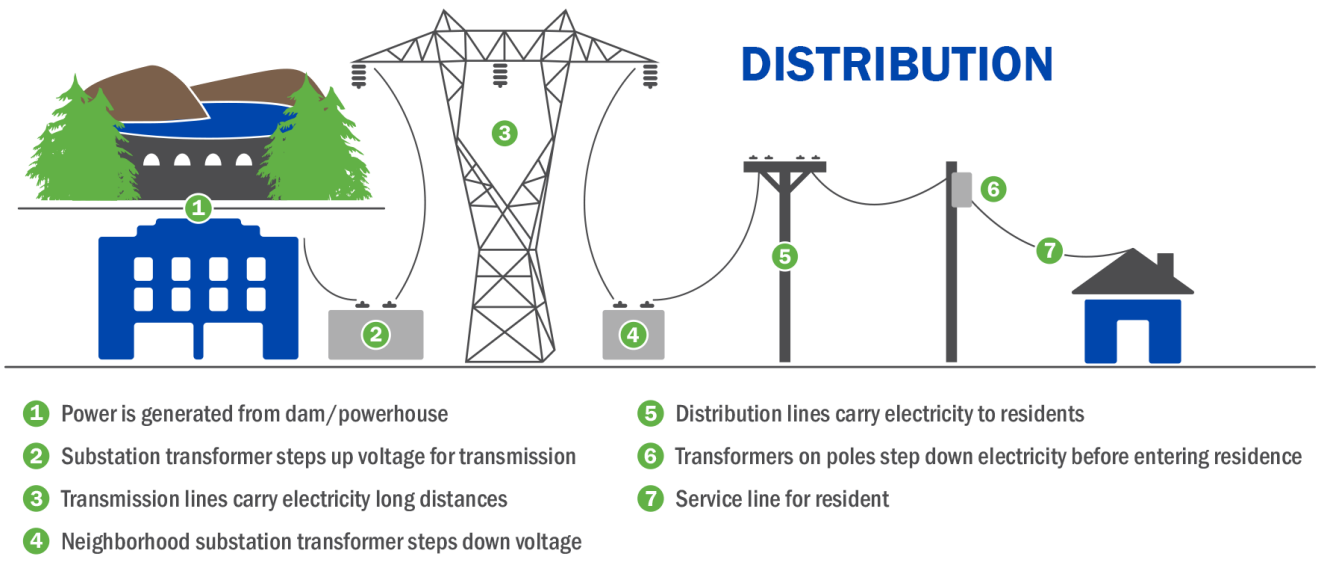
Fault Location, Isolation, and Service Restoration (FLISR)

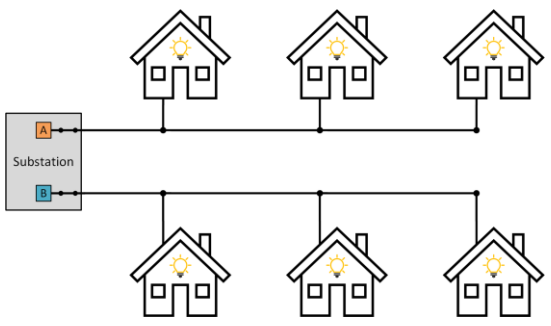


We all have distribution to thank for bringing us the electricity that we use every day. The distribution lines scattered all throughout Seattle and surrounding neighborhoods connect customers to the greater power grid, supplying the power that keeps the lights on and your fridge cold. But what happens when there is a problem with these distribution lines?

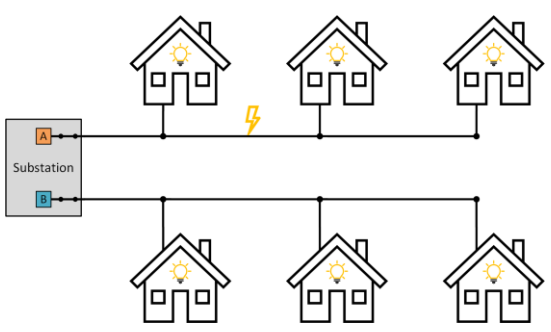
You've probably experienced a power outage before, and it was likely a frustrating experience. Overhead distribution lines can be vulnerable to faults (when power flows in a path that is not intended) from high winds, heavy weather, falling tree limbs: things that we see a lot here in the PNW. At Seattle City Light, we want your power to be on all the time with zero outages. However, outages are inevitable, which is why we are investing in exciting new technologies that can reduce the number of outages and help bring customers back online faster when an outage does occur.

Fault location, isolation, and service restoration equipped feeders are a great tool for improving customer power reliability. FLISR equipped feeders are capable of automatically recognizing faults and reconfiguring the grid to minimize an outage as much as possible, all before crews are even dispatched to the scene of a fault. Let's take a look at how it works.

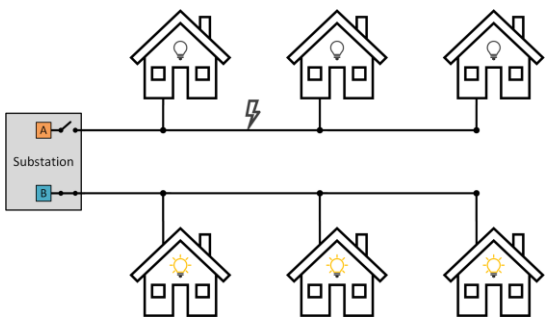
Traditional Distribution Feeders



In the diagram above, a substation supplies six customers on two separate feeders. At the substation, each feeder has a circuit breaker to protect the system in the case of a fault condition. Like the circuit breakers in your home, they are a switch that will physically open the circuit if a fault occurs on the feeder



Let's imagine a fault occurs on one of the feeders. Strong winds have broken a tree limb, which falls onto the power lines and causes a fault. The circuit breaker at the substation will sense this fault and open the circuit, causing an outage for the three customers.



At this point, Seattle City Light would send crews to drive along the lines to find and fix the fault so that the feeder can be turned back on, which could take hours. With this traditional distribution system, one fault plunges all three customers on the feeder into darkness, and it could take hours to get the power turned back on.

Does it Actually Work?

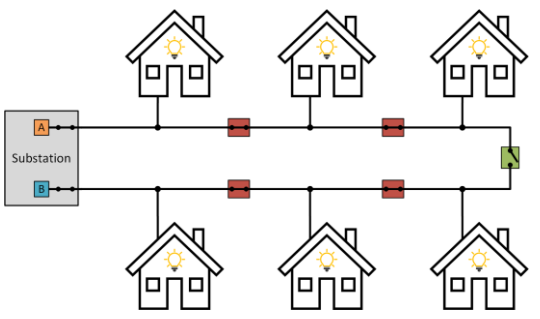
This FLISR technology sure sounds cool, but can it really help keep my lights on?

The first FLISR system installed by Seattle City Light was on two feeders in Shoreline in 2015. In 2016, there were five operation events where the FLISR switches carried out automatic operation. During these five events, an estimated **13,300 fewer customers suffered interruptions** compared to estimated outcomes without the FLISR system, and customers experienced nearly **two million fewer minutes of interruption.**

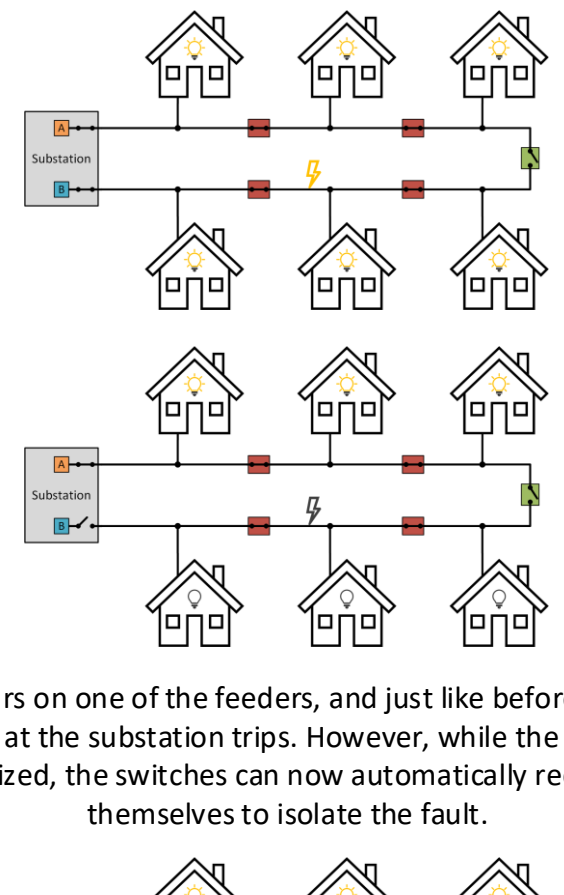
Clearly the FLISR system works, and works well. Two other FLISR installations are currently underway in Tukwila and University District, and the SCL Grid Modernization team is working to bring more Distribution Automation and other Smart Grid technologies to the SCL service area to improve power reliability and transform Seattle into a grid of the future.

FLISR Equipped Feeders

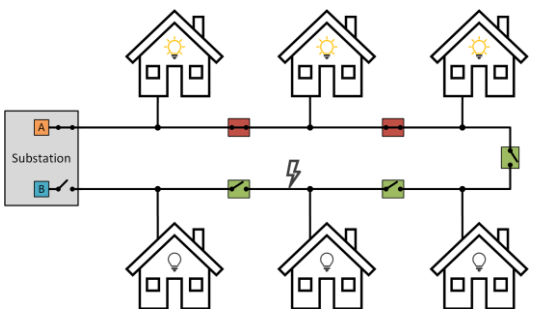
So, how does FLISR technology improve the system response to a fault? Let's reimagine the previous scenario, but this time we will add smart computerized switches at multiple points along the feeders, as well as one between the feeders known as a tie switch.



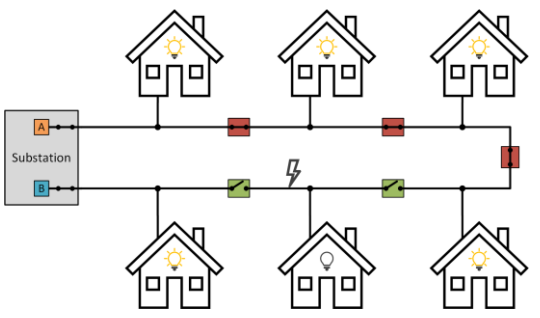
These switches can communicate with each other and with the grid operator, allowing them to be opened and closed automatically or remotely in the event of a fault. Let's break it down.



A fault occurs on one of the feeders, and just like before, the circuit breaker at the substation trips. However, while the feeder is deenergized, the switches can now automatically reconfigure themselves to isolate the fault.



With the fault now isolated, the circuit breaker and the tie switch can now close, bringing two of the three customers back online in less than a minute.



The FLISR switches identify the location of the fault and reconfigure the feeder completely automatically, and thanks to these switches two of the customers experienced an outage of less than one minute. Because the system operators now know the location of the fault to be within the two open switches, restoring power to the last house won't take as long either.

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