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REPRESENTING AVISTA CORPORATION

Avista Utilities

Substation Infrastructure Plan

2020

AVISTA

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Executive Summary

The Substations group is heavily impacted by the same factors driving investments in all of the other areas of the Company as well as utilities across the nation: continually increasing regulations from the federal to the local level, aging infrastructure, increasing customer demands for reliability, changing technology, and increasingly complex siting issues and construction permitting to name a few.

Substations and their associated equipment are critical to the integrity of the grid. The Federal Energy Regulatory Commission (FERC)[1] and the North American Electric Reliability Corporation (NERC)[2] are well aware of this and have a strong focus on regulating almost every detail of substation operating, maintenance, processes, and planning procedures as well as equipment operation and protection, all in the service of preserving the integrity of the interconnected system. Their mandates are heavily enforced, backed by significant fines for non-compliance.

In addition to federal regulating bodies, the electric power industry must comply with literally hundreds of national, state and local regulations. For example, utilities are governed by laws related to federal lands or affecting unique interests, such as culturally significant sites, environmental issues, or endangered species. The National Electrical Safety Code defines the rules for installation of electrical gear, electrical protection, methods and materials and even communications for all electric utilities. The Occupational Safety and Health Administration (OSHA) regulates safety standards. State and local authorities and regulators focus on facility siting and zoning, safety regulations, environmental considerations, and more; state regulatory commissions determine revenue requirements, allocate costs, set service quality standards and oversee the financial responsibilities of the utility. All of these regulators and regulations have developed over time to ensure that people and equipment stay safe and that the lights stay on.

These mandatory standards heavily inform Avista's decision-making processes and behaviors. They also help to ensure that the Company's system is reliable, resilient, and secure. However, decisions that were once based on qualitative risk assessment under a voluntary framework are now made based on deterministic criteria within standards required by law, with non-compliance resulting in substantial financial penalties. This has resulted in changes which influence the Company's capital spending decisions and operating practices to a significant degree.

[1] The Federal Energy Regulatory Commission (FERC) oversees all electricity transmission and wholesale marketing in the United States. FERC has regulatory authority over both the reliability of Avista's system and the commercial aspects of Avista's wholesale uses of its transmission.
[2] FERC has assigned reliability standard development and enforcement to the North American Electric Reliability Corporation (NERC). Its purpose is to regulate, enforce, monitor and manage the physical and logical security of systems that manage the electrical power grids.

At the same time, across the nation and specifically at Avista, thousands of assets are well past their expected lifespans, including transformers, reactors, capacitors, conductor, and poles. The Company is replacing these assets over time and as funding allows, but concurrently the traditional utility business is undergoing significant changes that make this work even more pressing and challenging. Customers are increasingly demanding "perfect power," meaning zero service interruptions, due to the sensitive nature of their technology systems and changing perceptions of inconvenience and disruption. This in part drives the need for new devices to detect and automatically manage outages.

Burke Substation

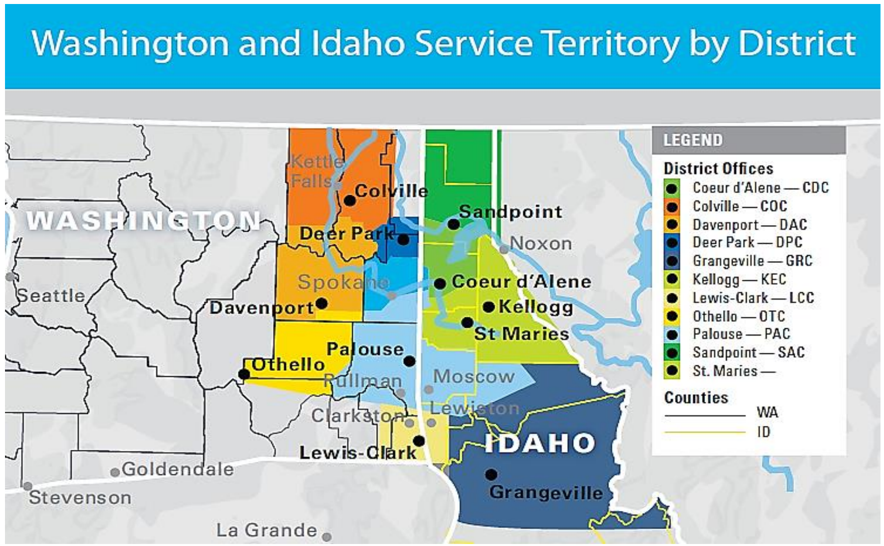
To add even more complexity to this mix, power system requirements are changing in directions never anticipated when the system was built, most of it in the 1950s and 1960s. Interconnections to private parties for integration of new variable energy resources particularly wind and solar, distributed generation, electric vehicles, smart grid technology, customer-requested technologies, and more require significant capital investment to extend or reinforce the electric system in order to provide for these non-traditional uses of the power grid. The Substations team is right at the heart of these efforts. This report describes the capital programs that impact the Substations group, put in place to try to address these diverse needs in the most effective, cost-conscious way possible while achieving the multiple objectives described above.

Cabinet Sub

Metro Sub

INTRODUCTION

Avista Utilities serves nearly 400,000 electric customers in Washington and Idaho over an extensive electric system that is designed, built, operated and maintained by the Company. This infrastructure system consists of nearly 19,000 miles of electric distribution lines, approximately 2,750 miles of high voltage transmission lines[3] along with 176 substations and their associated equipment crossing 30,000 square miles and bringing electric power to over 1.6 million people in Washington and Northern Idaho.[4] Avista currently has 176 substations, including 13 generation (step-up) substations, 21 transmission and switching substations, 31 transmission with distribution substations, 109 distribution only (step-down) substations, and two substations that are owned by other utilities but which contain Avista equipment.



All of the various kinds of substations are designed to handle different tasks. Generation substations take the energy from the power plant and step it up to transmission level for long distance travel to other substations. Transmission switching stations do not reduce the power level to distribution level, instead the lines come in and go out at high voltage, the electricity is just rerouted in different directions, split onto other lines, or stepped up or down in voltage, for example from 230 kilovolt (kV) to 115 kV. Transmission with distribution subs transform high voltage (transmission) into distribution (sub-transmission) level voltage and send it out onto distribution feeders. Distribution-only subs may route distribution-level power to various feeders or transform sub-transmission to different power levels to suit different customer needs. Each type of substation serves a particular purpose in serving customers.

Number of Substations	
Distribution	109
Foreign	2
Generation	13
Switching	13
Transmission	8
Transmission w/Dist.	31
	176

Substation Count by Voltage	
13 kV	4
24 kV	1
34 kV	1
115 kV	142
230 kV	14
Generation	14
	176

Location of Substations	
Coeur d'Alene	19
Colville	12
Davenport	13
Kellogg-St. Maries	13
Lewiston-Clarkston	22
Othello	12
Palouse	26
Sandpoint	13
Spokane	45
Coyote Springs	1
	176

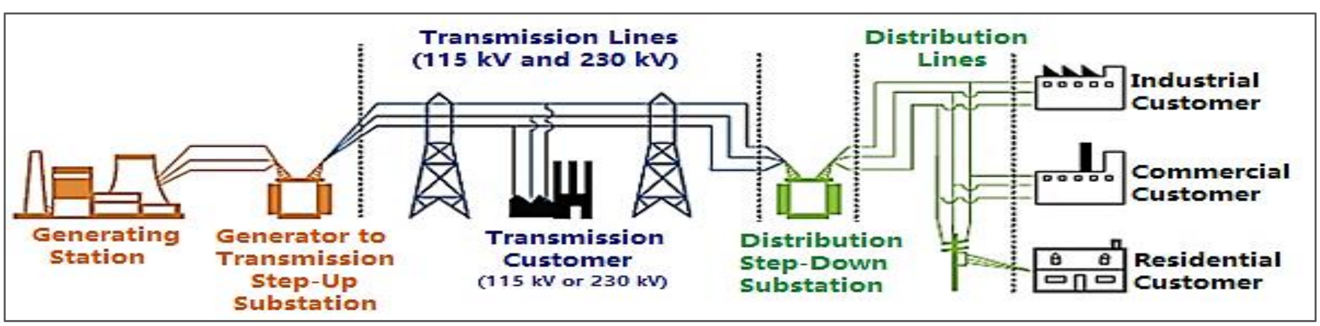
[3] This includes 700 miles of 230 kV, 1550 miles of 115 kV, and 500 miles of co-owned (Colstrip) 500 kV lines.
[4] Avista Quick Facts, https://investor.avistacorp.com/static-files/a7342b27-72cc-44d4-b9a7-b62903e999df

Avista must continually make new investments in this system in order to continue providing customers with safe and reliable electric service, at a reasonable cost, with service levels that meet customer's expectations for quality and satisfaction, and that meet stringent national, regional, state, and local regulatory requirements.

In order to meet all of these requirements, the Company develops specific capital programs. These programs are developed through planning and engineering studies and analyses, as well as scheduled upgrades or replacements identified in the operations districts and within engineering groups or to replace equipment that has been damaged or failed. Capital projects undergo internal review by multiple stakeholders who help ensure all system needs and alternatives have been identified and addressed. If proposed projects are initially approved, they go through a formal review process referred to as the Engineering Roundtable, a diverse group of engineering leaders[5] who track project requests, prioritize them, and establish committed construction package dates and required in-service dates for projects. Once a project has passed this phase of evaluation, it moves to the Capital Planning Group.

The Capital Planning Group (CPG) is a group of Avista Directors that represent capital intensive areas of the Company. Committee members are directors from a variety of business units to add a depth of perspective, though their role is to consider capital decisions from the perspective of overall Company operations and strategic goals as well as spending guidance set by senior management and approved by the Finance Committee of the Board of Directors. They develop a final budget that represents a reasonable balance among competing needs required to maintain the performance of Avista's systems, as well as prudent management of the overall enterprise in the best interest of customers.

Though all of Avista's assets play a role in providing the electricity that ultimately reaches consumers, in this report this discussion is confined specifically to substation facilities. All of us have passed by substations many times in the course of our travels, filled with complicated-looking electrical equipment and surrounded by high fences and barbed wire. They are easy to overlook and ignore, but they touch our lives every day, playing a critical role in providing the electricity we all depend upon. Substations play the primary role in the safe and reliable operation of the electric system, in essence providing the physical locations to monitor and manage the grid.



[5] Eleven representatives are included in this group from: Transmission and Distribution Planning, Transmission, Distribution, and Substation Design, System Protection, System Operations, Asset Management, Communications and Generation Engineering, and Transmission Services.

SUBSTATION FUNCTIONS

- *Changing voltage from one level to another*
- *Controlling the flow of electricity in various directions and onto various lines; splits the electricity out onto various feeders*
- *Providing circuit breakers to protect the system from faults*
- *Protecting the transmission system by insuring proper voltage levels and frequency*
- *Regulating voltage to compensate for changes due to fluctuating load, unexpected equipment failures, etc.*
- *Switching transmission and distribution circuits into and out of the grid system for maintenance or to meet other system conditions*
- *Measuring the electric power quantities flowing in the circuits*
- *Connecting communication signals to the circuits*
- *Eliminating surges from the system caused by lightning or other electrical conditions*
- *Connecting electric generation plants to the grid*
- *Correcting reactive power flows to insure voltage is stable*
- *Creating interconnections and controlling the electricity flow between electric systems of more than one utility*
- *Data transmission and communications*
- *General control and protection*
- *Fault analysis and pinpointing the location of a fault*
- *Providing the ability to shed load in a controlled fashion if demand exceeds power supply*

Before electricity can travel into your home, it must first pass through a substation. Substations are, in fact, the very heart of the electrical system, performing the critical functions necessary to get electricity from a generator to the customer. They are the center of protection and control of the electrical system, monitoring the voltage levels and frequency of the grid to insure they are sufficient, providing breakers to isolate faults, routing the power to where it is needed, and switching transmission and distribution lines in and out of service for maintenance and to serve customer loads.

Substations are also connection points. One of the most important and obvious connections is between the generator and the customer. Electricity is created at the generator, which passes it to a transmission substation where it is stepped-up to the high voltage level required for it to be conveyed long distance on transmission lines to the load source. This high-voltage electricity cannot be used in most homes and businesses. Voltage is like pressure, and high-voltage electricity has too much pressure to run everyday things. A residential customer's voltage need is only 120 volts. The voltage level of a transmission line is typically 115,000 volts or more to minimize line losses. This level is unusable for most end-use applications. Trying to use power at that level for all but extremely high-level industrial customers would be like trying to fill water glass with a fire hose. To deal with this challenge, the transmission line carries the electricity to a substation. The substation takes the electricity provided by the line and steps it down to the distribution level using a transformer. After converting the electricity to a usable level, the substation transfers the lower voltage electricity to the distribution system. Thus, the substation is vital to the functionality of the entire power system as the means by which power can be delivered to the customer in a form they can use.

Another substation function is splitting the power off in different directions, sending it onto different transmission or distribution lines for delivery to where it is needed.

Substations also provide a place for interconnections between different utilities in the grid, enabling them to buy and sell power to or from one another.

Substations are designed to provide switching, which is the connecting and disconnecting of transmission and distribution lines or other components to and from the system. An example of this function is switching the electricity from a line that is de-energized to another line or lines to keep the power flowing to customers, which helps maintain system reliability. Switching is used if a line needs to be de-energized for maintenance, due to a fault, to move power to a different location, or for new construction.

One of the highest priorities in a substation is to detect and isolate failures in the transmission system as quickly as possible. Short circuits or overloaded currents on a transmission line feeding a large substation can leave thousands of people without electricity. To protect against such an event, substations have specialized equipment to monitor, manage and protect the transmission system so the power can continue to flow. Substation equipment can isolate a faulted area so the rest of the system continues to function normally.

This report provides a summary overview of Avista's substations and the way the Company manages and invests in these critical assets and their associated equipment. Collectively these historic, current, and planned investments allow Avista to effectively respond to customer needs and expectations, provide service enhancements, meet regulatory and other mandatory obligations, replace equipment that is damaged or fails, support electric operations, address system performance and capacity issues, support the interconnected grid, and replace infrastructure at the end of its useful life based on asset condition. The investments described in this plan are based on what we know about the business today, including a range of precision in future cost estimates, applicable laws, regulatory requirements, and the capabilities of current technologies.

For more information about substations, their associated equipment, functions, and a glossary of terms, please see the 2019 Electric Substation Infrastructure Plan located on the Company's internal website[6] or as a hardcopy available upon request.

Above: Work at Cabinet Sub
Left: Inside Post Street Sub

[6] On the Avenue under "Tools and Resources" then "Avista Infrastructure Plans."

Avista Substation Capital Investments

Classification of Infrastructure Need by Investment Drivers

As a way to create more transparency around the particular needs being addressed with each capital investment as well as simplify the organization and understanding of overall project plans, the Company has developed "investment drivers" to classify its capital projects. These drivers are broad categories that attempt to sort projects by the need they are addressing, as described below:

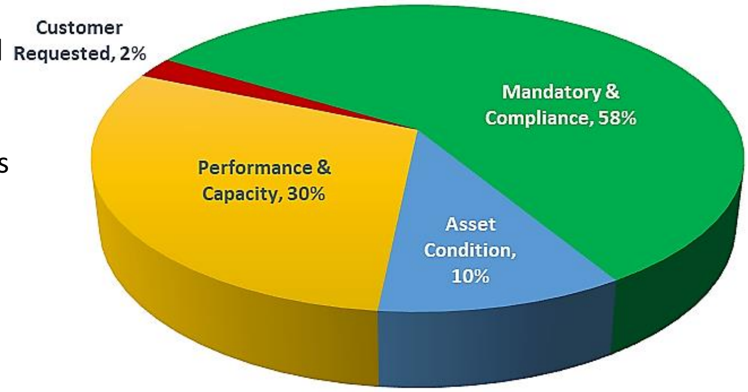
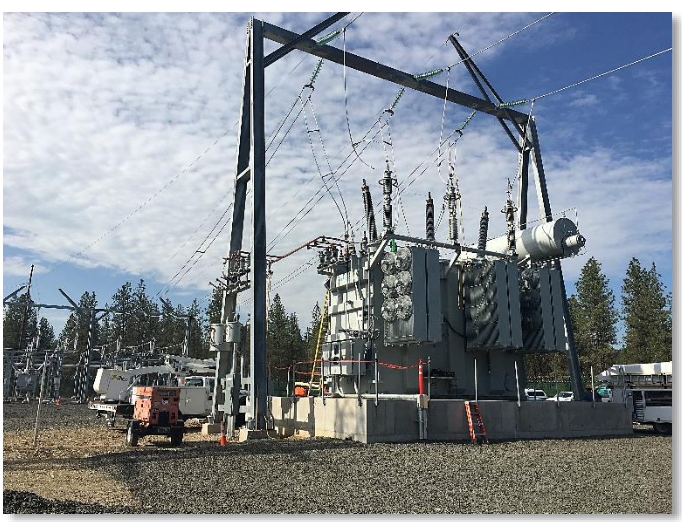


Figure 1. Total Substation Planned Capital Expenditures by Investment Driver

1. ***Customer Requested*** – This category is primarily related to customer growth, but also provides funding to enhance customer service as requested. The Company must build new or upgrade existing substations in response to changes in load or consumption patterns. This category also includes funding related to requested interconnections of third party resource developers such as the Lind Solar Project and the Rattlesnake Flat Wind Project.

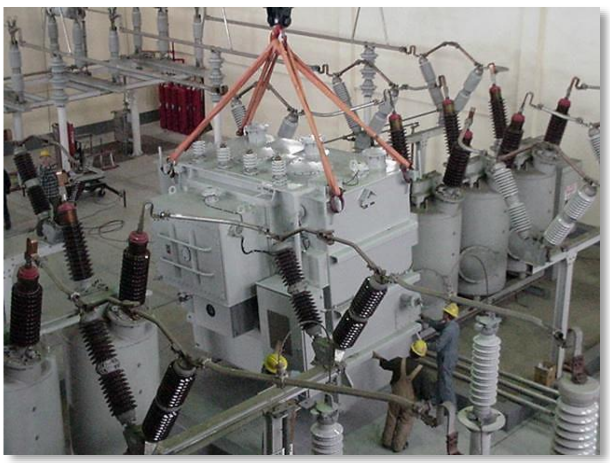
2. ***Mandatory & Compliance*** – The Company makes a large number of business decisions as a direct result of compliance with laws, mandatory standards, safety codes, contracts, and agreements. An example is control equipment required by NERC to preserve and monitor the reliability of the interconnected grid or to replace equipment that is exceeding thermal limits, as substations are a key part of maintaining system reliability. Projects in this category are primarily driven by external requirements that are largely beyond the Company's control, such as building the Saddle Mountain Substation, required to meet NERC grid stability requirements, as well as construction of the West Plains Substation and the reinforcement of the Ninth and Central and Westside Substations, again required by NERC related to remediating system reliability issues.



Installation of new autotransformer at Westside Sub

3. ***Failed Plant & Operations*** – This category sets aside funds which allow the Company to replace failed equipment and support ongoing utility operations as assets are damaged or no longer provide adequate functionality. Often these expenditures are the result of storm damage, but they can also be required by other unexpected equipment failures, animal or human-caused damage, and the like. In Substations, Failed Plant and Operations dollars are combined with funds for planned and unplanned failed plant in the Substations Rebuilds Business Case, which is held under the Asset Condition business driver.

Animal-caused damage at Deer Park Substation



Post Street Sub receives a new transformer to replace one that reached end-of-life

4. ***Asset Condition*** – All assets have a defined useful service life. This category provides funding to replace equipment as needed so the system can continue to function effectively. This may include replacing parts as they wear out or when items can no longer meet their required purpose, as systems become obsolete and replacement parts are no longer available, to remedy safety or environmental issues, or if the condition of an asset is such that it is no longer optimizing its own performance or customer value. The Company also proactively replaces critical equipment to mitigate the risk of failure.

5. **Customer Service Quality & Reliability** – This category is for costs related to meeting customers' expectations for quality of service and electric system reliability. Substations does not have any specific dollars set aside under this category, as this is primarily a function of Distribution. An example of this type of expenditure is Distribution's programs to replace old style streetlights with energy-efficient LED lights. Another example is Avista's installation of smart meters to provide customers the ability to manage their energy usage, among many other benefits.[7]

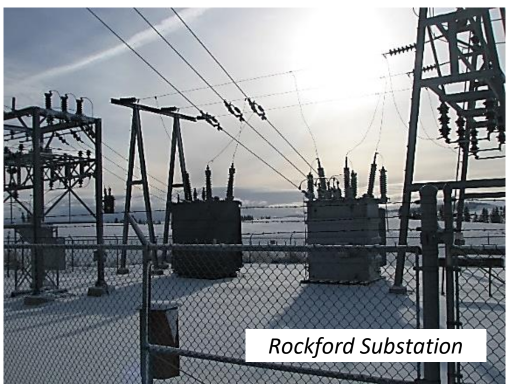
6. ***Performance & Capacity*** – Programs in this category ensure that the Company's assets satisfy business needs and meet performance standards, typically defined by Company experts or in line with industry expectations. Some examples include adding redundant distribution feeders to reduce the impact of outages on customers, replacing equipment that is not functioning at nominal levels, or adding monitoring capability to enable viewing critical equipment in real time. This category is also used to add new substations or upgrade existing stations to manage customer

[7] Customer benefits include providing customers access to their energy usage to allow managing it and controlling costs, energy alerts, billing accuracy, support for customer "smart home" technology, and more.

load growth/change. During this budgeting cycle, funding has been set aside to add new transmission lines to the Mead, Colbert, and Milan substations for service redundancy and the resulting improvement in customer reliability.[8]

Building the Opportunity Substation in Spokane to manage customer growth

Note that not all investment driver categories are utilized in all Avista's business units. For example, electric Distribution includes budgets in all six categories listed above; however, investments planned for Substations during the upcoming five-year planning cycle do not include any specific projects in the category of Customer Service Quality & Reliability or Failed Plant & Operations. It is also important to note that some projects may resolve issues under more than one investment driver category.



Rockford Substation

While projects are categorized by a *principal* investment driver, a project that resolves multiple issues may be prioritized differently than it would be if it fell fully under a single investment driver category. For example, investments in Substations related directly to service reliability for all customers are generally driven by mandatory compliance requirements, so they can be found in the "Mandatory & Compliance" driver even though the project may also provide more dependable customer service. Though the Substations team implements the T&D projects that impact substations and associated apparatus, these expenditures are typically dictated by Transmission and Distribution projects, thus many of the Substation business cases are the same ones listed in those reports.

Business Driver	2020	2021	2022	2023	2024	Five Year Total	Five Year Ave.
Customer Requested	$2,225,000	$0	$0	$0	$0	$2,225,000	$445,000
Mandatory & Compliance	$10,000,000	$15,900,000	$5,300,000	$1,650,000	$24,000,000	$56,850,000	$11,370,000
Asset Condition	$2,450,000	$1,670,000	$1,600,000	$2,900,000	$1,550,000	$10,170,000	$2,034,000
Performance & Capacity	$500,000	$1,800,000	$1,000,000	$11,900,000	$14,150,000	$29,350,000	$5,870,000
Total	**$15,175,000**	**$19,370,000**	**$7,900,000**	**$16,450,000**	**$39,700,000**	**$98,595,000**	**$19,719,000**

Figure 2. Substation Planned Capital Budget by Business Driver 2020 – 2024

[8] These projects are under the "Transmission New Construction" subcategory of Performance and Capacity and are share with the Transmission Group.

Overview of Currently Planned Capital Investments in Substations 2020 – 2024

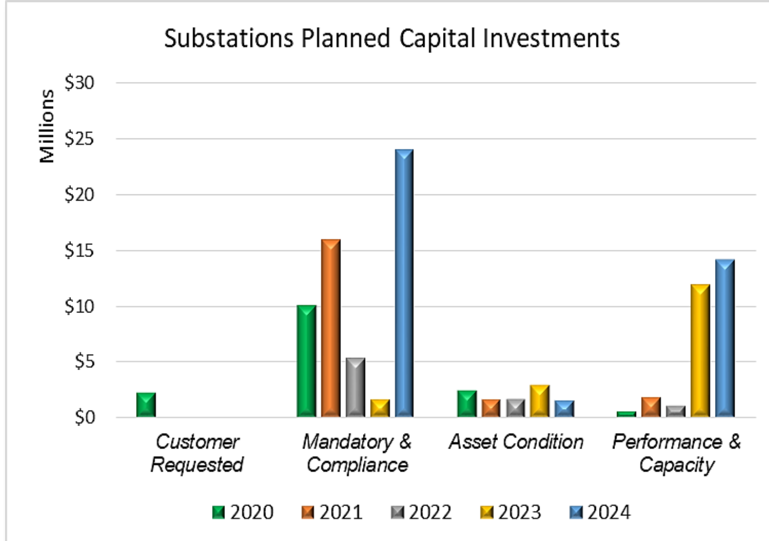
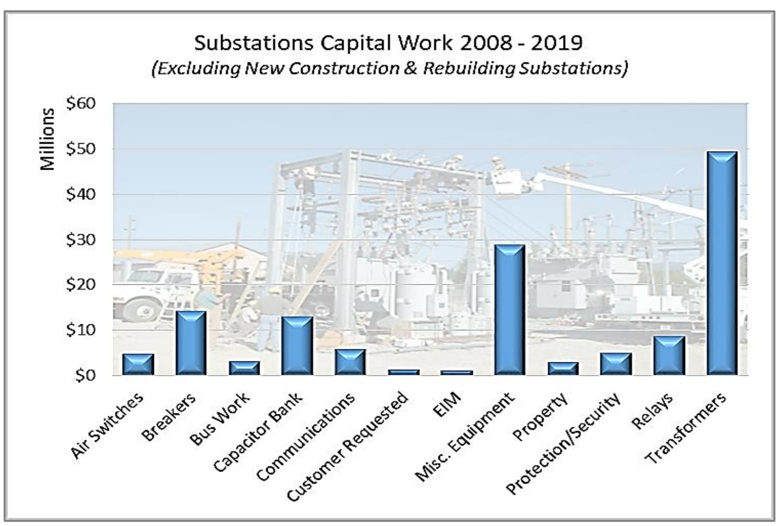


Figure 3. Planned Capital Substation-Related Expenditures by Investment Driver 2020-2024

Substation construction and maintenance activities are heavily regulated by state, regional and federal agencies that implement compliance standards, safety requirements, work activities, thermal limits, and the like. These rules govern when equipment must be replaced, how it must be monitored and maintained, operating characteristics and limits, and even cyber and physical security. Compliance with these mandatory standards is not optional and drives a number of the Company's investment decisions. This is clearly reflected in the expenditures the Substations team expects during the upcoming budget cycle and into the future.

This focus on compliance makes sense, as substations are the key to a utility's ability to serve customers. Equipment must be replaced or upgraded as loads grow or load patterns change, when equipment wears out or no longer functions to prescribed levels, to address potential outage or safety issues, to deal with equipment that is exceeding its tolerances, and to maintain the high level of reliability the Company and its customers expect. In addition, customers can request service that may require a new substation or adding capacity to an existing station, such as a wind project, a new subdivision, or a new manufacturing facility that require new or more robust substations.



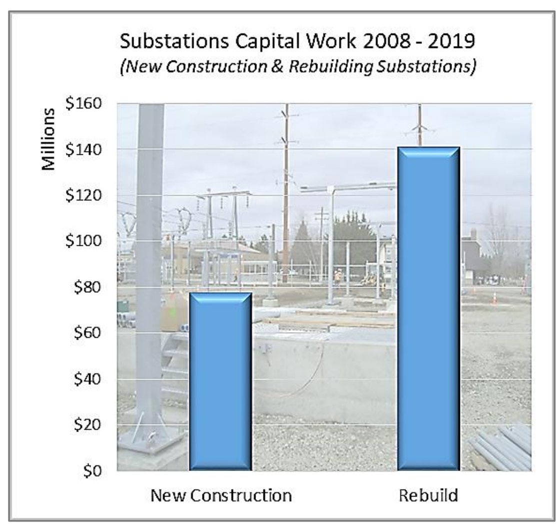


Figure 4. Historic Substation Capital Expenditures 2008 – 2019[9]

[9] Misc. Equipment includes batteries, reclosers, fuses, switches, metering, voltage regulators, and technology equipment.

The Substations group is in the middle of all of these mandates and requirements, constantly monitoring the health and effectiveness of their equipment, rebuilding old substations to meet current standards or needs, constructing new substations as needed to manage loads and system stability, and adding equipment or replacing it as necessary. These crews also manage the substation property, insuring fences and gates are secure, installing security systems, and maintaining the associated substation yard and buildings. This team also installs and manages system protection and communication equipment, ensuring it is kept in working order so the Company can keep an eye on the operation of the system as well as detect equipment performance issues or be alerted to unauthorized intrusion.

Above: Break-in at Garden Springs Sub
Left: Security at Northeast Substation

As can be seen in Figure 4 above, rebuilding old substations (some built in the early 1900s) to replace aging equipment has been a major driver in Substation expenditures. This is required in order to handle growing demands as well as to stay in compliance with increasing numbers of stringent federal regulations, which include requirements for more monitoring, control and security measures, as well as replacing aging or undersized transformers to maintain reliability. These three requirements dominate Substations capital expenditures.[10]

Transient issues at the 3rd & Hatch Substation

Over the current five-year planning horizon, Avista expects to spend nearly $100 million for substation-related capital investments. Note that this figure includes some Transmission projects, as these projects are planned by Transmission but implemented by Substations.[11]

Salvaging the old transformer at Benewah in 2010

[10] Note in Figure 5 the “Misc. Equipment” category includes batteries, communications equipment, fuses, grounds, meters, reclosers, regulators, relays, and switches.

[11] The sister Transmission Infrastructure to this report can be found on the Company’s internal website, the Avenue, under “Tools & Resources” in ‘Avista Infrastructure Plans” for more information about Transmission capital expenditures.

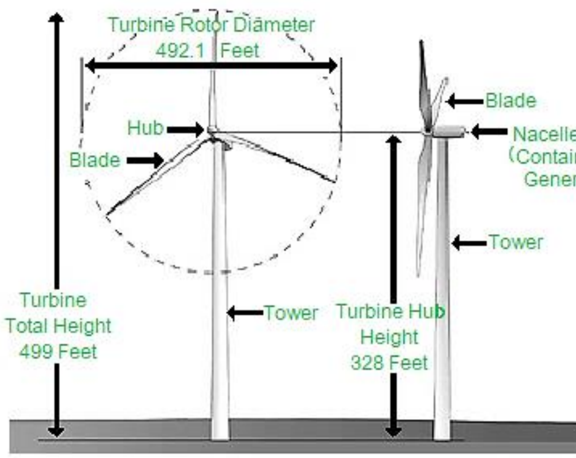
Planned Capital Investments

Customer Requested

Responding quickly to customer requests is a requirement of providing utility service. Customer requested activities are typically limited to the electric distribution system, but may be extended to include substation infrastructure and dedicated high voltage transmission facilities. The Company must also upgrade existing substations or build new ones in response to customer growth or at the request of generation resource developers such as the one described below.[12]

Rattlesnake Flat Wind Project

Avista issued a request for proposal in June 2018 for additional renewable energy. An external company, Clearway Energy Group, was selected to provide this resource. Clearway is developing a wind power facility known as Rattlesnake Flat Wind, which is projected to provide Avista with approximately 50 average megawatts of renewable energy, or as much as 144 megawatts of nameplate wind capacity, under a 20-year power purchase agreement with deliveries beginning in 2020. This project, including 90 wind turbines and associated facilities, is located on approximately 23,000 acres in Adams County, Washington. This project requires significant upgrades to Avista's existing infrastructure in order to allow this new generation to be added to the power grid. The required work includes rebuilding nearly 27 miles of 115 kV transmission including distribution underbuild and optical ground wire. It also necessitates a new substation (Neilson) with adequate protection, control and communications equipment, as well as upgrades to three existing substations[13] to handle the increased system demands this project will create. *This business case is part of the same Transmission business case.*



Rattlesnake Flat Wind Turbine Design

Building the new Neilson Substation to add the Rattlesnake Flat Wind generation to the power grid

[12] Purchasing qualifying output from independent power producers and providing the transmission, substations, and other necessary equipment to allow this projects to connect to the grid is required by law. http://app.leg.wa.gov/WAC/default.aspx?dispo=true&cite=480-107

[13] The substations requiring capacity upgrades include Lind, Warden, and the Othello Switching Station as well as replacement of the circuit switcher at Roxboro. The developer is responsible for a portion of the cost of this project.

Mandatory & Compliance

Avista operates in a complex regulatory and business framework and must adhere to national and state laws, state and federal agency rules and regulations, and county and municipal ordinances which drive much of the Company's capital spending requirements as mentioned earlier. Compliance with these laws and rules, as well as with contracts and settlement agreements, represent obligations that are generally outside of Avista's control. The types of investments that fall into this driver include the obligation to relocate facilities to accommodate state, county and municipal infrastructure projects (frequently transportation related) and compliance with environmental regulations. FERC and NERC requirements for grid stability have a significant impact on the Substations group workload and budgets as described below.

Saddle Mountain 230/115 kV Station

Avista's System Planning group and related outside entity studies determined that the western portion of the Avista's existing system is not meeting NERC performance requirements during heavy load scenarios. The Saddle Mountain project, undertaken in two phases, will allow Avista to continue serving Company load in the Big Bend Area near Othello while eliminating the pressure Avista's load is putting on the Grant County Public Utility District system. This issue will be solved by constructing a new 230/115 kV substation where the Walla Walla – Wanapum 230 kV and the Benton – Othello 115 kV transmission lines cross. This new sub will consist of a three-terminal 230 kV double bus double breaker configuration,[14] a 250 MVA 230/115 kV auto-transformer,[15] four 115 kV breakers, rebuilding existing aging 115 kV transmission lines, and building ten miles of new 115 kV transmission. This project will greatly improve the reliability of transmission in the area and rem n existing single point of failure situation which could create widespread outages in case of a fault. It also mitigates potential thermal overloading and voltage issues in this area. *This business case is part of the same Transmission business case.*

Saddle Mountain Substation under construction

[14] A double bus double breaker bus configuration consists of two main buses, each normally energized and electrically connected to each other so that if one is removed from service by a fault or for maintenance, the other breaker continues to function so there is no interruption to service.
[15] An auto-transformer is used to adjust line voltages or hold them constant, and can step up or step down voltages in the 115 kV and 230 kV range, for example, providing a 115 kV tap from a 230 kV line.

Spokane Valley Transmission Reinforcement

This project reinforces transmission in the Spokane Valley area, spurred by load growth in the region as well as compliance with the NERC TPL-001-4 Reliability Standard[16] which requires each utility to ensure that their system is robust enough to operate reliably over a broad spectrum of system conditions and under a wide range of possible contingencies. Avista system studies identified this area as requiring additional reinforcement in order to be in compliance with the NERC standard about ten years ago, and the Company has been working on it since that time. This long term project required the construction of a new switching substation (Irvin) off of Trent Avenue. It also includes rebuilding 4.4 miles of the Beacon-Boulder #2 115 kV transmission line, building 1.75 miles of transmission for the new Irvin-Opportunity 115 kV tap, construction 2.2 miles of 115 kV transmission from the new Irvin sub to the existing Millwood sub, and installing circuit breakers to handle the upgrades changes at the Opportunity Sub. These changes will not only address compliance issues, but will make the transmission system in this urban area more stable and reliable, specifically for serving large industrial customers. *This business case is part of the same Transmission business case.*

Site of new Irvin Substation in Spokane Valley

West Plains New 230 kV Substation

Planning studies of the Spokane area transmission system revealed specific transmission performance issues which will occur within the next five to ten years, including an inadequate number of transformers. These performance issues have a significant potential to exceed NERC reliability standards, designed to prevent cascading outages and ensure the integrity of the interconnected system especially around thermal or voltage limit issues.[17] System studies identified at least seven NERC thermal or voltage limit violations including:

- Inadequate 230/115 kV transformation provided by the four existing substations in the area, especially in the case of system events. Existing transformers are reaching maximum thermal capacity now and in time will exceed it.
- Related 115 kV transmission lines are running at 96% to 135% of their rated capacity during specific contingency scenarios.[18]

[16] NERC Standard TPL-001-4: http://www.nerc.com/files/tpl-001-4.pdf requires the Company to avoid load loss and have circuit breakers with sufficient interrupting capability for faults.
[17] NERC Reliability Guidelines, September 2018, https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability_Guideline_Methods_for_Establishing_IROLs.pdf. Non-compliance with NERC directives can lead to fines of up to $1 million per day until the violation is rectified.
[18] This includes the Northwest-Westside 115 kV, the Bell-Northeast Waikiki Tap 115 kV lines, and the lines from the Beacon and Westside substations.

These issues are expected to intensify with projected growth in this region. In addition, some of the transmission lines in the Spokane area are radial lines, requiring manual intervention in order to restore service to customers after a fault, with a total customer exposure of up to 31 miles. In order to manage this situation and remain in compliance with NERC directives, the Company is planning to construct a new 230 kV substation in the West Plains area. The Company selected this property at the convergence of two major transmission lines to provide maximum value for this new substation. No new transmission lines will need to be built; the existing lines along with this new substation will address the transmission performance issues. This location also provides an opportunity to interconnect with a 230 kV line owned by Bonneville Power Administration, strengthening Avista's grid and adding additional operating flexibility. The West Plains Substation is designed to mitigate all of the identified system deficiencies, including adding 500 MVA of transformer capability and redundancy to the transmission system in this area. *This business case is part of the same Transmission business case.*

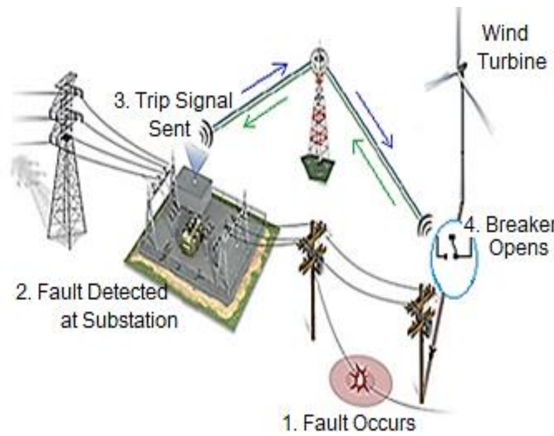
Ninth & Central 230 kV Station & Transmission

The Spokane area transmission system is heavily dependent upon the Beacon Substation, which is networked to the Bell Substation as well as eight 115 kV transmission lines. In order to reduce this dependency, create redundancy, enhance customer reliability, and remain in compliance with mandatory standards, Avista is planning on upgrading the infrastructure of the Ninth & Central Substation to provide a more robust and dependable infrastructure for the Spokane area. The Company is adding new 230 kV infrastructure to accommodate a 230/115 kV auto-transformer and associated circuit breakers, and putting in place additional transformer capacity for the Spokane transmission system. This project will also build eight miles of new transmission lines, utilizing existing 115 kV corridors in a double circuit configuration in order to fortify the Spokane area transmission system without increasing the transmission footprint through the area. This project significantly strengthens the electric system in the Spokane area, especially in the South Hill region. *This business case is part of the same Transmission business case.*

Work on the Ninth & Central Substation

Ninth & Central transmission line

Protection System Upgrade



NERC Reliability Standard PRC-002-2[19] defines the disturbance monitoring and reporting requirements for Bulk Electric System elements.[20] This Standard requires collecting and recording data needed to analyze disturbances. The Standard requires 50% compliance with these data requirements by 2020 and 100% compliance by 2022. To achieve compliance, Avista is required to upgrade fault recording capability at several substations including: Beacon, Boulder, Rathdrum, Cabinet Gorge, North Lewiston, Lolo, Pine Creek, Shawnee and Westside. This project will be ongoing until 2022.

Westside 230/115 kV Substation "Brownfield Rebuild"[21]

The Westside 230 kV Substation Rebuild is a major project made necessary because the existing Westside #1 230/115 kV transformer exceeded its applicable facility rating during heavy summer loads, resulting in the cascading failure of the Westside #2 230/115 kV transformer. This situation created a compliance risk with NERC TPL-001-4, a standard which has very specific requirements around equipment failure that could result in shedding customer load.[22]

New Westside #1 230/115 kV transformer being put into place

Engineers determined that the existing old transformers (one was manufactured in 1976 and one in 1958) were underrated for their use and not up to current design standards. These transformers will be replaced with 250 MVA[23] rated transformers designed for current performance and safety standards. Importantly, this replacement will meet stringent NERC requirements related to critical equipment being operated beyond its ratings and failing, which could ultimately impact the interconnected system.[24] These types of transformers are highly specialized, must be custom-ordered, and can take months to arrive. They weigh approximately 170 tons (making transportation an issue) and have prices tags of approximately

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[19] NERC PRC-002-2 "Disturbance Monitoring & Reporting Requirements," http://www.nerc.com/_layouts/PrintStandard.aspx?standardnumber=PRC-002-2&title=Disturbance%20Monitoring%20and%20Reporting%20Requirements&jurisdiction=United%20States

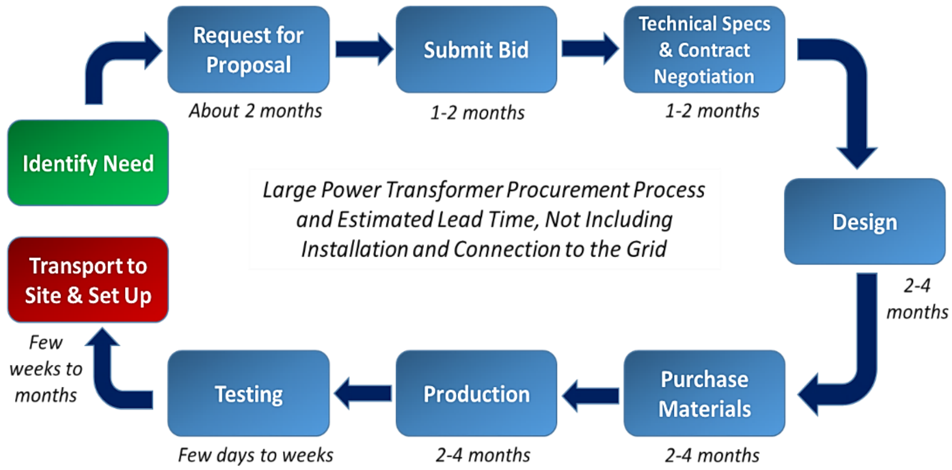
[20] NERC defines the Bulk Electric System as any transmission element operated at 100 kV or higher that has the potential to impact the grid.

[21] A "Brownfield" project refers to a project that takes place on land that has been occupied by a "permanent" structure at some point, requiring demolishing or renovating a prior structure, versus a "Greenfield" project that will be built in a place where nothing had been built before.

[22] NERC TPL-001-4, http://www.nerc.com/files/tpl-001-4.pdf

[23] MVA refers to the amount of power output a transformer is capable of delivering at a specified voltage under normal operating conditions without exceeding internal temperature limitations. A 250 MVA transformer is a very large transformer.

[24] "System Operating Limit Definition and Exceedance Clarification," NERC, https://www.nerc.com/pa/Stand/Prjct201403RvsnstoTOPandIROStndrds/2014_03_third_posting_white_paper_sol_exceedance_20141001_clean.pdf



$2,000,000[25] so entail a great deal of planning and preparation as well as installation time, making this a multi-year project.

Along with the transformer change-outs, numerous other equipment replacements are required to have the capacity needed from this station. To maximize the value the construction time, failing air switches and breakers at this substation will be replaced, the end-of-life protection equipment will be updated and upgraded, oil containment provisions will be made, and site security issues will be addressed. The 230 kV and 115 kV buses at the substation will be upgraded to a double bus double breaker configuration to provide adequate redundancy. This project, started in 2016, should be completed during the current budget cycle. *This business case is part of the same Transmission business case.*

Failed Plant & Operations

Above: Warden Switching Station failed PT
Left: Circuit switch failure at Gifford Sub

While large-scale outages are vividly remembered by both Avista employees and customers, the Company responds to thousands of outage events each year that occur almost every day of the year. The replacement of assets due to equipment failure or outage events, however, is only one component of the investments required to operate the electric system. In addition to outage response, Avista's nominal operations involve reconfiguration and replacement of electric facilities under a variety of circumstances. Causes of damage to the system include weather events, lightning, fire, snow and ice, downed trees/vegetation, wildfires, human or animal caused damage, and equipment failure. Other failures include the unanticipated loss of assets due to a range of factors including age and condition. Funding in this category is split between Transmission and Distribution, but often it is the Substations group that performs many of the repairs, replacements, and upgrades.

[25] U.S. Department of Energy, "Large Power Transformers and the U.S. Electric Grid," 2012, https://www.wecc.biz/Reliability/2014_TEPPC_Transmission_CapCost_Report_B+V.pdf, page 7.

Asset Condition

Assets of every type will degrade with age, usage and other factors, and must be replaced or substantially rebuilt at some point in order to ensure continuation of service. Across the utility industry and likewise for Avista, the replacement of assets based on condition constitutes a substantial portion of the infrastructure investments made each year. At Avista, asset replacement strategies are "optimized" in the sense that a given approach may not achieve the overall lowest possible lifecycle cost, but rather the lowest cost that allows meeting a variety of important performance objectives, such as electric system reliability or the efficient use of employee crews.

Switchyard equipment failure at Little Falls

Post Street Substation Wall

Because failure of some critical assets is unacceptable, they must be replaced near the end of their useful life even if they are still providing reliable service to proactively prevent outages. In other instances it may be reasonable and economical to wait until an asset fails before it is replaced, a strategy known as "run to failure." The Company sets aside funding to provide for swapping out old substation equipment as it reaches the end of its useful life, no longer meets performance requirements, becomes a safety hazard, is creating outages, or is so critical to operations that it must be replaced prior to failure. The Asset Condition category is a major focus for the Substations group, as they are continuously rebuilding, replacing, upgrading and repairing equipment to keep the system operating at optimal performance levels. Some of their specific programs in this category are described below.

Failed cable at Moscow City Sub

South Othello circuit switch interrupter failure

Substations Rebuild Program

Work on the Lee & Reynolds Substation in 2018

Investments in this program include updating old equipment to meet new safety and construction standards, installing communications systems (often in response to NERC directives), and replacing or upgrading other equipment such as circuit breakers, reclosers, switches, capacitor banks, transformers, and regulators. In addition, supporting equipment like relays, meters, batteries, panel housing, and fences must be replaced or rebuilt periodically to ensure the full functionality and safety of Avista's substations. Other projects in this category include rebuilding some of the Company's older wood substations, replacing or improving equipment at others, or increasing the capabilities of a substation due to growth or load changes in the area. *Please note that capital allocated for this program is shared between Transmission, Substations, and Distribution though Transmission creates and manages this program.*

Performance & Capacity

Avista's projects and programs grouped in this category of need include a range of investments that address the capability of assets to meet defined performance standards, typically developed by the Company, or to maintain or enhance the performance level of assets based on a demonstrated need or analysis. Substations projects in this category are typically related to system reliability, as substations are the primary provider of system protection. Projects may include replacing circuit breakers that are not performing to optimum protection levels or adding automation that instantly responds to and mitigates system issues. Other projects include adding redundancy to transmission and distribution lines to provide substations with the ability to switch lines to continue service when a fault occurs. In addition, this category incorporates customer growth-required substation equipment and upgrades.

Cabinet Gorge 230 kV Add Bus Isolating Breakers

The existing circuit breaker arrangement at the Cabinet Gorge substation causes a fault to trip off all four of the hydro units (about 260 megawatts), as well as trip both 230 kV lines and the primary 115 kV transmission line into Sandpoint. In the past this type of fault was an unusual occurrence so resolving the problem was not a high priority, but recently the number of these outages has increased, resulting in seven NERC Event Reports so far and driving the need to resolve this reliability issue as quickly as possible. The Company plans to install two breakers to separate the 230 kV bus at Cabinet from the generation step-up transformers to isolate the impact of faults across the bus and reduce the large scale impact currently experienced. Relay protection will also be added. *This business case is part of the same Transmission business case.*

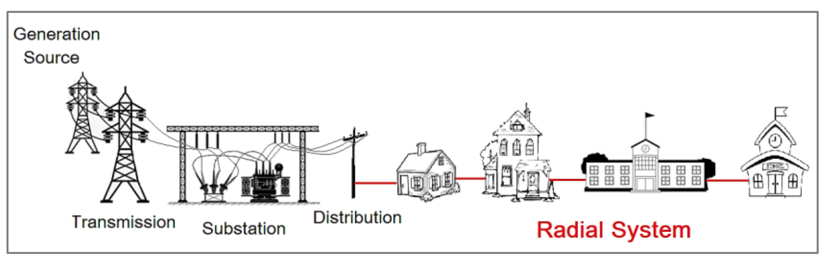
Cabinet Gorge 230 kV Substation breakers

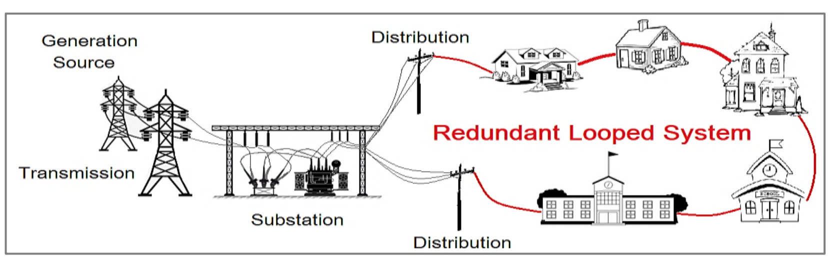
Substation – New Distribution Station Capacity

Adding new substations for load growth and reliability is critical to the long term safe, dependable, and cost-effective operation of the system. As load demands change and increase and customer expectations related to reliability also continue to increase, incremental substation capacity is required to serve those demands. Funding under this category is based on the historical experience of needing to add approximately two new substations to the system per year or to rebuild/upgrade existing substations to ensure that the system is growing at an adequate pace to maintain the expected level of service and reliability.

During the upcoming five year budget cycle, this program will fund upgrades to Spokane area substations to handle the increased load growth and add needed redundancy to the distribution system there. These changes will improve operational flexibility, allowing loads to be shifted to other lines in case of a fault or maintenance, maintaining continuous customer service through these types of events. *The capital allocated to this program is shared between Transmission, Substations, and Distribution.*

Transmission New Construction





Investments made under this program support the addition of new substations due to load growth in a particular area or to reinforce existing substations with new transmission required for increased performance, system stability, or customer service reliability. Funding in this category is also used to provide redundant feeds to radially-fed substations, reducing the potential for customer outages. *This program is managed through the joint efforts of Avista's Transmission Design & Engineering, Substations, Operations, and Transmission Planning groups, from which the requests for upgrades or additions are initiated.*

Operations & Maintenance Expenditures

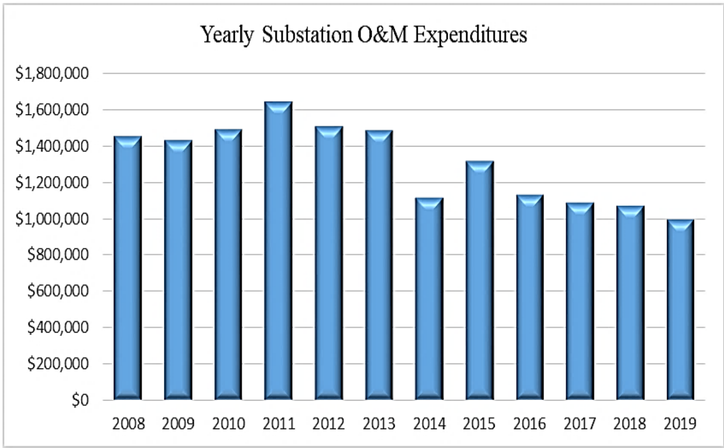


Figure 5. Substation O&M Expenditures 2008-2019

Avista's Substations employees are responsible for maintenance activities that involve Generation, Distribution, and Transmission assets. These employees are crucial to maintaining the integral equipment that transfers electricity to the end customer. Over the past decade, Substations has typically spent about $1.3 million per year[26] on a huge variety of operations and maintenance related tasks including servicing power lines, transformers, breakers, regulators and even the fences and grounds under and around their substations. The highly specialized and sophisticated equipment they maintain, repair, and install requires continual upkeep – checking the oil levels and quality, ensuring that breakers work when they are needed, repairing damaged equipment, and replacing blown fuses and dead batteries to name a few.

As an example, transformers are critical to grid operations and reliable power supply. Their failure can pose a variety of unsafe conditions, lead to extended outages for customers, and impose extraordinarily high costs on the utility for replacement. Therefore routine maintenance, diagnostic testing, and insuring proper operation of this equipment is of paramount importance. Equipment must be kept cool, leaks must be repaired, and equipment must be cleaned to protect against arcing. As can be seen in Figure 6, there is a great deal of work to be done in maintaining the substations portion of the power system.

Even beyond the major projects shown in Figure 6, there are constant small projects that must be managed. Substation buildings contain critical equipment that must be kept cool in hot summer months (fans and HVAC systems), wildlife guards are installed to reduce the number of outages caused by birds and squirrels, weeds must be kept at a minimum to avoid arcing. This group also utilizes specialized equipment to monitor and test equipment. One of the many ways they do this is with infrared imaging to identify hot spots in transformers. All of this work is in the service of preventing outages and maintaining system stability.

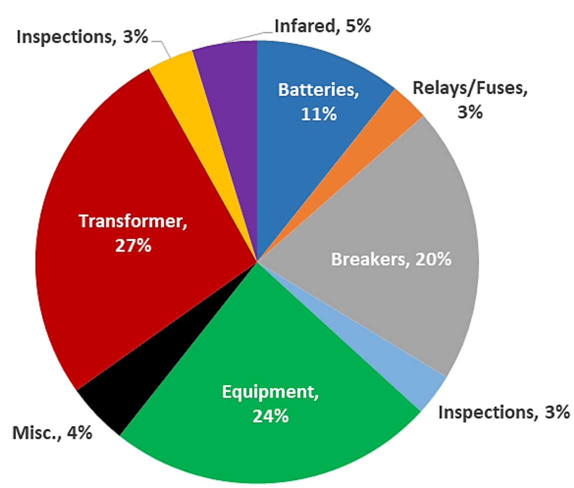


Figure 6. Primary Substation O&M Expenditures 2008 - 2019

[26] This average has dropped to approximately a million dollars per year over the past five years as the Company reduces O&M expenditures. Note that the required work does not go away, but is only postponed when budgets are reduced.

Summary

Avista’s substations are the very heart of Avista’s electrical system, performing the essential functions needed to provide power to customers. They serve a number of vital purposes. They are the focal point for protection and control of the electrical system. They contain highly technical and specialized equipment that monitors and maintains the voltage levels and frequency of the interconnected grid, provide breakers to isolate faults, route power to where it is needed, switch transmission and distribution lines in and out of service to serve loads or to perform maintenance, and transform power to required voltage levels. Substations are the backbone of power stability and quality. They play the primary role in the safe and reliable operation of the entire grid and are the means of getting power to the customer.

As discussed throughout this report, substations are filled with complex and sophisticated equipment, enabling the utility to monitor and manage the electric system. Avista has over 176 substations across a 30,000 square mile service territory, each fulfilling a particular purpose. Whether it is to step up the power from the power plant to high voltage transmission level, re-route power lines, manage power quality, connect to neighboring utilities, or step down the power to distribution level, all of the Company’s substations play a central role in protecting and maintaining the electrical system and getting the power to customers.

The Substations group is responsible for some of the most important equipment in the Company, both for customer service and in protecting the integrity of the interconnected grid. They are intensely focused on insuring that this equipment continues to perform reliably into the future. Avista’s Substation Engineering team, in collaboration with the Generation Production and Substation shops, oversees the design, testing, maintenance, repairs, rebuilds, and monitoring of all of the Company’s substations and associated equipment. These critical connection points must be carefully managed to preserve not only reliable electrical service to customers and to maintain compliance with national regulations, but also to manage costs and provide safety for the public, employees, and the entire Western Interconnection. At Avista, substation failure could potentially lead to a local or even regional outage, with the very real possibility of costing millions of dollars and impacting millions of lives. The Substation team takes on these responsibilities while managing to fixed capital budgets and limited operations and maintenance allowances. About two Avista substations are built or rebuilt each year to meet customer growth and system needs, but the future indicates that even more work will be required. Changing customer reliability expectations, increasing state and federal regulations, cybersecurity concerns, aging infrastructure, and limited manpower are having an impact already and are likely to change the landscape of Avista’s substation management and required expenditures into the future.

Appendix A: Avista's Substations

Coeur d'Alene Substations

Appleway 115kV
Avondale 115kV
Blue Creek 115kV
CD'A 15th St 115kV
Dalton 115kV
Huetter 115kV
Idaho Road 115kV
Lakeview 230/13kV
Pleasant View 115kV
Post Falls 115kV
Prairie 115 kV
Ramsey Rd. 115kV SS
Rathdrum 230kV
Spirit Lake 115kV

Lewiston-Clarkston Substations

Clearwater 115kV
Cottonwood 115kV
Craigmont 115kV
Critchfield 115kV
DryCreek 230kV
Dry Gulch 115kV
Grangeville 115kV
Holbrook 115kV
Kamiah 115kV
Kooskia 115kV
Kooskia 34kV
Lewiston Mill Rd. 115kV
Lolo 230kV
Nez Perce 115kV
N. Lewiston 230kV
Orofino 115kV
Pound Lane 115kV
S. Lewiston 115kV
Sweetwater 115kV
Tenth & Stewart 115kV
Weippe 115kV
Wickes 115kV

Colville Substations

Addy 115kV (BPA)
Arden 115kV
Chewelah 115kV
Colville 115kV
Gifford 115kV
Greenwood 115kV
Kettle Falls 115kV
Orin 115kV
Spirit 115kV
Valley 115kV

Davenport Substations

Davenport 115kV
Devil's Gap 115kV SS
Ford 115kV
Harrington 115kV
Little Falls 115kV
Long Lake 115kV
Long Lake 115kV SS*
Odessa 115kV
Reardan 115kV
Stratford 115kV SS
Wilbur 115kV

Othello Substations

Lee & Reynolds 115kV
Lind 115kV
Marengo 115kV
Othello 115kV
Othello 115kV SS
Ritzville 115kV
Roxboro 115kV
South Othello 115kV
Sprague 115kV
Warden 115kV SS
Wanapum 230kV (GCPUD)
Washtucna 115kV

Spokane Substations

Airway Heights 115kV
Barker 115kV
Beacon 230kV
Boulder 230kV
Boulder Park 115 kV
Chester 115kV
Colbert 115kV
College & Walnut 115kV
Deer Park 115kV
East Farms 115kV
Fort Wright 115kV
Francis & Cedar 115kV
Garden Springs 115kV SS
Glenrose 115kV
Greenacres 115kV
Hallett & White 115kV
Indian Trail 115kV
Inland Empire Paper 115kV
Liberty Lake 115kV
Loon Lake 115kV
Lyons & Standard 115kV
Mead 115kV
Metro 115kV
Milan 115kV
Millwood 115kV
Nine Mile 115kV SS
Ninth & Central 115kV
Northeast 115kV
Northwest 115kV
Opportunity 115kV
Otis Orchards 115kV SS
Post St. 115kV
Ross Park 115kV
Silver Lake 115kV
Southeast 115kV
Spokane Ind. Park 115kV
Sunset 115kV
Third & Hatch 115kV
Waikiki 115kV
Westside 230kV

Sandpoint Substations

Blanchard 115kV
Bronx 115kV SS
Cabinet Const. 115kV
Cabinet 230kV
Clark Fork 115 kV
Noxon 230kV SS
Noxon Const. 230/13kV
Noxon 230 kV Reactor
Oden 115kV
Oldtown 115kV
Priest River 115kV
Sagle 115kV
Sandpoint 115kV

Palouse Substations

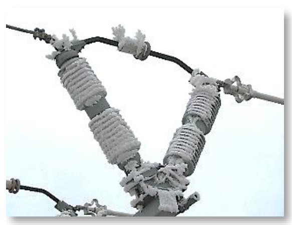
Benewah 230kV
Deary 115kV
Diamond 115kV
E. Colfax 115kV
Ewan 115kV
Garfield 115kV
Juliaetta 115kV
Latah Jct. 115kV
Leon Jct. 115kV
Moscow 230 kV
Moscow City 115kV
N. Moscow 115kV
Palouse 115kV
Potlatch 115kV
Rockford 115kV
Rosalia 115kV
Shawnee 230kV
South Pullman 115kV
Spangle 115kV
St. John 24kV
Tekoa 115kV
Terre View 115kV
Thornton 230kV SS
Turner 115kV
WSU 13kV
WSU - E. Campus 13kV

Generation Substations

Noxon Rapids HED
Cabinet Gorge HED
Post Falls HED
Upper Falls HED
Monroe St. HED
Nine Mile HED
Long Lake HED
Little Falls HED
Kettle Falls GS
Kettle Falls CT
Northeast CT
Boulder Park GS
Rathdrum CT
Coyote Springs 2

Control room at Beacon Sub

Lightning arresters at Lakeview Substation



Fire retardant at Avondale Sub

Post Street Sub

Upgrade work at Westside