced technologies, regulatory policy, and declining utility avoided energy and demand costs. With this background, when Otter Tail models DSM and energy efficiency within Strategist models (IRP forecasting tool), the results show around a 0.90 percent coincident impact to demand.

In addition to energy and demand savings from CIP projects, Otter Tail actively promotes its robust demand response (DR) portfolio. Currently Otter Tail has about one-third of customers participating in DR programs, which shift customer's load from peak periods to non-peak periods. The Company's DR rate offerings and customer rebates for installation of the associated equipment encourage wide-spread participation in DR. By shifting load to non-peak periods, Otter Tail can avoid purchasing energy at high prices and lower the Company's capacity reserve requirements within the Midcontinent Independent System Operator (MISO). Currently Otter Tail has about 20 MW of summer load, which is accredited in MISO. The savings from these DR programs is reflected in historical demand numbers, which in turn are already accounted for in future load-growth projections. Though MISO is summer peaking, as noted earlier, Otter Tail is a winter peaking utility and has a long history of mitigating winter peaks. With that history, Otter Tail is able to control nearly 15 percent (around 120 MWs) of its winter peak demand.

Regarding electric vehicles (EVs), Otter Tail assumes a baseline electric vehicle penetration of less than 0.1 percent in its service territory. There are currently 44 electric vehicles within the Company's Minnesota service territory and 5 of those vehicles on the Company's off-peak charging rate. To increase adoption of EVs Otter Tail offers customers a $400 rebate to customers going on Otter Tail's off-peak charging rate. Otter Tail is a member of Drive Electric Minnesota and partners with them on numerous promotional activities such as; Ride and Drive events, Win an EV for a Week, social media posts and public education forums. Otter Tail has also partnered with customers to contribute to the installation of 10 level 2 EV charging stations. Based on projections from the United States Energy Information Administration and other modeling, Otter Tail estimates a high scenario for penetration in its service territory of 2.6 percent (6.2 MWs of non-coincident demand) in 2025, 5.3 percent (12.6 MWs of non-coincident demand) in 2030, and 6.8 (15.8 MWs of non-coincident demand) percent in 2035. Despite the company's proactive efforts to facilitate and encourage EV adoption, it is likely that Otter Tail will see less penetration than this forecast due to the rural nature of its large service territory. Legislative and regulatory policies, as well as technological changes, over this time frame can significantly change these projections. From high-level reviews, Otter Tail estimates 25 percent of the non-coincident load from EVs to align with the coincident peak. For the baseline scenario, Otter Tail proposes to utilize a 0.03 percent increase in annual demand due to EVs. This is based on an EIA "high pentation" EV scenario modeling, in which it is expected to see 1.6 MWs of coincident demand across the entire system by 2025, which is largely negligible in the overall growth for Minnesota planning. For the high penetration EV scenario within the IDP, Otter Tail utilizes a 0.15 percent annual increase, which is five

times the amount of EV growth expected from the high EIA estimates.

5.B Distributed Generation Forecasts and Trends

Over the last five years, Otter Tail has averaged seven distributed generation projects interconnected to the Company's distribution system in Minnesota each year. These equate to approximately 89 kW of total nameplate of new installed distribution generation each year in Minnesota. Due to the small penetration and magnitude, Otter Tail does not measure the generation for all these units to know the exact effect of these units on demand growth. In a sense, these are simply netted into load forecasts. This has been appropriate and cost effective with such low penetration as shown in section 3.B. If these units were assumed to be at a 20 percent capacity factor, this would equate to around 18 kW of peak demand reduction annually. For the purposes of the IDP and distribution planning, Otter Tail can assume these to be negligible although the Company acknowledges that awareness and understanding of these systems is certainly important to operations for safety reasons and should not be discounted. It could also be argued that historical trends for distributed generation are included within demand growth estimates since these units are netted into current load forecasts. For these reasons, the baseline estimate is proposed to be a zero percent net affect to demand growth. For the high penetration estimate, Otter Tail has assumed the number or request and amount of generation will triple and thus assume an 0.2 percent effect on annual demand growth.

As indicated above, Otter Tail has averaged seven DER installations per year over the last five years (2013-2018). In this same timeframe, Otter Tail has seen DER installation more in the southern part of its Minnesota service territory. The two southern-most customer service areas, Fergus Falls had fourteen installations and Morris had eleven. The other area where Otter Tail has had installations is within the Bemidji area, which has had nine. The service territory north of Fergus Falls and west of Bemidji has had only one DER installed over the last five years. This information is summarized within Table 4 below. From the table it can also be noted that none of the fuel sources are electric battery storage. Otter Tail did not have any requests that carried over from 2018 into 2019. In all these prior installations, Otter Tail has not needed to charge the DER customer for upgrades on the distribution system other than through tariff rates.

Table 4 – MN DER Interconnections between 2013 and 2018

Queue No	Customer Service Area	Size (kW)	Fuel Source
D13-03	Fergus Falls	11	Solar
D13-05	Fergus Falls	3	Solar
D14-02	Morris	10	Solar
D14-04	Morris	9.1	Solar
D14-05	Bemidji	3.225	Solar
D14-07	Morris	19.68	Solar
D15-01	Fergus Falls	9.84	Solar
D15-02	Fergus Falls	8.4	Solar
D15-03	Fergus Falls	5	Solar
D15-04	Crookston	20	Solar
D15-05	Morris	11.995	Solar
D15-06	Fergus Falls	6.8	Solar
D15-07	Morris	22.8	Solar
D15-08	Morris	6.48	Solar
D16-01	Fergus Falls	12	Wind
D16-02	Morris	39.9	Solar
D16-03	Fergus Falls	6.72	Solar
D16-04	Fergus Falls	7.5	Solar
D16-05	Bemidji	14.4	Solar
D16-06	Fergus Falls	7.6	Solar
D16-07	Morris	7.975	Solar
D17-01	Bemidji	36	Solar
D17-02	Bemidji	10	Solar
D17-03	Morris	8.5	Solar
D17-04	Fergus Falls	8.35	Solar
D17-05	Fergus Falls	5.04	Solar
D17-06	Morris	5.45	Solar
D17-10	Bemidji	10	Solar
D17-11	Bemidji	3	Solar
D17-12	Morris	9.92	Solar
D17-13	Fergus Falls	10.35	Solar
D18-01	Bemidji	38.7	Solar
D18-02	Fergus Falls	3.84	Solar
D18-03	Bemidji	12.96	Solar
D18-04	Bemidji	38.98	Solar

Over the past five years (2013-2018), Otter Tail had two solar DER projects totaling 144 kW that requested interconnection but did not sign an interconnection agreement. Likewise, Otter Tail did have one solar unit that signed an interconnection agreement but later decided not to proceed. In addition, table 5 below represents the requests queued in 2019 as of September to the Minnesota distribution system.

Table 5 – Queued Interconnection Requests

Queue No	Customer Service Area	Size (kW)	Fuel Source
D19-01	Fergus Falls	11.31	Solar
D19-02	Bemidji	112	VFD Inverter
D19-03	Morris	8.03	Solar
D19-04	Morris	15.2	Solar

Otter Tail does not keep detailed records to track the cost to review and install a DER. However, Otter Tail estimates it spends about $1,400 per application by the time the application is processed, the necessary agreements are in place, the meter is installed, testing is performed, and incorporate the new DER into the system. Table 6 below shows an estimated breakdown of the costs associated with the interconnection process.

Table 6 – Interconnection Processing Costs

Application Phase	Hrs
Interconnection Coordinator	2
Admin assistant	2
Distribution Engineering	3
Transmission Engineering	1
Installation	
Interconnection Coordinator	1
Contract close out administrator	2
Other administrator	2
GIS updates	1
Meter tech – start-up test, travel	3
Customer Service notification	1
Total Hours	18
Cost at $75/hr	**$1,350**

5.C DER Forecasting and Discussion

As reviewed above and discussed at the stakeholder presentation on October 4, no near-term impacts due to DER penetration are expected. If trends continue within the business-as-usual pace, case-by-case monitoring of distribution impacts will be appropriate, and the level of requests will be able to be handled through existing processes.

As discussed in the comment period that led to the development of the MN IDP requirements, Otter Tail does not believe DER penetration levels of 10 percent and higher, as listed in the Company's requirements, are appropriate for its service territory and customer base. For these reasons, the baseline estimate is proposed to be a zero percent net affect to demand growth.

For the high penetration estimate, Otter Tail has assumed the number or request and amount of generation will triple and thus assumed an 0.2 percent effect on annual demand growth. This results in a 0.55% overall effect on demand. If DER assumptions continued to increase, the effect on net demand would continue to push further into the negative direction. Table 7 below summarizes the various inputs that form the basis for the two recommended scenario forecasts. In future IDPs, these scenarios will be reviewed. For this report, however, Otter Tail does not believe there is value in reviewing the prescribed DER penetration levels that might be applicable to other areas of the state, which are seeing much higher impacts due to DER. For both levels shown in Table 7 below, Otter Tail's existing processes and tools are capable of handling.

Table 7 – Scenario Summary

DER Component	Baseline Scenario	High DER Penetration Future
Demand Growth	+0.92%	+1.0%
Energy Efficiency and Demand Response Effect on Demand	-0.90%	-1.5%
Electric Vehicle Adoption Effect on Demand	0% (Negligible)	+0.15%
Distributed Generation Effect on Demand	0% (Negligible)	-0.2%
TOTAL Annual Net Load Modeled	**+0%**	**-0.55%**

The percentages shown in Table 7 represent system averages for Minnesota. There are areas of the system where load growth is more than average, as well as less than average. Because of this variance, Otter Tail uses sensitivities for load growth as necessary during actual distribution studies. In addition, the forecasts do not have a way to account for large, unknown and/or unplanned industrial spot loads, which could adjust the percentages as well. However, those loads are typically connected at a transmission level and would not impact distribution planning directly.

5.D Feeder Minimum Loading Levels

One approximation used for determining available interconnection capacity is to review minimum feeder loading levels. Of course, this is certainly an approximation and true interconnection impacts can only be determined through actual planning studies. In addition, when Otter Tail reviewed the minimum feeder or substation loading reports, many reported a loading of 0 MWs. This can be due to outages and normal maintenance switching where the substation or feeder monitoring device may have been out of service. Because of this, the table in Appendix A shows the minimum "non-zero" loading level.

Metering for Otter Tail Power distribution substations measures and records the aggregate load for the substation. Metering data is collected in 15-minute intervals, and feeder-level metering

is not available. Some substations have cellular communication capability while most require an on-site visit. The daily non-zero minimum MW loads are reported in Appendix A with column headers of month, day, and substation name. The months are numbered 1 through 12, and the days of the month are numbered 1 through 31 for the 2018 calendar year.

5.E System Loss Analysis

Due to metering constraints discussed earlier and the manually intensive analytical efforts, loss information cannot be provided using actual metering and billing data from 2018 at this time. In lieu of utilizing 2018 data, Otter Tail provides the following loss factors as calculated in the most recent loss study conducted internally in 2010. Otter Tail is working on modifications to improve this past study, including the development of automated processes and improvements to data set quality. It is anticipated that these changes will enable Otter Tail to efficiently complete this analysis annually starting in 2020.

From the 2010 analysis, energy losses on Otter Tail's distribution system are estimated to be 4.34 percent. This comes from losses analyzed starting from the distribution substation transformer to the primary distribution system to the secondary distribution transformer and finally to the secondary distribution system.

As mentioned previously, this information through an analysis of the Otter Tail distribution system in 2010. Substation metering data for the Otter Tail system was added together to determine the energy delivered to the distribution system. Likewise, the retail metering data at customer locations was also collected for the same timeframe to determine the amount of energy delivered to customers. The difference between the customer metering and the distribution substation metering represents the total losses on the distribution system.

6 Financials

The following financial information is based on the Company's last approved capital budget forecast (December 2018 approval for years 2019–2023) as well as actuals through December of 2018.

6.A Historical

Within Otter Tail IDP requirements, historical distribution spending is to be broken down into the following categories:

a. Age-Related Replacements and Asset Renewal
b. System Expansion or Upgrades for Capacity
c. System Expansion or Upgrades for Reliability and Power Quality
d. New Customer Projects and New Revenue
e. Grid Modernization and Pilot Projects
f. Projects related to local (or other) government-requirements
g. Metering

h. Other

However, for 2019 and earlier data, Otter Tail provides data in the following categories:

1. New Load or Reliability
2. Replace
3. Relocate
4. Metering
5. Grid Modernization or Pilot Projects

Each year, Otter Tail executes construction projects categorized within the funding classifications shown above. The process for the identification of projects was described earlier, in Section 3. Based on the requirements noted for Otter Tail's IDP, Otter Tail has included 2019 – 2023 financial data within the categories specified for Otter Tail's IDP. For clarity, the following definitions are used for the budget categories prior to 2020.

New Load or Reliability:

The work performed within the new load category includes projects such as building or installing new facilities to connect new customers and upgrading existing facilities to serve expanding customers, or load pockets where load has grown over time by many customers incrementally adding load. Reliability projects are used for a few different types of projects. One type of project is used to address reactive deficiencies of the system. In addition, these projects are used to replace failed facilities that have caused an interruption. This category of capital spend accounts for roughly 55-60 percent of the overall distribution spend each year. This work does not include events caused by storms.

Replace:

The Replace budget is used for planned or proactive work to replace aged and failing infrastructure field crews or other sources have identified. This work is evaluated by engineering staff to assess risk and priority. This includes the program spending briefly discussed in Section 3 (i.e. underground replace, pole replace, etc.). In addition, this category also includes capital projects that were generated due to storms. The distribution replace budget consumes approximately 35 percent of the distribution budget each year.

Relocate:

Relocation projects occur every year in cooperation with local and state government improvement projects. Many times, these projects require the construction of new facilities and the removal of old facilities to accommodate roads and infrastructure replacement and improvement. This budget is generally minimal and typically consumes one to two percent of the overall distribution capital budget each year. That said, a large relocate project can have bigger impacts on the annual budget.

Metering:

Metering replacements and additions include residential, commercial, and industrial metering related material such as the meters themselves but also PTs, CTs, and support hardware. Some of this budget is also used to maintain the manual meter information systems.

Grid Modernization:
According to Commission definition "a modernized grid assures continued safe, reliable, and resilient utility network operations, and enables Minnesota to meet its energy policy goals, including the integration of variable renewable electricity sources and distributed energy resources. An integrated, modern grid provides for greater system efficiency and greater utilization of grid assets, enables the development of new products and services, provides customers with necessary information and tools to enable their energy choices, and supports a standards-based and interoperable utility network." With this definition, different projects could span the other definitions listed above as well. For example, a replacement project may include a reconductor of a line, which also makes the system more efficient. Though it may meet the definition of grid efficiency, its primary objective was replacement. Another example may be Otter Tail's new customer information system, which provides future flexibility for customers to have more energy choices. However, those spends are not even listed within the distribution budget and thus are not included in this report.

That said, Otter Tail's intent with the projects shown in this budget were identified with the primary purpose of meeting the Commission's adopted definition. It should also be noted that grid modernization is not a current category within the budgeting system and thus it took extra effort and manual intervention to find these projects. As a result, there are likely other projects that could meet the definitions above.

Table 8 below shows Otter Tail's historical spends in Minnesota for the categories described above.

Table 8 – Historical Distribution Spends for MN

	Year				
Category[9]	**2014**	**2015**	**2016**	**2017**	**2018**
New Load or Reliability	$5,691,854	$5,759,672	$5,756,953	$6,736,132	$7,486,374
Replace	$3,021,808	$2,013,023	$5,421,753	$4,281,649	$4,099,947
Relocate	$84,924	$82,655	$589,784	$416,079	$268,539
Metering	$596,050	$641,249	$673,124	$869,316	$788,318
Grid Modernization or Pilot Projects	$0	$97,818	$297,006	$400,094	$1,334,832
Total Capital Costs	$9,394,637	$8,594,417	$12,738,619	$12,703,271	$13,978,010

[9] All costs specific to MN. When system wide costs were not broken down by state or a part of larger programs (i.e. metering) a 50% allocator was applied to represent MN only costs. 50% is used because approximately half of company energy and demand use resides within MN.

6.B Forecasted

Each year, Otter Tail engages in the exercise of planning and documenting a five-year budget. Senior area engineers, as well as the delivery maintenance department, predominantly create the distribution area budget. These roles were described in section 3, as well as some of the background to the planning process. The forecasted dollar figures are provided in the categories as required by the Commission in Table 9 below. It should be recognized the projects outside of those in 2019 which make up the spends below are forecasted and not approved spends. Future year spends are approved in December of the prior year of the forecasted project spends.

Table 9 - Forecasted 5-year Distribution Spend for MN

	Forecast Year[10]				
Category	**2019**	**2020**	**2021**	**2022**	**2023**
New Customer Projects and New Revenue	$5,742,164	$5,783,058	$6,306,805	$6,283,565	$8,412,912
System Expansion or Upgrades for Reliability and Power Quality	$299,986	$470,674	$531,534	$440,967	$327,967
System Expansion or Upgrades for Capacity	$355,850	$503,783	$328,420	$142,312	$409,081
Age-Related Replacements and Asset Renewal	$3,848,089	$3,949,514	$5,014,436	$8,747,961	$9,417,647
Projects Related to local (or other) Government Requirements	$259,981	$308,783	$137,689	$142,312	$146,581
Metering	$550,000	$592,500	$611,500	$630,000	$625,000
Grid Modernization or Pilot Projects	$650,000	$575,000	$1,150,000	$9,150,000	$11,050,000
Total	$11,706,071	$12,583,312	$14,930,383	$26,137,117	$30,389,187

To see the full list of projects in the upcoming five years, please refer to Appendix B. It should be noted that Otter Tail budgets on a 5-year cycle and for the purposes of a 10-year plan within the IDP, costs from 2022 and 2023 could be extrapolated into the last 5 years of a 10-year

[10] All forecasted costs were given a 50% allocator to represent MN only costs vs Otter Tail system wide costs. 50% is used because approximately half of company energy use resides within MN.

action plan. However, because this is not a part of normal business planning today, no specific details have been provided for that timeframe.

6.C Non-Company Spends in the Distribution System - Billable

The capital spends listed below are what the Company has classified as billable projects. These projects may have been a result of something such as a tractor or vehicle hitting a pole or a ditch fire that got out of control and damaged Otter Tail facilities. This would also include any costs where a relocation requires moving Otter Tail facilities in which Otter Tail has superior land rights and thus can bill the relocation costs back to the causer. Lastly, Otter Tail would also bill costs to customers that are requesting a change to facilities for their own benefit, which would have not otherwise been done through Otter Tail's normal course of business, such as a customer asking to have their overhead line buried. In addition, this category would include spends that were paid for by 3rd parties seeking to interconnect to the system. However, Otter Tail does not have any spending that fits that aspect of the definition within the past distribution budgets.

Table 10 – Billable Distribution Costs in MN

	Year				
Category	**2014**	**2015**	**2016**	**2017**	**2018**
Billable	$155,912	$(96,825)	$25,880	$54,088	$108,345

All forecasted costs were given a 50% allocator to represent MN only costs vs Otter Tail system wide costs. 50% is used because approximately half of company energy use resides within MN.

7 Grid Modernization and Infrastructure Action Plan

7.A Advanced Metering Infrastructure

Otter Tail has been investigating Advanced Metering Infrastructure (AMI) deployment options and developing a supporting business case for possible implementation. Otter Tail views AMI as a significant enabler of other technologies and benefits. The expectation is that where AMI is deployed, the communication network could be utilized for many other systems, possibly including distribution automation, outage detection and management, conservation voltage reduction, load management, and distribution SCADA.

Otter Tail's business case for deployment of AMI is expected to be favorable. One factor supporting AMI deployment is that Otter Tail is not moving from an Automated Meter Reading (AMR) system to an AMI system. The Company's service representatives will be more efficient and more capable of providing real time information to customers if a customer does call with an electric use question.

An AMI system will affect many existing systems and departments. Because of these impacts, Otter Tail is currently completing a review of the implementation of a new Customer Information System (CIS) and the new staking system described earlier. The expectation is that the knowledge from these system improvements will help improve the execution of an AMI deployment.

Other possible benefits for AMI include: 1) development of new rates; 2) providing customers with enhanced services and choices; 3) improved efficiencies for field personnel and customer service personnel; 4) reduced meter related expenses; 5) improved outage assessment and restoration; 6) improved customer relationships by providing real-time data to customers; 7) reduced safety incidents due to meter reading; and 8) other related benefits. One key item that Otter Tail is assessing is the best use of all the new data that will be available. There is a recognition that more data does not always provide better information. The approach the

Company will intend to take will be to develop a prioritized list of desired improvements and consider the least amount of data needed to meet those desired improvements.

At this time for planning purposes, Otter Tail has included costs for deploying an AMI system starting in the 2022 timeframe within Table 9 of forecasted costs. Prior to any substantial capital spends on an AMI project, a detailed cost to benefit analysis will be brought forth to customers and the Commission. Currently, however, Otter Tail is refining this analysis to further understand impacts to customers.

7.B Telecommunication Architecture Plans

The current Otter Tail telecommunications architecture is primarily comprised of a combination of nonredundant microwave systems and leased circuits from local and regional telephone companies. The current microwave systems are non-redundant, at capacity, and the hardware platforms have reached end of life causing availability, reliability and security concerns. Neighboring utilities leverage the aged microwave system to provide various services, reducing critical infrastructure dependency on public services to operate the bulk electric system. Otter Tail currently relies on leased services to provide business, industrial network, and interpersonal communication services throughout its tristate service territory.

The future of Otter Tail's telecommunications infrastructure will be designed as a two-tier system. Tier 1, the core backbone network, will be a redundant fiber infrastructure. The fiber infrastructure will be a hybrid system including both optical ground wire (OPGW) on the transmission system and underground. The fiber infrastructure will provide a reliable and secure medium for communications capable of scaling to meet future application requirements. Customer services centers, generation facilities, transmission substations, AMI takeout nodes, and neighboring utility locations are strategic locations identified to be included in the tier 1 design. The tier 2 infrastructure will extend beyond tier 1, providing additional

access to less critical assets and the future field area network. The tier 2 network will be a mixture of fiber and wireless providing remote visibility into the operations of the bulk electric system. Collectively, the two-tier system will provide reliable and secure communications for business requirements today and into the future.

There are no estimated costs for the telecommunications architecture plans at this time, but Otter Tail anticipates providing estimates and timing for these projects in subsequent reports.

7.C Load Management Plans

The current Otter Tail Load Management System (LMS) consists of a workstation-based master control system running on a virtualized Windows OS. The LMS master control system software is a Microsoft Windows based system from Comverge, Inc. The master control system is interfaced to the customer information system (CIS) to support the transfer and update of the controlled customer information. The master control system is also used to model various load control strategies to support the companies load control requirements. The current master control system is an antiquated system that is no longer supported by the vendor, which introduces limitations in terms of what new control strategies and functionality can be supported.

The master control system is also used to facilitate control of approximately 50,000 field-based LMS receivers via an interface to an Otter Tail-owned two-way voice radio system. The LMS receivers are assigned to control groups by controllable load type, allowing the master control system to control them on a group by group basis. Due to the significant latency inherent to the two-way radio system, the group-based load control is necessary to ensure that control can be completed in a tolerable timeframe. Additionally, the current LMS is a one-way control system in that load control communications requests can be sent to the receivers, but the receivers cannot provide confirmation back that they received the control request.

As Otter Tail modernizes the grid, both advancements in metering and load management will be essential. As described above, there is an obsolescence need to put in a new load management system (both hardware and software) as the existing system is no longer supported and will not be able to offer the new rates and services that new systems can provide. While at this time Otter Tail does not have a concrete plan on what future metering and load management systems will look like, one of the guiding principles moving forward is for both of those systems to share a common communication infrastructure. For this to be a reality, selection of future AMI and LMS infrastructure will be coordinated to ensure interoperability.

Otter Tail has been working with Open Access Technologies Inc. (OATI) to research and develop next-generation water heater control programs and technology. The pilot program is used to

demonstrate new technology and new control strategies, which are intended to improve financial performance, increase energy conservation, improve customer comfort, and increase customer participation over Otter Tail's existing residential demand response water heater program.

During the pilot program, multiple technology vendors and differing control strategies have been considered with two technologies selected for deployment into Otter Tail's customers' homes for evaluation. A full project update report can be found in the Company's April 1, 2019, CIP Status Report filing, docket no. E017/CIP-16-116.02.

7.D Conservation Voltage Reduction (CVR)

Conservation Voltage Reduction is a means that utilities have used in the past, and continue to use, to help manage system demands. To date, Otter Tail has not leveraged this technology due to success in controlling demand through the LMS described above. Otter Tail has, however,

investigated the costs and estimated benefits of deploying CVR. There are operational and financial benefits for CVR and Volt/VAr Optimization especially on larger residential/non-commercial or industrial feeders. At this time, communications and the lack of monitoring and control have deferred the implementation of the technology. Otter Tail will be revisiting the application following the deployment of supporting infrastructure. It is expected that AMI will provide an ability to feed into CVR as well as provide a communication network to communicate to CVR related end points such as regulators and capacitor banks. Currently, there are no CVR costs within the 5 or 10 year grid modernization action plan.

7.E Outage Process Investigation and Plans

Otter Tail currently has limited distribution visibility (D-SCADA), which is isolated to a handful of the largest distribution substations as was discussed earlier. In addition, Otter Tail does not have a formal outage management system or leverage interactive voice response (IVR) for outages. The below steps summarize how Otter Tail's outage management processes works today:

1. An outage is reported
    a. A customer calls Otter Tail to report an outage; or
    b. Feeder or substation level outages are reported in real time by Otter Tail's Interruption Monitoring System
2. Customer Service Representative personnel (dispersed throughout the Otter Tail service territory in nine remote customer service centers) document the outage and emails a distribution list of internal stakeholders
3. Customer service personnel dispatch field employees to investigate the outage
4. After patrolling and identifying the issue, the field employees fix the outage cause and notify office personnel when power is restored

5. If outage calls continue to come in after initial power is restored, field personnel are notified of isolated or nested outages.

Throughout this process, most of the workflow is manual and handled through email dialogue and/or phone calls. During regular business hours, the local Service Representative largely handles outages until there are too many issues to handle alone, at which time the Operations Manager will typically help with assigning resources. After-hours management of field dispatching is handled through an internally developed Personnel Dispatch Tool. This tool allows all employees in the company to know who is out working on an outage and who is available for response.

To inform external customers of outages, Otter Tail does publish interruptions identified through the interruption monitoring system and provides outage updates at otpco.com/outages.

Over the past few months, Otter Tail has been investigating industry tools to help improve these processes which are intended to improve customer service, response time, reliability, and organizational efficiency. Through this review, Otter Tail has visited neighboring peers to understand their processes. Currently, Otter Tail is developing estimated values and costs of deploying added tools to automate and improve these processes. The costs for these are not included at this time in the Grid Modernization action plan, but as noted are being investigated and refined for possible future inclusion.

7.F Company-Owned Street & Area Lighting

As part of our infrastructure plans, Otter Tail is in the process of changing to LED fixtures all illumination services provided in Minnesota, as approved under docket no. E017/M-17-152. Below is an update on our progress as an excerpt from our 2019 CIP Status Report, which is filed under docket no. E017/CIP-16-116.02. This project has become an immense value for customers; reducing energy use, increasing customer satisfaction, and improving safety, all at a low cost.

Otter Tail provides illumination services to 161 Minnesota communities and other customers through company ownership, operation, and maintenance of approximately 19,677 street and area lighting fixtures. Customers receive hassle-free illumination service, including equipment installation, asset rental, electricity, and maintenance for a convenient low monthly charge on the customer's electric service bill. Otter Tail installs street and area lighting fixtures at the request of our customers and, consequently, classifies electricity consumption for company-owned street and area lighting fixtures as customer electricity usage.

The objective of the Company-owned Street and Area Lighting program is to retrofit all Company-owned street and area light fixtures used in providing illumination services for retail customers from HID to LED technology.

Participation & Budget:

PARTICIPATION AND BUDGET – 2018			
Company-Owned Street & Area Lighting	**Actual**	**Proposed**	**% of Goal**
Participation	3,831	3,892	98%
Budget $	$386,327	$775,483	50%

Otter Tail worked closely with leaders of municipal governments in launching its successful 2018 street and area lighting retrofit campaign. Critical public relations milestones accomplished jointly with municipal streetlighting customers included:

- In-person discussions and meetings with key municipal administrators and government leaders.
- Development of public relations kits, including direct mailers, community posters, and news releases.
- Web pages with specialized LED street and area light information.
- Training for internal Otter Tail staff, including talking points and frequently asked questions.

The Company was able to minimize third party-program administration expenses by leveraging services offered through existing relationships with key vendors, as well as internal procedures already in place for existing street and area lighting services. Otter Tail is very pleased with the quality and performance of LED lighting products used in the retrofits. Customer feedback on the new LEDs has also been extremely positive, with little to no customer complaints. Field representatives for Otter Tail report how well the project has been received for being such a significant change in our communities.

The Company-owned Street and Area Lighting program has been a success from the operations/installation side as well. Otter Tail was able to install 98 percent or 3,381 LEDs, while only spending 50 percent of budget ($386,327). By managing expenses closely, Otter Tail has ultimately saved customers money, in addition to the energy savings of the LEDs. The following table summarizes expenses for the Company-owned Street and Area Lighting program for 2018:

Summary of 2018 Tracker Account for Street & Area Lighting	Budgeted Expenses	Actual Expenses[1]
CIP Program Evaluation	$3,000	$2,941
CIP Rebate (reduction to rate base)	$178,572	$222,552
Admin. Costs (external project management and advertising/printing)	$125,000	$6,197
Retirement and Disposal Costs	$432,803	$135,721
Return on Incremental Costs of New Lights	$36,108	$18,916
Total Recovery through CIP Tracker	**$775,483**	**$386,327**

[1]In addition to the expenses listed, Otter Tail also spent around $1,200,000 in capital in 2018.

Evaluation Methodology:

The Company compares the fixtures being installed to the fixtures being removed to determine energy and demand savings. The savings calculation utilizes the Department's Technical Reference Manual values for hours of operation.

Energy Savings & Adjustments:

ENERGY AND DEMAND RESULTS – 2018	
Company-Owned Street and Area Lighting	**At the Generator (DSMore Summer Coincident Peak kW)**
Energy Savings – kWh	2,936,340
Demand Savings – kW	0.00

7.G System Infrastructure and Reliability Improvement Initiative

Through the Company's strategic planning process, Otter Tail's leadership identified the need for an initiative to focus on improving the electrical network and infrastructure to meet three strategic objectives: improve reliability and safety, improve customer engagement, and improve business efficiency while looking forward to the future. The initiative was developed to help address aging infrastructure, as well as prepare for future system needs and technology.

Throughout 2018, the Company has been in the initial stages of developing an initiative that is centered around improving reliability and the health of assets used in the transmission and delivery of energy. This initiative is called SIRI which stands for System Infrastructure and Reliability Improvements (SIRI). One aspect of the initiative includes improving the process of identifying the highest value projects to meet the initiative's goals of improving reliability, safety, efficiency and customer engagement. This aspect of the initiative is a somewhat continuous improvement activity surrounding the prioritizing of our existing capital budgets. Another large component of the initiative is to better understand the overall health of our existing assets and the current replacement programs in place for those assets. While work continues in each of these areas of prioritizing projects and assessing overall asset health, Otter Tail has already found the need to increase spending for certain existing asset health programs. The next few paragraphs describe these opportunities at a high level. The spending levels needed to improve our aging infrastructure is currently budgeted into the 2022 timeframe, as can be seen by the increase in "replace" dollars in Table 9.

Underground Cable Example:

Otter Tail owns around 1400 miles of primary underground cable and approximately another 500 miles of secondary underground cable (total of approximately 1900 miles). Today's replacement program follows a trend of replacing around 8-10 miles of primary and secondary cable per year. This equates to around $750,000 in annual average spending for replacements. At the current pace of replacement, Otter Tail would need to achieve a lifespan of around 190 years (1900 miles / 10 miles replaced annually) from our underground cable and not add any new underground cable during this same timeframe. Per vendor and industry information, Otter Tail can realistically expect cable to last on average around 35-45 years. Historically, the amount of spending allocated for replacing underground cable has been appropriate because of the existing vintage of cable in the system. However, around the late 1970s and into the 1980s an influx of underground cable was installed, and more recently more underground cable failures have been experienced. This vintage of cable is approaching the end of its useful life. Table 11 shows both primary and secondary cable vintages. Because of these trends, Otter Tail will need to increase our spending in this asset class to maintain a healthy fleet of underground cable assets. Increased spending will also help maintain or reverse the increasing average age trend shown in Table 12.

Table 11 – Installed Underground Cable by Vintage (Primary and Secondary) as of YE 2018 Within the Otter Tail Asset Fleet

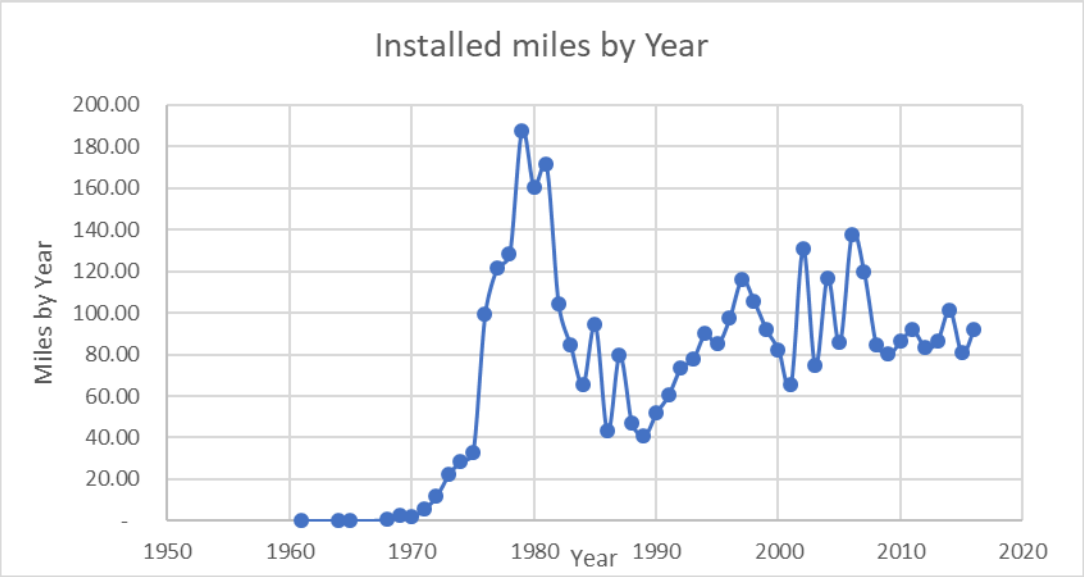
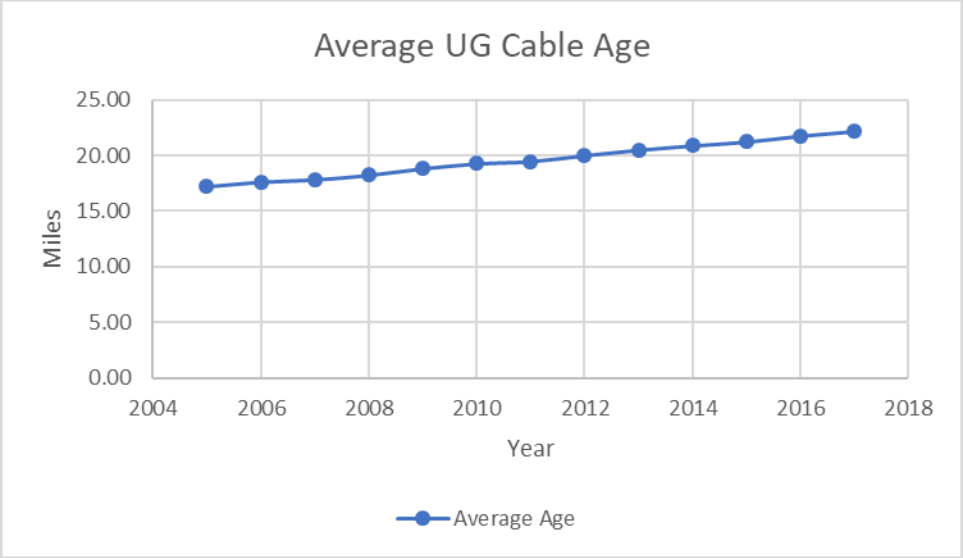


Table 12 – Underground Cable Average Age Trend



Transmission and Distribution Poles Example:

Otter Tail has approximately 180,000 distribution poles and about 100,000 transmission poles. The two tables below (Tables 13 and 15 respectively) show the vintage of the Otter Tail delivery system's transmission and distribution poles as of the end of the year 2018. In addition, Tables 14 and 16 show the trends of the average age of transmission and distribution poles. Both

transmission and distribution pole classes are also seeing an influx in existing assets reaching their average end of life of around 60-70 years (i.e. 1950s vintage). The information below is from Otter Tail's property accounting system.

Table 13 – Transmission Pole Installations as of YE 2018 Within the Otter Tail Asset Fleet

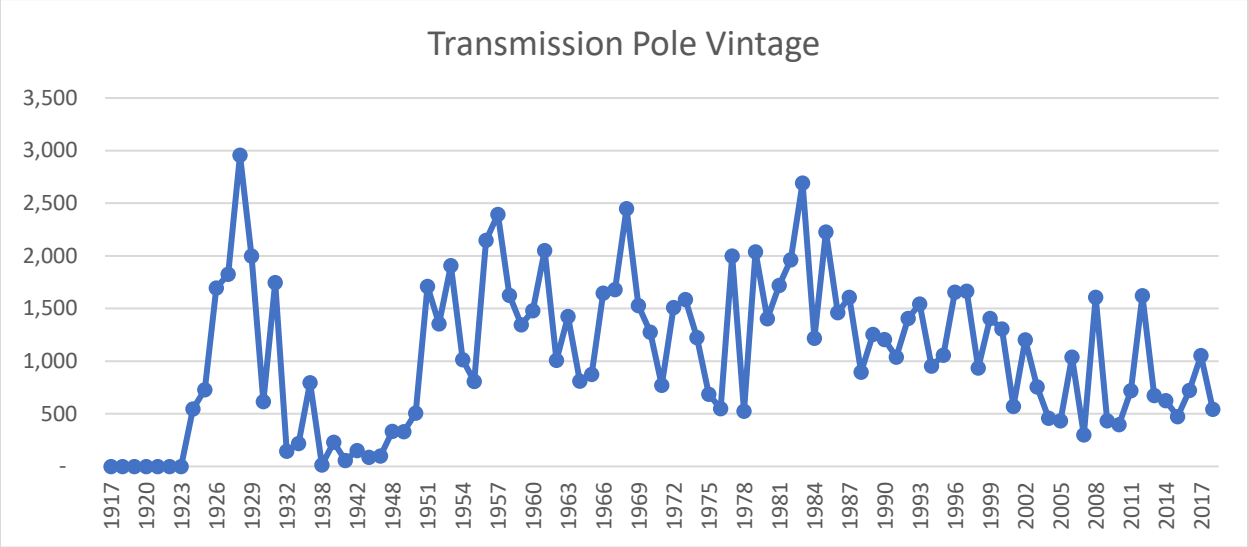


Table 14 – Average Transmission Pole Age Trend

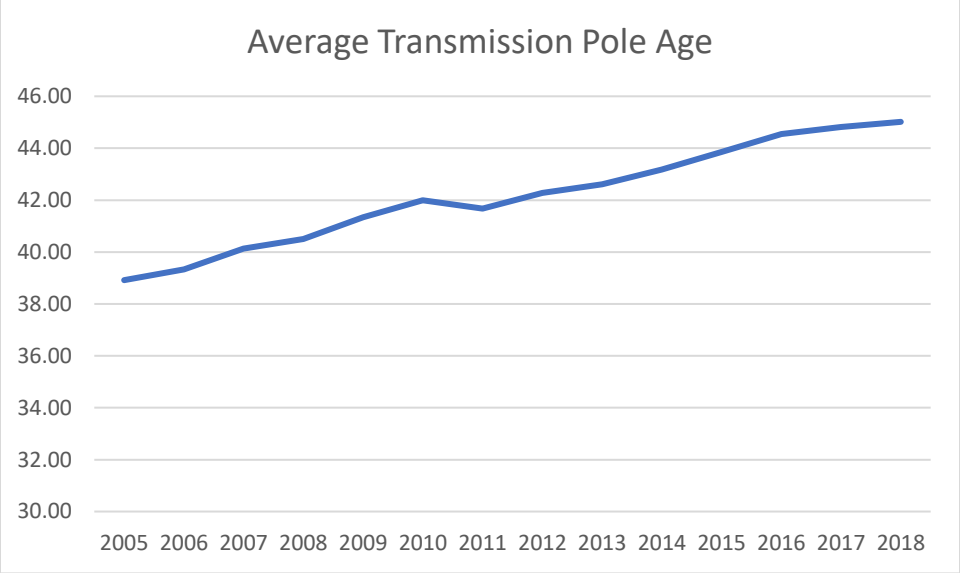


Table 15 – Distribution Pole Installations as of YE 2018 Within the Otter Tail Asset Fleet

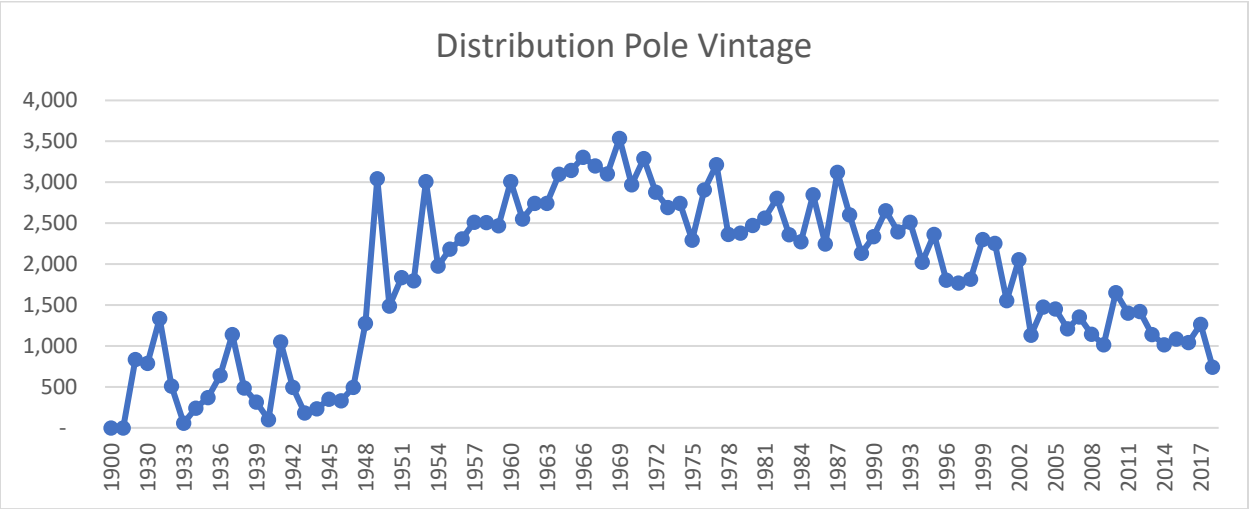
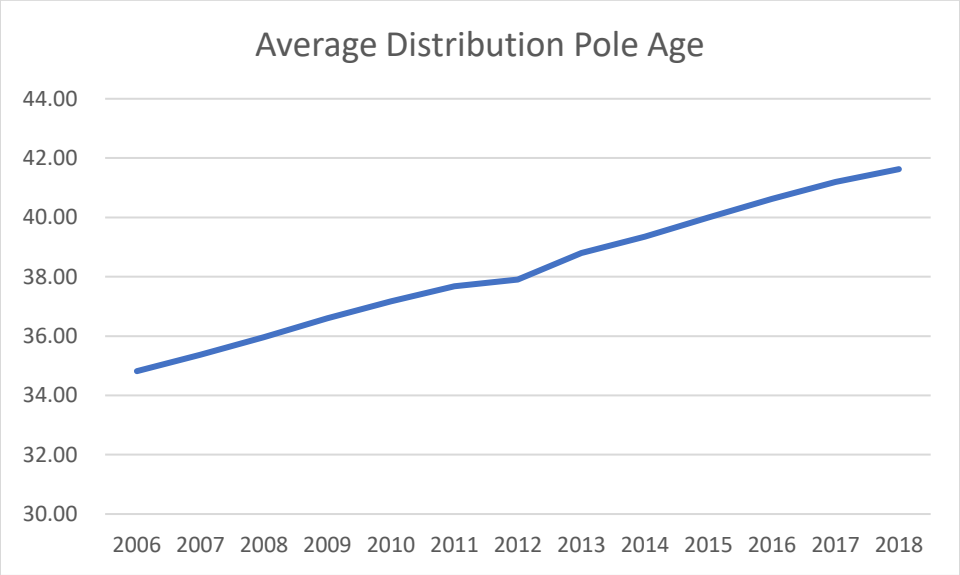


Table 16 – Average Distribution Pole Age



The Company's current budget plans and cycles support about 900 transmission pole replacements and 1400 distribution pole replacements each year. These are handled either as pole rejects via strength testing (OSMOSE) or through full line replacements. Historically, this has not been of concern due to the vintage of the assets in the field. However, as noted in Tables 13 and 15, a larger influx of assets are approaching average end of life. Increased replacement spending will also aim to maintain or reverse the increasing average age trends shown in Tables 14 and 16. By increasing spending and decreasing the average age of assets in the field, customers should experience better reliability.

8 Non-Wires Alternatives Discussion

Otter Tail was recently faced with a challenge of mitigating the number of momentary interruptions that were being experienced by a large commercial customer. When identifying options for mitigating these momentary service interruptions, Otter Tail evaluated both a non-wires alternative and a traditional wires solution.

Otter Tail engaged with suppliers to support and supply budgetary estimates for a 5 MW, 10 MWh energy storage system (ESS). The budgetary cost for the ESS was $5.3M plus additional distribution facilities to connect the ESS to the system. Evaluation of the ESS lost momentum due to the cost comparison with a wires project that involved addressing a four mile stretch of transmission line that was identified as the root cause of momentary interruptions.

In this situation, a targeted transmission improvement project was implemented at a cost of $675,000 that significantly helped reduce the number of momentary interruptions to the commercial customer. As a result of the transmission project, the performance of the line after the rebuild has resulted in an 80 percent reduction of momentary interruptions.

Comparing the budgetary cost for the ESS at $5.3M (plus additional distribution facilities) to $675,000 for the four-mile transmission rebuild clearly indicates that the transmission upgrade was a much cheaper alternative to mitigate the momentary interruptions. Additionally, in the event that the ESS solution would have been chosen as the preferred mitigation, the transmission line rebuild would still need to take place in order to address aging and failing facilities that were causing the momentary interruptions in the first place.

Otter Tail doesn't have any distribution projects in the forecasted five-year budget that would qualify for a comparison with a non-wires alternative solution because none of our individual distribution projects exceed a cost of two million dollars.

Non-wires solutions are not usually “one size fits all” projects. Otter Tail faces a number of project classes that will not lend themselves to be good comparisons. These project classifications are new load, relocate, and replacement. New load, as referred to in this instance, is a newly connected or wanting to be connected customer. Relocate projects are typically driven by a customer, government, or authority requesting or directing the removal or relocation of facilities from a location. To propose a non-wires solution to projects like these would essentially remove a customer(s) or feeder from the electric power system, islanding them with the ESS. This would not be a favorable solution for the system nor for the customers as neither the customers nor the feeder would benefit from the vast number of resources interconnected for security and reliability.

That said, projects that would be suited for comparison and evaluation would be capacity and reliability projects. There are several papers and articles available for review in the industry. Xcel Energy references a unit cost of $600,000/MWh for an ESS in their IDP. Electric Power Research Institute (EPRI) reports in their Energy Storage Cost Summary for Utility Planning: Executive Summary (November 2016), price ranges from $1200 to $5000 per kWh for bulk

storage and grid support functions. Otter Tail has explored the function and pricing for an ESS project to address a reliability concern. Our findings are similar to Xcel Energy in terms of approximately $600,000/MWh. As technology matures and costs decline, it is likely the technology will gain acceptance and usability. However, at this time our review of available batteries as non-wire alternatives has not been cost justifiable.

It should be noted, Otter Tail has leveraged an extensive Load Management System as a non-wire resource to reduce system demands and lower overall costs for customers since the 1960s. More than one-third of our customers participate in load control programs, which allows the ability to control approximately 15 percent of our winter peaking load.

9 Stakeholder Input

Otter Tail hosted a webinar and in-person meeting on October 4, 2019, for any stakeholder who wanted to participate in our Integrated Distribution Planning process. Invitations for the meeting were sent out within Docket No. 18-253, as well as through individual emails about

three weeks prior to the meeting. Attendance to the meeting was minimal, but the entire presentation has also been posted to the Docket referenced above for viewing.

10 Other Requirements

10.A FERC Order 841 impacts

"FERC order 841 states that Independent System Operators (ISOs) and Regional Transmission Organizations (RTOs) must ensure that markets rules must allow the provision of services by energy storage resources. The order requires that storage resources are allowed to de-rate their capacity to meet minimum run-time thresholds.

The order states that "existing RTO/ISO market rules are unjust and unreasonable in light of barriers that they present to the participation of electric storage resources." These barriers, FERC said. "reduce competition and market efficiency…. Where such conditions exist, resources that are technically capable of providing services are precluded from competing with resources that are already participating in the RTO/ISO markets."

ISOs and RTOs will be acquired to propose participation models for FERC approval. Once they receive approval, they will have one year to implement them."

Otter Tail does not see any near-term impacts as a result of this FERC Order. Currently, Otter Tail does not have any electric storage on our system or anything within the interconnection queue. However, as noted in earlier sections, Otter Tail does have a long history of providing thermal storage through various rate options. That said, thermal storage is not included within FERC Order 841. Otter Tail will continue to monitor the order and any subsequent impacts it may have on the system.

Checklist of Requirements

Filing Requirement	Description	Report Section
3.A.1	Modeling software	3
3.A.2	Percentage of substations and feeders with monitor & control	5
3.A.3	Summary of M&V and planned improvements	5
3.A.4	Number of customers with AMI/Smart Meters	5
3.A.5	Discussion of IRP and IDP relationship	5.A
3.A.6	Discuss how DER is considered in load forecasting	5.B
3.A.7	IEEE 1547-2018 impacts	3
3.A.8	Distribution system loss percentages	5.E
3.A.9	Coincident load at distribution interface	5
3.A.10	Substation capacity	5
3.A.11	See 3.10 – same answer	5
3.A.12	Total Miles OH	5
3.A.13	Total miles of UG	5
3.A.14	Total number of distribution customers	5
3.A.15	Costs spent on DER gen installations	5.B
3.A.16	Total charges to customers for DER	5.B
3.A.17	DER nameplate gen installations	5.B
3.A.18	DER count installations	5.B
3.A.19	Existing DER	5.B
3.A.20	Queued DER	5.B
3.A.21	EVs in MN	5.A
3.A.22	Number and capacity of EV chargers	5.A
3.A.23	Units of battery storage	5.B
3.A.24	Savings and demand savings from EE	5.A
3.A.25	Amount of Controllable Demand	5.A
Financial Information		
3.A.26	Historical spends in categories	6
3.A.27	Investments on the system not by OTP	6
3.A.28	Projected spends 5-year into the future	6
3.A.29	Projected capital project spends	6/Appendix
3.A.30	Non-Wires alternatives ben/cost	8

DER Deployment		
3.A.31	Current DER deployment and geographical dispersion	5.B
3.A.32	Areas of high DER penetration	5.B
3.A.33	Information where advanced inverters are needed	5.B
Prelim Hosting Capacity Data		
3.B.1	Excel spreadsheet of minimum load by feeder	5.D
DER Scenario Discussion		
3.C.1	DER scenario recommendations	5.C
3.C.2	Methodology of DER scenario creation	5.C
3.C.3	Tools needed for higher DERs	5.C
3.C.4	Impacts of FERC order 841	Other
Long Term Distribution Grid Mod Plan		
	Advanced Metering Infrastructure	7
	Network Plans	7
	Load management	7
	Conservation Voltage Reduction	7
	Outage Management System	7
	SIRI Initiative	7
	LED Street Lighting	7
	Water Heater Storage Pilot	7
3.D.3	Distribution grid evolution	3 & 7
Non-Wire Alternatives		
3.E.1	Non-wire alternative screening	8

CERTIFICATE OF SERVICE

RE: In the Matter of the Distribution System Planning for Otter Tail Power Company
Docket No. E017/CI-18-253

I, Kim Ward, hereby certify that I have this day served a copy of the following, or a summary thereof, on Mr. Daniel P. Wolf and Sharon Ferguson by e-filing, and to all other persons on the attached service list by electronic service or by First Class mail.

Otter Tail Power Company
Integrated Distribution Plan

Dated this **1st** day of **November, 2019.**

/s/ KIM WARD
Kim Ward, Regulatory Filing Coordinator
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First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
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First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
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First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
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Generic Notice	Residential Utilities Division	residential.utilities@ag.state.mn.us	Office of the Attorney General-RUD	1400 BRM Tower 445 Minnesota St St. Paul, MN 551012131	Electronic Service	Yes	OFF_SL_18-253_Official
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