Tooele County
Electrical Plan 2040
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Planning for future growth in Tooele County commands the attention of government leaders, water managers, land-use, community development and transportation planners, educators and others who strive to ensure that future generations will enjoy a high quality of life. Traditional planning models typically focus on facilities like water, sewer, schools, roads and highways. Often missing from these long-range plans, however, is the interconnected electrical network that powers virtually every aspect of modern life.

The population of Tooele County is expected to more than double by 2040, adding 64,000 new residents to a current base of about 60,000. Household formation is expected to grow by 141 percent, from 18,000 in 2010 to approximately 43,500 households by 2040. Additionally, the county’s economy could add 24,100 new jobs by 2040, which is more than twice the 2010 employment base. How much electrical capacity Tooele County communities will need and where they will need it are questions rarely considered by local officials in traditional growth scenarios and planning decisions—until now.

The Tooele County Electrical Plan is a collaborative effort to integrate local governments’ long-term land-use development plans with future electrical network requirements. The effort recognizes that development decisions made by local government are a major driver of electricity requirements. The primary goal of this collaborative process is to develop a clear and documented plan to guide future infrastructure siting decisions to ensure adequate electrical capacity for local communities to achieve their goals.

The task force leading this effort includes a broad range of stakeholders including planning representatives from Tooele County, Tooele City, Grantsville City, Tooele Army Depot, regional growth and transportation planners, the Tooele Chamber of Commerce and Rocky Mountain Power. The product of the task force’s seven-month effort includes three elements: 1) a set of criteria for evaluating future substation and transmission sites, 2) a map showing the approximate preferred locations of two future substations and two future transmission lines and 3) suggestions for communication and adoption of the facility siting plan by local governments in their respective jurisdictions. The plan does not address “main grid” high-voltage facilities used for bulk power. It is limited to substations and transmission lines of 138,000 volts or less.

By applying current usage patterns to projected growth within the context of the participating jurisdictions’ future land-use plans, Rocky Mountain Power expects the equivalent of five new substations will be needed throughout Tooele County in the next 30 years to meet customer demand. Some of this capacity will come from expansion or voltage upgrades of existing substations while new substations will also be required to meet the needs of an expanding population.

The task force supports using the plan in future infrastructure planning within their respective jurisdictions. The reciprocal commitment between Rocky Mountain Power and task force members means they will uphold the decisions reached through the process—or notify each other if circumstances change. Likewise, as representatives of their communities, task force members will also be able to rely on neighboring jurisdictions to follow the plan. Since an interconnected electrical network operates across jurisdictional boundaries, a change by one community could impact its neighbors. (Communities may consider formalizing a mutual commitment with Rocky Mountain Power to observe the principles outlined in the plan through a memorandum of understanding. A sample can be found on Page 20.)

Task force members and Rocky Mountain Power plan to work together in a public process to incorporate the plan in each community’s formal planning process. Identifying where electrical facilities are needed to support future growth will benefit local governments, transportation planners, developers, residents, businesses and Rocky Mountain Power. This type of clarity and predictability will not only help assure electrical capacity is available to meet communities’ development needs, but also make more efficient use of limited financial resources and minimize potential conflict in the future.
1. Developing the Plan
Background

Like most utilities in the United States, Rocky Mountain Power operates as a regulated utility within a framework of legal, regulatory and financial requirements. The utility’s prices and policies are regulated by the Utah Public Service Commission, which closely scrutinizes Rocky Mountain Power’s resource portfolio, energy efficiency and peak reduction programs, customer services, capital, operational and administrative expenses. The utility is also subject to rules and regulations of various federal agencies and national reliability standards and electrical safety codes.

A legal obligation to deliver a safe, adequate, reliable supply of electricity at the lowest reasonable cost guides utility decisions about timing and location of new substation and transmission capacity. Historically, system requirements were the primary driver of the utility infrastructure planning process with secondary consideration given to local government land-use plans. When customers’ needs approached the capacity limits of existing substations and power lines, Rocky Mountain Power made plans to bring new projects on-line to meet customers’ growing needs.

As Rocky Mountain Power contemplated a two-fold increase in Tooele County’s population by 2040, it determined the time was right for a new approach to infrastructure planning. The Tooele County Electrical Plan represents a new approach to electrical infrastructure planning by bringing together local officials and other key stakeholders with the utility to create a mutually acceptable plan to meet customers’ future electric energy needs.

A network of five substations and more than 582 miles of high-voltage transmission lines and neighborhood distribution lines delivers electricity to approximately 60,000 people in Tooele County. Electrical infrastructure systems are designed to meet customers’ needs when usage is at the highest point during the year. Utilities refer to this point of maximum customer use as “peak demand.” Peak demand on Rocky Mountain Power’s system in Tooele County occurs in the heat of summer, typically in late afternoon and early evening.

In 2013, peak customer use in Tooele County registered 242,000 kilowatts (kW) on June 27 at 5pm, making the average per capita “demand” on the electrical system in Tooele County about 2.6 kilowatts per person. The system peak includes distribution substations that serve homes and businesses as well as transmission-voltage substations owned by large industrial customers.
A significant challenge facing task force members is, quite simply, the unknowable future. It is prudent to plan for tomorrow based on what we know today—realizing that a host of uncertainties will change many of the assumptions. For that reason, task force members and Rocky Mountain Power agree it is essential to update the plan periodically to account for changing circumstances, such as:

- Population projections, employment projections and development patterns are subject to economic, demographic and market conditions.
- While the economy is gaining strength, it has not fully rebounded to pre-recession levels. The speed and scope of continued economic recovery may alter customer demand projections.
- Climate change and carbon reduction strategies could impose higher energy costs on consumers. Utah is among the states where prices are expected to increase significantly due to gradual replacement of inexpensive coal-based generation with more costly alternatives.
- Residential usage has grown steadily with the proliferation of electronic consumer devices and installation of central air conditioning.
- Electric rates are projected to escalate. Price elasticity could reduce the growth rate of future customer demand.
- Electric vehicles may gain broader penetration with technology advancements and higher oil prices. How might widespread use affect peak demand? Rocky Mountain Power already offers Time of Day pricing, but will consumers respond to price signals or re-charge at their own convenience? Many communities nationwide—and some in Utah—have already installed charging stations in public places.
- Unforeseen load growth could develop. Large industrial customers may expand existing operations or new industry could locate operations in the area.

Barring new technology developments that eliminate the need for substations and transmission lines, task force members recognize that these facilities will be necessary to supply future growth of Tooele County communities and industry. The foregoing uncertainties, and perhaps others that are unfathomable today, will alter the timing of new facilities. The plan represents the best efforts of local government, important stakeholders and Rocky Mountain Power to identify preferred locations for electrical infrastructure based on what is known today about Tooele County’s future growth. It’s the place where local government, stakeholders and the utility can begin the conversation when increased customer use calls for new facilities.
The Tooele County Electrical Plan Task Force met monthly from October 2012 through March 2013. Throughout several months of meetings, members became more knowledgeable about the generation, transmission and distribution aspects of the electric utility industry as well as its legal and regulatory requirements. They discussed alternative energy resources, energy efficiency and peak reduction measures as potential means to offset future infrastructure needs. They also learned about utility operating requirements such as reliability standards required by the National Electric Regulatory Corporation and Western Electricity Coordinating Council. They became familiar with transmission structure design and clearance requirements prescribed by the National Electric Safety Code.

The task force set 2040 as the planning horizon for the Tooele County Electrical Plan. Members shared their general plans, land-use plans, prospects for future development and transportation plans. They also reviewed population growth assumptions from participating jurisdictions, the Governor’s Office of Planning and Budget and Wasatch Front Regional Council. Meanwhile, Rocky Mountain Power used the communities’ land-use plans and growth projections to estimate future electrical capacity needs based on existing usage of various development types and customer classes. The data are displayed as “hot spots” on a map to indicate growth of electricity-intensive areas. The plan does not address “main grid” high-voltage facilities used for bulk power. It is limited to substations and transmission lines of 138,000 volts or less.

A central part of the task force process was a discussion of community issues and concerns. Task force members developed a set of siting criteria that reflect these issues and concerns that served as guidelines during several mapping sessions where they identified preferred locations for new substations in areas where future growth and development potential are expected to exceed existing electrical capacity. Between mapping sessions they critiqued and refined their choices. Finally, Rocky Mountain Power reviewed the facility locations for engineering and operations feasibility.

Although it is difficult to predict future demand, the task force agreed to apply the existing average of 2.6 kilowatts per person to population projections of 122,500, bringing estimated future customer requirements to approximately 320,000 kilowatts in 2040. System planners expect the equivalent of five new substations will be needed throughout Tooele County in the next 30 years to meet customer demand. Some of this capacity will come from expansion or voltage upgrades of existing substations while new substations will also be required to meet the needs of an expanding population.

The map represents the consensus of members’ location choices for new substations and transmission lines to meet the county’s projected growth by 2040. It is intended to facilitate discussion about final site selection among local jurisdictions, the community and Rocky Mountain Power when it comes time to build additional electrical infrastructure to meet customers’ needs. As a regulated utility, Rocky Mountain Power must provide electrical capacity to meet customers’ needs but it cannot build new facilities until they are necessary. As that point approaches, the Tooele County Electrical Plan, including both the map and siting criteria, will serve as the blueprint for facility siting decisions.
An essential element of the plan is a set of “siting criteria” that may be used to help guide future infrastructure planning decisions. They are less likely than specific map locations to become outdated over time and can serve a broader application. The siting criteria represent the considerations that the task force believes should be taken into account when evaluating sites for new infrastructure.

The siting criteria capture the intent and goals of the task force in terms of important considerations and also their relative importance to site selection. Task force members refined and prioritized the criteria and ultimately ranked them in relative order of importance, acknowledging that there could be inherent conflicts among the various criteria.

The siting criteria were essential to refining facility locations on the map. However, the scale of the map does not accommodate precise locations. At this point, substation “markers” indicate approximate locations. When peak customer use increases to the point that new infrastructure is required in an area, the community and Rocky Mountain Power can use the siting criteria as a tool to evaluate alternate site options and select a specific location.

The preferred scenario calls for two new distribution substations, provided that several existing substations can be expanded or upgraded to provide additional capacity in the future. These substations are shown on the map as well as existing substations for reference.

The final product gives both local communities and Rocky Mountain Power a degree of predictability that neither has previously enjoyed. New facilities will be built over a 30-year period as Tooele County’s electrical needs grow. Task force members agreed that a commitment among all the communities, other stakeholders and Rocky Mountain Power is required to take the plan forward towards implementation and make it a reality. When it comes time to build new facilities to keep pace with growth, the Tooele County Electrical Plan, including both the map and siting criteria, will serve as a blueprint for facility siting decisions.
2. The Plan
Siting Criteria

Siting criteria were developed to guide the future facility siting process. The criteria represent the priorities established by the task force to optimize benefits and mitigate drawbacks to both the community and Rocky Mountain Power. They will be particularly useful in comparative evaluation of alternative sites.

Each criterion includes the following:

**Priority:** An indication of the priority level or relative importance on a scale of 1 to 5, shown with compact fluorescent lamp icons

**Why:** A statement of rationale and underlying logic

There may be conflicts among the criteria at any given site. For example, one site may be in a residential area (a negative consideration), yet have few impacts on prominent views. The siting criteria must be considered as relative priorities among several others and adapted to individual circumstances.

1. **GENERAL SITING FACTORS**

System capacity, reliability and cost considerations are inherent in utility system planning. Related considerations also have broad application to system design, operation and facility siting decisions. The following criteria are included as general factors that should be considered in future facility siting decisions. Generally accepted as essential to the siting process, they are not ranked and example applications are not provided.

1A. Provide adequate system capacity and reliability

**Why**  
Rocky Mountain Power is required to provide adequate electrical capacity to meet customers’ needs during peak-use times and emergencies, i.e., loss of generation resource, main grid transmission line or substation transformer. Rocky Mountain Power transmission facilities are usually designed with alternate service capability, or redundancy, in order to maintain service from an alternate source if the main source is interrupted.

1B. Conduct joint planning efforts across all jurisdictions

**Why**  
Cooperative planning will facilitate integration of electrical network planning with known development plans contemplated by other organizations, such as Tooele valley political jurisdictions and key stakeholders, i.e. Tooele Army Depot, Utah Department of Transportation, Wasatch Front Regional Council, etc. Cooperative planning will enable stakeholders to address siting issues in advance of development and potentially avoid future conflicts.

1C. Balance cost with risk and need for adequate, reliable service

**Why**  
Aesthetics is important to communities. However, aesthetics also must be balanced with cost, electric service reliability and operational requirements. Careful consideration should be given to select sites that optimize operational ease, economic considerations and aesthetic factors.

1D. Consider mega-power users

**Why**  
“Mega-power” users like data centers or large manufacturing plants have large power needs. Some are large enough to require a dedicated substation. While it is difficult to know precisely where and when they might shop for development sites, it is important to plan for them. Local government and Rocky Mountain Power should work together closely when either becomes aware of a potential large customer.

The impact of a large power user will change infrastructure development plans. It is difficult to anticipate their needs.

1E. Consider small-scale renewable energy systems

**Why**  
Distributed solar and wind installations will achieve greater penetration as technology and costs improve, potentially offsetting electrical capacity supplied by the utility.

1F. Modify the plan to reflect technology advancements and changing circumstances

**Why**  
Stakeholders and Rocky Mountain Power should evaluate the plan periodically to account for changing circumstances that alter the supply and demand equation, like energy technology advancements and cost improvements, growth, demographic changes, economic factors, etc. The siting criteria should be modified to incorporate changes. A dynamic planning process will ensure the plan moves forward as the task force intended and retains its validity to local government, other planning organizations and Rocky Mountain Power.
2. SUBSTATIONS

DESIRABLE LOCATIONS FOR SUBSTATIONS

The following criteria pertain to important land-use characteristics or related considerations that are favorable to siting new substations.

2A. Maximize use of existing facilities and adjacent property before building new substations
2B. Site substations in areas with potential for large-energy users
2C. Locate residential substations in adjacent buffer areas
2D. Utilize land adjacent to other infrastructure
2E. Site in areas with topographical screening and buffer capabilities
2F. Build aesthetically pleasing facilities
2G. Protect critical habitat, wetlands, rivers and stream corridors, and bird sanctuaries
2H. Protect significant view sheds

2A. Maximize use of existing substations and adjacent property before building new substations

*Priority – High*

*Why*

Where feasible, use adjacent property and infrastructure to expand or upgrade existing substations before building new substations. Use of existing facilities may minimize land disturbance and reduce land acquisition cost for new facilities. The use of existing facilities also minimizes visual impacts by reducing the total number of new sites needed for new substations.

Maximizing use of existing facilities may also produce fewer conflicts with nearby buildings, land uses and environmental issues. A community already accustomed to existing facilities may prefer an upgrade or expansion over construction of a new facility at another location.

2B. Site substations in areas with potential for large-energy users

*Priority – Medium*

*Why*

Where possible, select substation sites in areas where future land-use plans call for industrial or technology-type customers with high energy-use characteristics. Advance planning of substation sites in such areas ensures adequate electrical capacity is available to meet customers’ needs while also minimizing future conflicts with other uses. Siting substations in areas with high growth potential may also minimize the need for extensive transmission lines to serve the location.

Care should be taken to preserve prime real-estate parcels needed for economic development. For example consider siting substations on less traveled streets and roads.

2C. Locate residential substations in adjacent buffer areas

*Priority – High*

*Why*

Where substations are needed to serve residential development, look for sites in adjacent buffer zones located outside the residential development.
2D. Utilize land adjacent to other infrastructure
Priority – High

Why
Where possible, substations should be sited adjacent to existing infrastructure and other complementary uses such as transportation corridors and other utilities. However, issues can arise from locating in or near freeway rights-of-way, including salt spray from snow plows, lack of access and insufficient clearance for incoming transmission lines.

2E. Site in areas with topographic screening and buffer capabilities
Priority – Medium

Why
If possible, select areas where topography provides natural screening to minimize the visual impacts of a substation. Coves, raised berms or slopes can be used to obscure a substation, leading to better public acceptance. It is also important to select sites with similar uses such as industrial or low-traffic areas to create a buffer for aesthetic purposes.

2F. Build aesthetically pleasing facilities
Priority – Medium

Why
Infrastructure will be better integrated into the area and find greater acceptance if it is built to be aesthetically pleasing. A combination of landscaping, fencing or concrete walls can be used to improve aesthetics. The use of high quality materials will ensure facilities withstand years of operation without deterioration and costly maintenance. Wall/fence design should be complementary to the area. For instance, in some areas, such as industrial development, a simple fence may draw less attention than a solid concrete wall.

Pre-cast concrete walls and water-wise vegetation are the screening and landscaping standards used by Rocky Mountain Power in residential and commercial zones. Communities may select the color scheme of the concrete walls to harmonize with the neighborhood. At the time new substations are proposed, communities may explore cost-sharing arrangements with Rocky Mountain Power for design changes beyond the standard design.

2G. Protect critical habitat, wetlands, rivers and stream corridors, and bird sanctuaries
Priority – Medium High

Why
It is Rocky Mountain Power’s policy to treat critical habitat, wetlands, river and stream corridors, and bird sanctuaries with extreme care and to avoid them where possible. Sites with potential for environmental issues should be evaluated for impacts and possible mitigation measures. Discussions with concerned parties should be held to identify locations with fewer adverse impacts.

2H. Protect significant view sheds
Priority – Medium

Why
View sheds are an essential element of community character and scenery. It is important to consider impacts to the landscape as well as the view from surrounding areas. Where possible, substations should be sited outside of areas prized for their scenic beauty.

A natural slope obscures the view of a substation to the surrounding neighborhood.
3. TRANSMISSION LINES

DESIRABLE LOCATIONS FOR TRANSMISSION LINES

Criteria in this section pertain to important land-use characteristics or related considerations that are favorable to siting new transmission lines.

3A. Share rights-of-way with utilities, trails, railroads, canals, roads, etc.

3B. Upgrade existing facilities before building new facilities

3C. Build aesthetically pleasing facilities

3D. Utilize areas with development potential

3E. Select sites that allow for maintenance access

3F. Minimize the length of transmission corridors

3G. Co-locate multiple transmission lines in the same corridor

3H. Protect significant view sheds

3I. Protect critical habitat, river and stream corridors and bird sanctuaries

3A. Share rights-of-way with utilities, trails, railroads, canals, roads, etc.

Priority – High

Why
Where possible, co-locate transmission lines in existing major corridors and identified rights-of-way. Sharing corridors with complementary uses creates fewer disturbances to the aesthetic character of the area. The use of existing utility corridors and rights-of-way will also minimize the cost of purchasing additional rights-of-way and mitigating potential impacts. Transmission lines in a greenway serve as a buffer between major transportation corridors and other uses. Where transmission lines can be co-located with trails, railroads, and canals, they are more easily integrated into the surrounding landscape. Communities may want to utilize areas under transmission lines as trails or greenways. This can benefit the community by adding green space and recreation.

3B. Upgrade existing facilities before building new facilities

Priority – High

Why
Whenever possible, it is preferable to upgrade existing facilities rather than build new transmission lines. Voltage upgrades and/or addition of a second circuit will minimize land disturbance by reducing the total number of new corridors and also potentially reduce land acquisition and rights-of-way costs. Maximizing use of existing facilities may also produce fewer conflicts with nearby land uses and environmental issues. A community already accustomed to existing facilities may prefer an upgrade over building a new transmission line in another corridor.

3C. Build aesthetically pleasing facilities

Priority – Medium

Why
Infrastructure will be better integrated into the area and find greater acceptance if it is built to be aesthetically pleasing. In siting new facilities, seek locations with minimal adverse aesthetic impact, such as utility corridors, industrial area and along freeways and major streets and highways. This may reduce impacts to surrounding areas such as residential view sheds. Communities may choose to create greenways, trails and pocket parks under transmission lines to beautify the corridor and enhance community amenities.
3D. Utilize areas with development potential  
*Priority – Medium*

**Why**
Optimize use of land in projected growth areas, thus ensuring adequate electrical capacity is available to meet communities’ growing needs. It is valuable to plan electrical infrastructure in advance of development to minimize conflicts with developing uses. However, care should be taken to preserve prime real-estate parcels needed for economic development.

3E. Select sites that allow operations and maintenance access  
*Priority – High*

**Why**
Access to transmission lines for emergency operations and regular maintenance is an important consideration and should be considered in conjunction with other siting criteria.

3F. Minimize the length of transmission corridors  
*Priority – High*

**Why**
In balance with other criteria, electrical lines should be sited to minimize the length of corridors to reduce the aesthetic impact to the community and minimize construction costs.

3G. Co-locate multiple transmission lines in the same corridor  
*Priority – High*

**Why**
In some cases, more than one transmission line can be sited in a single corridor rather than separately. Co-location has the advantage of reduced land disturbance and impacts to surrounding areas. There are reliability risks, however, if service is interrupted by wind, lightning or other disturbances. This is the reason why the National Electric Reliability Corporation may reduce the capacity rating of lines built in the same corridor.

3H. Protect significant view sheds  
*Priority – Medium High*

**Why**
View sheds are an essential element of community character and scenery. It is important to consider impacts to the landscape as well as the view from surrounding areas. Where possible, transmission lines should not interfere with areas prized for their scenic beauty.

3I. Protect critical habitat, river and stream corridors, and bird sanctuaries  
*Priority – Medium Low*

**Why**
It is Rocky Mountain Power’s policy to treat critical habitat, wetlands, river and stream corridors, and bird sanctuaries with extreme care and to avoid them where possible. Sites with potential for environmental issues should be evaluated for impacts and possible mitigation measures. Discussions with concerned parties should be held to identify locations with the fewer detrimental impacts.

Tooele County Electrical Plan
A scorecard was developed as a tool for local jurisdictions and Rocky Mountain Power to use in evaluating alternative locations for new facilities. It provides a means to compare specific locations in terms of how well each site meets the siting criteria established by the task force. It is not intended to replace careful consideration and debate about the relative benefits or impacts of specific locations. Rather, it is a tool to be used in combination with other information to facilitate comparative evaluation.

**Scorecard**

The scorecard is separated into two sections, one for substations and one for transmission lines. To score the potential site, ask yourself how well the location meets each criterion and enter an X in the corresponding line. Then multiply the score for each criterion by the corresponding criterion weight to produce a total score for that criterion. The weight assigned to each criterion corresponds to the priority it was given by the task force and shown in the Siting Criteria section of this document. Finally, sum the points in the last column to obtain a total score for the potential infrastructure location.

### INSTRUCTIONS FOR USE

- **Substations**
  - **Criterion**: Maximize use of existing facilities and adjacent properties before building new
  - **Weight**: 5
  - **Score**: 3
  - **Total Score**: 15

- **Transmission Lines**
  - **Criterion**: Select areas that allow for operations and maintenance access
  - **Weight**: 5
  - **Score**: 5
  - **Total Score**: 25

**Tooele County Electrical Plan Scorecard**

<table>
<thead>
<tr>
<th>Siting Criteria</th>
<th>Substations</th>
<th>Transmission Lines</th>
<th>Subtotal</th>
<th>Score Weight</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A. Minimize use of existing facilities and adjacent properties before building new</td>
<td>3</td>
<td>5</td>
<td>15</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1B. Minimize use of existing facilities before building new</td>
<td>3</td>
<td>5</td>
<td>15</td>
<td>5</td>
<td></td>
</tr>
<tr>
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<td>3</td>
<td>5</td>
<td>15</td>
<td>5</td>
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<tr>
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<td>3</td>
<td>5</td>
<td>15</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
Map (North)
Map (South)
How to use the plan in the future

The goal of the Tooele County Electrical Plan is to facilitate cooperative planning by local government and Rocky Mountain Power for electrical infrastructure needed to supply growing communities. It represents a shared understanding of the preferred locations of new electrical infrastructure and the process they will follow in making future siting decisions. It has no force of law; however communities and the utility can realize measurable benefits over time if it is implemented voluntarily.

The effort can fulfill three important goals of long-range planning:

1) Ensure adequate electrical capacity to supply communities' future growth.
2) Define appropriate land uses and design characteristics for future electrical facilities.
3) Let residents and property owners know what to expect as the community changes over time.

Cities and counties are accustomed to working towards these aims within the transportation or mobility components of their general plans. Further, community development considerations such as land use, parks and recreation are typically integrated into their transportation plans. But most cities do not address electrical infrastructure with the same long-range view. The Tooele County Electrical plan offers communities an opportunity to treat electrical infrastructure in a similar and thoughtful manner.

TOOELE COUNTY ELECTRICAL PLAN UPDATES

The plan should be updated periodically to reflect the changing geography of energy use, such as land-use changes, or to incorporate major local modifications.

Updates and Changes

Minor changes, those that affect only one jurisdiction and maintain the basic technical feasibility of the plan, should be shared with Rocky Mountain Power. The Rocky Mountain Power representative to contact with minor changes is:

Mickey Beaver
801-576-6106
Mickey.Beaver@rockymountainpower.net

Major changes, those that affect more than one jurisdiction or affect basic technical considerations, should be addressed by affected parties (jurisdictions and Rocky Mountain Power) on an as-needed basis.

Overall Updates

The task force should meet every five years to update the Tooele Electrical Plan. An update should include changes to the plan map, the shared siting criteria, and effective local implementation practices.

LOCAL IMPLEMENTATION CHECKLIST: SUGGESTED NEXT STEPS

☑ Present plan as an informational item to planning commission and city council.
- Discuss concept and approaches to address electrical infrastructure in your area.
- Review the siting criteria and the maps in the Tooele County Electrical Plan.
- Identify compatibilities/ incompatibilities with your existing general plan.
- Develop a planning approach and schedule to address electrical infrastructure that considers:
  - Input regarding approach from your elected and appointed officials. Approaches to consider include:
    i. Developing an electrical infrastructure general plan element.
    ii. Adopt as a stand-alone plan, referenced in relevant general plan elements.
    iii. Note the plan as a reference document within the general plan.
- Schedule of anticipated general plan updates
- Implement basic electrical infrastructure considerations in local plans and ordinances.
- Begin addressing substantive incompatibilities between local plans and ordinances and the Tooele County Electrical Plan.
  - On an ongoing basis, inform Rocky Mountain Power and neighboring jurisdictions of any changes you make to plan elements to address incompatibilities.

How to use the plan in the future

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- Schedule of anticipated general plan updates
- Implement basic electrical infrastructure considerations in local plans and ordinances.
- Begin addressing substantive incompatibilities between local plans and ordinances and the Tooele County Electrical Plan.
  - On an ongoing basis, inform Rocky Mountain Power and neighboring jurisdictions of any changes you make to plan elements to address incompatibilities.
LOCAL GOVERNMENT MEMORANDUM OF UNDERSTANDING

Individual communities may consider entering into a Memorandum of Understanding with Rocky Mountain Power as a mutual commitment to observe the principles of collaborative planning outlined in the Tooele County Electrical Plan and to make adjustments to reflect changing future needs.

Whereas, a broad and diverse group of city, county and regional land-use and transportation planners, community stakeholders, and economic development representatives worked collaboratively to develop a shared electrical infrastructure plan for Tooele County; and

Whereas, one jurisdiction may have authority to modify the alignment of transmission infrastructure in the shared plan;

Now, Therefore,

We, as a local government jurisdiction of Tooele County served by Rocky Mountain Power, will consider the following Principles of Agreement once an Electrical Infrastructure element is adopted as part of our local General Plan, or we have taken other actions to incorporate electrical infrastructure considerations into local planning:

Principles of Agreement

1. RECOGNITION OF VALID PROCESS: We recognize the Tooele County Electrical Plan process is a good-faith collaborative effort to integrate community and local government considerations into an electrical infrastructure plan. These efforts include:
   a. Diverse involvement
   b. Developed from a county-wide perspective
   c. Open process

2. A COMMITMENT BETWEEN OUR JURISDICTION AND ROCKY MOUNTAIN POWER: Having adopted the plan as part of our General Plan, we commit to use the Map and Siting Criteria to plan appropriate land uses near future electrical infrastructure locations and will work to preserve locations for potential future infrastructure. By doing so, we expect a similar commitment from Rocky Mountain Power to utilize the Plan Map and Siting Criteria in cooperation with local governments and affected parties when specific site options are considered for new or expanded infrastructure. If we determine an element of the plan is no longer in our jurisdiction’s best interest, we will inform Rocky Mountain Power of our intention to modify our general plan. Conversely, Rocky Mountain Power will inform our jurisdiction if customers’ electrical needs require alterations to the plan.

3. A COMMITMENT BETWEEN OUR JURISDICTION AND ADJACENT JURISDICTIONS: Once the plan is adopted as part of our General Plan or electrical infrastructure considerations are incorporated into our local planning process and when any of our contiguous neighboring governmental jurisdictions also signs this Memorandum of Understanding, we will commit to either maintain shared boundary locations of infrastructure elements consistent with this plan or to notify and discuss modifications with the adjacent jurisdiction and Rocky Mountain Power.

4. PLAN FINDINGS WILL BE SHARED WITH STAKEHOLDERS: We will utilize our adopted General Plan Electrical Infrastructure Element to help stakeholders understand the basis for potential locations of electrical infrastructure in advance of construction. The elements of the plan will be made available on the Internet for easy access and will be referenced in staff reports as applicable.

5. UTILIZATION AND UPDATING: We will utilize the Tooele County Electrical Plan to understand the geographic interactions between this electrical plan and other infrastructure plans.

6. COORDINATE PLAN UPDATES: As necessary, we will work with Rocky Mountain Power and adjacent jurisdictions to clarify or refine mapped locations of infrastructure elements.

7. PROACTIVE COMMUNICATION: Once an adjacent local government jurisdiction signs this Memorandum of Understanding, participating local governments and Rocky Mountain Power will commit to 1) either follow the plan element or 2) notify participating adjacent jurisdictions, Rocky Mountain Power and Tooele County of its intent and reasons to not follow an element of the electrical plan.

8. COORDINATE INTER-JURISDICTIONAL IMPLEMENTATION: Participating local governments and Rocky Mountain Power will seek to maintain boundary locations of infrastructure elements consistent with this plan unless there is notification or discussion with adjacent jurisdictions and Rocky Mountain Power.
3. Appendices
Appendix A: Glossary of terms

A

Alternating Current (AC) – An electrical current which alternates direction repeatedly due to a change in voltage. The alternating current creates a sinusoidal waveform.

Ampacity – The current-carrying capacity, expressed in amperes, of an electric conductor under stated thermal conditions. Ampacity increases as ambient temperature decreases.

Ampere – A unit of measurement for electrical current produced by one volt applied across a resistance of one ohm. See Current.

B

Breaker – See Circuit Breaker.

Bus – An electrical connection that connects multiple electrical devices, sometimes referred to as a bus bar.

Bushing – An insulated connection between the internal and external components of electrical equipment.

C

Capacitor – A device to store an electrical charge. In the field of electric power transmission and distribution, capacitors are devices used for power factor correction and voltage regulation. Power factor correction improves the ability to deliver useful power (real power) to loads; voltage regulation helps to maintain constant service voltage.

Capacity – The maximum amount of electrical power that a device can utilize at one time without causing damage to the device; also, the maximum amount of all power that can be delivered at one time by a generating unit, generating station or all the plants on an electrical system.

Circuit – A conductor or system of conductors through which electric current is intended to flow.

Circuit Breaker – A device to open (de-energize) or close (energize) a circuit either during normal power system operation or during abnormal conditions. During abnormal conditions, when excessive current develops, a circuit breaker opens to protect equipment and surroundings from possible damage due to excess current.

Conductor – A material, usually in the form of a wire, cable or bus bar, capable of carrying an electric current, which allows an electric current to pass continuously along it.

Continuous Load – A sustained electrical load.

Current – The flow of electricity commonly measured in amperes. See also Ampere.

Cycles-per-Second – See Hertz.

D

Direct Current (DC) – Electrical current that normally flows in one direction only.

Demand – The rate at which electrical energy is delivered to or by a system, expressed in kilowatts or other suitable units, at a given instant or averaged over a designated period of time. Demand varies from hour to hour, day to day, and season to season.

Distribution Substation – A substation where one or more transformers reduces the line voltage from a local transmission level between 46,000 volts and 161,000 volts (46 kV – 161 kV) to a distribution level (4.2 kV – 34.5 kV) in order to distribute power to customers.

Distribution Line – A combination of conductors connected together to deliver power to customers at distribution voltages (4.2 kV – 34.5 kV). Each distribution line can be composed of overhead and/or underground conductors capable of serving hundreds of customers.

Distribution System – The distribution system includes all lines energized at voltages 34,500 volts (34.5 kV) and below.

DSM (Demand-Side Management) – Educational and financial incentive strategies designed to encourage consumers to improve energy efficiency, reduce energy costs or change the time of energy use. Such strategies could be expected to reduce the need for investments in networks and/or power plants.

E

Easement – A right of use over real property that belongs to another party. An easement entitles a utility, for example, to install power lines and to access the property for maintenance and repair.

Energy – Energy is a measure of the amount of power usage over time and is measured in kilowatt-hours or megawatt-hours.

F

Fault – A problem on a power line that interrupts the normal flow of power, which usually causes a protective device (see circuit breaker and fuse) to operate.

Feeder – See distribution line.

FERC (Federal Energy Regulatory Commission) – An independent U.S. government agency that regulates the interstate transmission of natural gas, oil, and electricity.

Franchise – A license or similar legal authority granted to a utility by a political jurisdiction to provide service at retail in a given geographic area and to utilize the public right-of-way for utility poles, wires, equipment, etc.
Frequency – The number of complete alternations or cycles per second of an alternating current measured in Hertz.

Fuse – A protective device designed to de-energize a circuit when a fault occurs on the circuit. The fuse can operate only once and must be replaced once it has operated.

Generator – A unit that converts thermal, mechanical, hydro, wind, chemical or nuclear energy into electric energy.

Generation Mix – A term used to describe the various types of energy sources used by a utility to generate electricity, i.e. coal, wind, hydro, etc.

Gigawatt (GW) – 1,000 megawatts, or 1,000,000 kilowatts, or 1,000,000,000 watts.

Ground – The reference point in an electrical circuit from which other voltages are measured. Electric utilities use the earth or ground as the reference point. The potential or voltage of ground or earth is assumed to be zero volts.

Grounded – Connected to or in contact with earth or connected to some extended conductive body in place of the earth.

Guy Wire – A cable fastened to the pole to keep it in position.

Hertz (Hz) – A unit of frequency. One Hertz equals one complete cycle per second of an AC source. This unit replaces the former “cycles-per-second.” The standard frequency in the US is 60 Hz. However, in some other countries the standard is 50 Hz.

Horsepower – A measure of power used to define electric motors. For electricity one horsepower = 746 watts.

Hot – Energized (i.e., the line is hot or live).

IEEE (Institute of Electrical and Electronics Engineers) – A nonprofit organization that is the world’s leading professional association for the advancement of electrical technology. The IEEE promotes the engineering process of creating, developing, integrating, sharing and applying knowledge about electro and information technologies and sciences for the benefit of humanity and the profession. The IEEE sponsors the National Electrical Safety Code (NESC).

Insulator – Hardware or equipment made of porcelain, glass, or polymer used to isolate conductors from distribution poles or transmission structures that support them.

IOU (Investor Owned Utility) – A utility that is structured as a tax-paying business financed through sales of common stock. Rocky Mountain Power is an investor-owned utility.

IPP (Independent Power Producer) – A company that generates power but is not affiliated with an electric utility.

IRP (Integrated Resource Plan) – A resource planning process used by utilities and utility commissions to evaluate future resource options that yield an optimum balance of cost and risk, taking into account environmental, engineering, social, financial and economic factors. The process uses the same criteria to evaluate both supply and demand options while involving customers and other stakeholders in the process.

Junction Box – An electrical junction box is a container for electrical connections, usually intended to conceal them from sight and deter public tampering.

Kilovolt (kV) – A measurement of voltage. One kilovolt = 1,000 volts. This unit of measurement is most commonly used when describing transmission and distribution lines.

Kilowatt (kW) – A measurement of electric power. Ten 100 watt bulbs would use one kilowatt or 1,000 watts.

Kilowatt-Hour (kWh) – A measurement of electric energy equal to one kilowatt of power supplied for one hour. A kilowatt-hour could be used to light a 100-watt bulb for 10 hours.

Load – The demand for power at a given point in time. The peak load is the highest amount of power drawn at any time, or the utility’s maximum demand. Load can be divided into three major customer classes – industrial load, commercial load, and residential load.

Load Curve – A graph showing power or demand against time.

Load Factor – Load factor is the average power divided by the peak power, over a period of time. A high load factor is electricity used at a more constant rate without fluctuations in peaks and valleys. A large business with a high load factor typically experiences a lower average cost per kWh and has a lower cost of service by the utility.

Load Forecasting – An estimate of future consumption of electricity. The estimates are used in planning for generation, transmission, and distribution facilities; in calculating future revenue from the sales of electricity; in determining cost allocations for the various
rate classes; and in assessing the impact on load of changes in policies or underlying conditions such as the level of employment in the region.

Megawatt (MW) – 1,000 kilowatts or 1,000,000 watts.

Megawatt-hour (MWh) – 1,000 kilowatt-hours or 1,000,000 watt-hours.

Municipal Utility – An electric utility system owned by a municipality that serves retail customers generally within the boundaries of the municipality.

NEC (National Electrical Code) – Standards designed to safeguard people and property from hazards related to the use of electricity. Compliance with this code, along with proper maintenance, will result in an installation essentially free from hazard. The NEC does not cover installations under the exclusive control of an electric utility. The NEC is sponsored and updated by the National Fire Protection Association.

NERC (North American Electric Reliability Corporation) – An independent organization that works to ensure that the bulk electric system in North America is reliable, adequate and secure.

NESC (National Electric Safety Code) – Standards published by the Institute of Electrical and Electronics Engineers (IEEE) applying to grounding, installation, maintenance and operation of electric supply, communication, utilization equipment, lines and facilities which have been adopted by the American National Standards Institute. By law or statute, electrical utilities are required to conform to the NESC.

Net Metering – A method of measuring the difference between the electricity a customer uses from the power company and the generation produced by a customer from his own generation source, such as solar panels. The net meter keeps track of power usage taken from the company and customer power provided back to the company.

Neutral Conductor – A system conductor other than a phase conductor that provides a return path for current to the source. It is intended to have approximately a zero voltage potential relative to earth or ground and such that the voltage differences between it and each of the phase conductors are approximately equal in magnitude.

Off-Peak – All times not identified as on-peak. See On-Peak.

Ohm – A unit of electrical resistance. A circuit resistance of one ohm will pass a current of one ampere with a voltage difference of one volt. Abbreviated using the Greek letter omega (Ω).

Ohm’s Law – An equation that defines the relationship between voltage, resistance and current. In 1828 the German physicist George Simon Ohm showed by experiment that the current in a conductor is equal to the difference of potential or voltage between any two points divided by the resistance between them. This may be written as I = V / R where V is the voltage difference in volts, R is the resistance in ohms, and I is the current in amperes.

On-Peak – Those periods of time when power is delivered near the utility’s maximum demand. Rocky Mountain Power’s on-peak periods are:

- October through April inclusive – 7a.m. – 11p.m., Monday through Friday, except holidays
- May through September inclusive – 7a.m. – 9p.m., Monday through Friday, except holidays

Peak Demand – The maximum demand imposed on a power system or component thereof.

Peak Load – See peak demand.

Point of Delivery – The point where the electrical utility’s circuit connects to the customer’s system.

Potential – See voltage.

Power – The rate at which work is performed or that electrical energy is converted to other forms of energy. Electrical power is the product of voltage and current (P =VI) and is commonly measured in watts, kilowatts or megawatts.

Power Grid – A network of power lines, transformers, generators, and associated equipment employed in distributing electricity over a geographical area. Rocky Mountain Power is part of a power grid that encompasses the western United States and parts of Canada and Mexico.
Power Plant – A complex of structures, machinery and associated equipment for generating electric energy from another source of energy, such as nuclear reactions, coal, gas, wind, water or sun.

PPE (Personal Protective Equipment) – Refers to protective clothing, helmets, goggles, or other garments worn for job-related occupational safety and health purposes that are designed to protect the wearer’s body from injury by blunt impacts, electrical hazards, heat, chemicals and infection.

Primary – The high voltage part of the distribution system. In Rocky Mountain Power service territory the primary distribution power is between 4,160 volts (4.2 kV) and 34,500 volts (34.5 kV) with the majority at 12,500 volts (12.5 kV).

PSC (Public Service Commission) – A state utility regulating authority.

PURPA (Public Utility Regulatory Policies Act) – A law passed in 1978 by the United States Congress as part of the National Energy Act, meant to promote small independent power production. This law created a market for non-utility electric power producers and required electric utilities to purchase power from these producers at the utility’s “avoided cost,” or the marginal cost for the utility to generate or purchase from another source. Generally, this is considered to be the fuel costs incurred in the operation of a traditional power plant.

Recloser – A switch that will automatically open a circuit if it detects electrical problems such as a fault, and attempts to close the circuit at timed intervals. If the electrical problem fails to correct itself, the switch will remain open after a certain number of attempts to close the circuit.

RMP (Rocky Mountain Power) – An investor-owned electric utility which serves customers in Utah, Idaho and Wyoming. Rocky Mountain Power is a division of PacifiCorp, which is a subsidiary of MidAmerican Energy Holdings Company (MEHC).

ROW (Right of Way) – Right-of-way is an interest in property either owned in fee or as an easement transferred through grant, prescription, dedication, or the right of Eminent Domain. Public utilities (regulated by a state utility commission) have the right under state statute to use a portion of the road right-of-way for installation and maintenance of their facilities.

Secondary – The low voltage part of the distribution system. In Rocky Mountain Power service territory the secondary distribution power is between 120 volts and 480 volts.

Sectionalize – To isolate a problem and restore as many customers to service as possible.

Single-phase – One phase of a three-phase system. Single-phase power is typically used to serve customers whose load characteristics are primarily lighting, heating and small motors (typically residential and small commercial customers).

Single-Phase Service – An overhead or underground service consisting of two “hot” wires and a neutral.

SCADA (Supervisory Control & Data Acquisition) System – Rocky Mountain Power’s SCADA system is a complex computer system that 1) monitors frequency, generation, power, current, voltage and control device status on the utility’s transmission and distribution systems and 2) controls (either automatically or via manual control) breakers, reclosers, and other control devices to maintain the integrity of the transmission and distribution systems.

Secondary – The low voltage part of the distribution system. In Rocky Mountain Power service territory the secondary distribution power is between 120 volts and 480 volts.

Smart Grid – A term used for an ever widening palette of utility applications that enhance and automate the monitoring and control of electrical use at the consumer level.

Structures – The poles or towers used to support transmission and distribution conductors.

Substation – An assembly of equipment in an electric power system through which electrical energy is passed for transmission, distribution, interconnection, voltage transformation or switching. Substations can range in size from one acre to several hundred acres. A typical distribution substation whose primary purpose is to convert power from 138 kV to 12.5 kV is one acre inside the fence or wall. However, a main grid substation whose primary purpose is to convert power from 500 kV to 345 kV and connect to several 345 kV transmission lines may be 200 acres.

Sub-transmission – Lines that are typically energized between the voltages of 46,000 volts (46 kV) and 161,000 volts (161 kV). Sub-transmission lines are used to transfer power from transmission substations to regional and distribution substations.

Switch – A device that opens or closes a circuit.

Switchyard – A substation that does not include voltage transformation.

Three-phase – The most common method used by electrical utilities worldwide to distribute power. In a three-phase system, three circuit conductors carry three alternating currents that reach their instantaneous peak values at different times. Three-phase power is typically used to serve customers whose load characteristics include large motors, (typically industrial customers and large commercial customers).
Three-Phase Service – An overhead or underground service usually consisting of three “hot” wires and a neutral.

Transformer – A transformer is an electrical device that takes electricity of one voltage and transforms it into another voltage.

Transmission System – An interconnected group of high voltage electric lines and associated equipment for transfer of electrical energy between points of supply and points at which it is delivered to other utilities or transformed one or more times to lower voltages for delivery to consumers. Typically, at Rocky Mountain Power, transmission lines are energized at 230,000 volts (230 kV) and above.

Trip – A sudden shutdown of a piece of equipment or line. A trip is generally caused when a protective device (breaker, recloser) operates to isolate a portion of the system in order to protect the equipment or line.

Undergrounding – The act of converting the overhead transmission or distribution system to an underground location.

Underground Service – Electric service supplied to the customer from the power company utilizing underground cable.

Volt – A unit of measurement for voltage. The voltage difference across a one ohm resistance carrying a current of one ampere.

Voltage – The driving force, or “electrical pressure,” that causes current to flow through a closed circuit. The force can be compared to the pressure of water in a pipe. Voltage is measured in volts (V) or kilovolts (kV).

Voltage drop – The amount of voltage loss that occurs through all or part of a circuit due to the impedance of the lines and equipment on the circuit.

Watt – A unit of measurement of power. One watt equals the power dissipated by a current of 1 ampere flowing across a resistance of 1 ohm.

X

Y

Z
Appendix B: Electricity 101

Voltage is a measure of electrical “pressure” (similar to water pressure in a hose).

Current is the movement of electrons through a conductor, (similar to water flow in a hose) measured in amperes or amps.

Power (volt-amperes) has two components, Watts and Vars, as shown in the below drawing.

\[ V = IR \] or Voltage (volts) = Current (amperes) X Resistance (ohms).

\[ P = IV \] or Power (volt-amperes) = Current (amperes) X Voltage (volts).

Typically vars are not considered except with large customers and utility engineers. The remainder of this document will ignore vars and assume power only has one component, watts.

- 1,000 watts = 1 kilowatt = 1 kW
- 1,000,000 watts = 1 megawatt = 1 MW

The maximum amount of power a transmission line can carry is referred to as capacity.

Energy represents the amount of power used or transmitted over a given period of time (energy = power x time). The basic unit of measure for electrical energy is the watt-hour.

- 1,000 watt-hours = 1 kilowatt-hour = 1 kWh
- 1,000,000 watt-hours = 1 megawatt-hour = 1 MWh

An electrical system is designed to accommodate Capacity (Demand (MW)). Since capacity can be accommodated then Energy (MWh) will also be accommodated.

Load is power being used by customers. Instantaneous load represents capacity used. If customer load is greater than the electrical system capacity then load must be reduced or one or more components of the electrical system will fail.

Power System

Transmission Lines

Clearance

Minimum vertical and horizontal clearance is established by the National Electrical Safety Code (NESC). When a utility designs a transmission or distribution line they consider the maximum sag of the conductor (vertical component) and the maximum deflection of the conductor (horizontal component).

Vertical Clearance

Items that influence conductor sag include: (line loading, conductor capacity, line tension, ambient temperature, conductor weight, and conductor composition). The clearance required by code considers what the conductor crosses (roads, railroads, trails, water, structures, etc.) and the operating voltage of the line.

Clearance requirements are dependent on transmission line voltage. As voltages increase, vertical clearances increase.

- Typical 345 kV single circuit H-frame structure will be 90-120’ above the ground.
- Typical 345 kV double circuit single pole structure will be 130-170’ above the ground (200’ in some cases).
- Typical 138 kV single circuit H-frame structure will be 60-90’ above the ground.
- Typical 138 kV double circuit single pole structure will be 70-95’ above the ground (115’ in some cases).

Horizontal Clearance and Right-of-way

Horizontal clearance, like vertical clearance, increases as the voltage increases. As illustrated in the adjacent drawing, items that influence deflection include: pole structure design, pole material, wire size and span length, and maximum wind speed where the line is constructed. The horizontal clearance required by code considers what the conductor is passing by: tress, signs, buildings, etc.

Right-of-way width is determined by...
combining the maximum conductor deflection, the no wind conductor position (pole width and insulator length) and the minimum clearance required by code.

Single pole structures typically require less ROW width than lattice or multiple pole structures. Right-of-way can be shared with other infrastructure such as roads and pipelines.

Main Grid
Energy is transmitted via high voltage lines (230kV, 345kV) from the power plants to major substations.

Main Grid lines typically operate at 230 kV and 345 kV

Double circuit 345 kV line in a power line corridor with other lines. Monopole structure is the current typical design.

Jim Bridger to Kinport 345 kV Line

Single circuit 345 kV line in a power line corridor with other lines.

Double circuit 345 kV line. Lattice towers are not built by the power company anymore.

Sub-transmission Lines (Local Transmission)
46 kV and 138 kV – Used to transmit energy from main grid substations to regional and local substations.

Double circuit 138 kV line with 12.5 kV distribution underbuild. Monopole structure. ROW is typically around 60 feet with distance between structures around 300 feet.

Single circuit 138 kV line, two pole structure. ROW is typically up to 100 feet; distance between structures is about 600 feet.
Single circuit 138 kV lines with distribution underbuild. ROW is typically up to 60 feet with distances between structures around 300 feet. Monopole structures.

Double Circuit and Single Circuit 46 kV
46 kV lines are similar to 138 kV lines. Older 46 kV lines are usually shorter, however, the current practice is to replace failing 46 kV structures with structures designed to accommodate future 138 kV conversion.

Distribution
4.16 kV to 12.47 kV

Substations
A substation is used to transform or change voltage levels and contains equipment to protect power lines and substation equipment. Substations can contain the following: transformers, switches, capacitors, reactors, and circuit breakers. Generally power flows from a high voltage substation to a regional substation; then to a distribution substation.

Main Grid Transmission
Major substations (main grid): Convert power from high voltage transmission lines (230 kV, 345 kV) to sub-transmission voltages (46 kV, 138 kV).

Main Grid co-located with Sub-Transmission and Distribution
Major substations (main grid): Convert power from high voltage transmission lines (230 kV, 345 kV) to sub-transmission voltages (46 kV, 138 kV) and distribution voltages (12.5 kV, 25 kV).

Midvalley Substation 345 kV to 138 kV

90th South Substation
345 kV to 138 kV
138 kV to 46 kV
138 kV to 12.5 kV

Camp Williams Substation
345 kV to 138 kV
138 kV to 46 kV
138 kV to 12.5 kV
Regional Transmission co-located with Distribution
Regional substations (sub-transmission): Convert power from sub-transmission lines (46 kV, 138 kV) to other sub-transmission voltages and distribution voltages (12.5 kV, 25 kV).

Cottonwood Substation
138 kV to 46 kV
138 kV to 12.5 kV
46 kV to 12.5 kV

Taylorsville Substation
138 kV to 46 kV
138 kV to 12.5 kV

Distribution
Local substations convert power from sub-transmission lines (46 kV, 138 kV) to distribution voltages (12.5 kV, 25 kV).

Ultimately serves up to 80 MW of load
- 1-3 square miles for industrial load
- 2-5 square miles for commercial load
- 6-8 square miles for typical urban residential load (8000 homes)

Capitol Substation
46 kV to 12.5 kV

Bluffdale Substation
46 kV to 12.5 kV

Cinder Butte Substation
161 kV to 12.5 kV

West Jordan Substation
138 kV to 12.5 kV
Hoggard Substation
138 kV to 12.5 kV

South Jordan Substation
138 kV to 12.5 kV

Sunrise Substation
138 kV to 12.5 kV