Written Testimony

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"Field Hearing to conduct oversight of the Department of Energy's functions and capabilities to respond to emergencies, including the impacts to critical energy infrastructure"

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Seattle City Light appreciates this opportunity to testify before the Senate Energy and Natural Resources Committee relating to the Oversight of the United States Department of Energy's functions and capabilities to respond to emergencies, including the impacts to critical energy infrastructure.

Seattle City Light is the 10th largest public electric utility in the United States. It provides reliable, renewable and environmentally responsible power to 750,000 Seattle area residents. City Light has been greenhouse gas neutral since 2005, the first electric utility in the nation to achieve that distinction.

My testimony today focuses on the Seattle City Light recently completed Climate Change Vulnerability Assessment and Adaptation Plan and participation in the Department of Energy's Partnership for Energy Sector Climate Resilience.

Seattle City Light obtains 90% of its energy from hydroelectric resources. Temperature and precipitation changes can have a dramatic effect on these resources. We also depend on hundreds of miles of transmission lines to bring this power to the City of Seattle. In 2013, as part of its resiliency strategy, Seattle City Light committed to researching the impacts of climate change on the utility and developing an adaptation plan including actions to minimize these impacts. City Light's Climate Change Vulnerability Assessment and Adaptation Plan summarizes the impacts of climate change on the utility and identifies potential actions needed to reduce vulnerability and increase resilience.

The goal of adapting or preparing for a changing climate is to ensure that Seattle City Light can continue to meet its mission to produce and deliver environmentally responsible, safe, low-cost, and reliable power as the climate changes. Electric utilities are facing an uncertain future, and a changing climate is one consideration in designing the utility of the future.

Why plan for climate change now?

To some people, climate change may seem like a far-off risk that will not affect electric utilities in the near-term. It can be tempting to label climate change as a "challenge for future generations," but this is not the case for several reasons:

- **Climate change is happening now, globally and here in the Pacific Northwest**. Temperatures have warmed and the effects of these warmer temperatures on snowpack, heat waves, and extreme weather have been detected globally, nationally, and locally in Washington.

- **These impacts are expected to intensify and new impacts will emerge regardless of reductions in emissions of greenhouse gases that cause global warming.** Mitigation to reduce emissions is critical to reducing the long-term magnitude of climate change impacts. However, some impacts are now inevitable because greenhouse gases that have already been emitted to the atmosphere will remain for decades to centuries.
- **Decisions are being made today that will shape the resources and infrastructure of City Light for decades into the future when the impacts of climate change will be more intense.** Decisions are underway regarding the location and design of facilities such as substations and transmission lines, the conditions for operating hydroelectric projects, and the acquisition of power resources and fish habitat. The effects of these decisions will still be in place for decades, so it is important to consider the increasing risk of climate change impacts throughout the life of these decisions.
- **Being proactive and preparing for climate change now can reduce the costs and consequences for City Light, its customers, and the environment.** It will be easier and more cost-effective to consider the impacts of climate change in the planning and design of new infrastructure and power resources now than it will be to retrofit infrastructure or replace resources once the impacts of climate change intensify.

United State Department of Energy Partnership for Energy Sector Climate Resilience

The City of Seattle is one of 18 electric utilities in the nation participating in the United States Department of Energy (DOE) *Partnership for Energy Sector Climate Resiliency (The Partnership)*. The Partnership Agreement signed by the participating utilities expresses a commitment to increasing resilience to climate change. The utilities in the partnership collectively represent 20 percent of the nation's generating capacity and 25 percent of customers. Seattle City Light submitted it Climate Change Vulnerability Assessment and Adaptation Plan to DOE in February 2016. The next deliverable is a Resilience Strategy which is due to DOE in October 2016.

The Partnership builds upon the lessons learned through previously conducted initiatives identified in the President's Climate Action Plan, and reflects the increasing pressures from climate change and extreme weather events on the electric sector in the United State. These vulnerabilities include:

- Decreasing water availability, reducing available thermoelectric and hydropower generation capacity, impacting oil and gas production and impeding barge transport of crude oil, petroleum products and coal.
- Increasing temperature, which leads to an increase in electricity demand for cooling as well as reduces the efficiency of thermoelectric power generation.
- Increasing sea level rise and heightened intensity and frequency of storms and flooding, potentially damaging or disrupting coastal and offshore oil and gas facilities as well as electric transmission and distribution lines, and threatening inland and coastal thermoelectric facilities.

The Partnership has been critical for establishing engagement between DOE and electric utilities that are committed to development and deployment of effective short- and long-term strategies for enhancing resilience to extreme weather and climate change. This allows utilities pursuing action on climate resilience to exchange knowledge and best practices, as well as receive recognition for their achievements. This Partnership also enhances energy security by establishing an energy system resilient to extreme weather and climate change and promotes investment in technologies, practices, and policies that will enable a resilient and modern energy system.

Seattle City Light looks forward to our continued collaboration with DOE and the other utilities as we work together to provide a more resilient energy sector across the United States.

Overview of City Light's Vulnerability and Risk Assessment

The Vulnerability Assessment evaluates how City Light is at risk from climate change. The Assessment describes eight changes in the climate, and resulting changes in natural hazards and streamflow (sea level rise, warmer temperatures and heat waves, changes in extreme weather patterns, increasing risk of wildfires, increasing risk of landslides and erosion, reduced snowpack and changes in runoff timing, higher peak flows and flood risk, and lower summer streamflows) that could affect five aspects of City Light's operations and infrastructure: **shoreline properties, hydroelectric project operations, electricity demand, transmission and distribution, fish habitat protection and restoration**. (See attached Figure: Climate Change Vulnerability Assessment.)

The Assessment then looks at how vulnerable of these operations and infrastructure are to climate change impacts and the potential magnitude of the impact on reliability, safety, financial costs and environmental responsibility. (See attached Table) This Assessment is then used to identify key risks for City Light and help prioritize adaptation actions.

Adaptation Actions

In the plan, City Light identified potential adaption actions to reduce the impacts of climate change on the utility. Adaption actions are intentional changes in policies and operations, or upgrades to infrastructure designed specifically to reduce vulnerability and increase resilience.

Adaptation Actions fall into four general strategies: (1) enhance adaptive capacity, (2) harden infrastructure, (3) increase resilience, or (4) retreating from exposed locations or resources. Many of these adaptation strategies are being considered or implemented by electric utilities across the nation. Each strategy may be useful depending on the magnitude of the impacts and the criticality of the objectives or infrastructure.

1. **Enhance Adaptive Capacity:** Actions to enhance adaptive capacity increase the ability of the utility to respond to extreme weather and climatic variability or change. Actions taken by electric utilities to increase adaptive capacity include employing meteorologists, investing in weather or wildfire monitoring as well as forecasting systems, and supporting research on the impacts of climate change.
2. **Harden Infrastructure:** Hardening involves protecting infrastructure in place by constructing new reinforced infrastructure or retrofitting existing infrastructure. Examples of hardening include installing submersible saltwater-resistant equipment, elevating infrastructure, or building flood barriers around substations to protect against sea level rise and storm water flooding. In wildfire prone areas, utilities are hardening by converting from wood to steel poles.
3. **Increase Resilience:** Increasing resilience is taking action to enhance the ability of the system to respond or recover from disruptions associated with extreme weather or climate change. Increasing resilience reduces the consequences of impacts in terms of recovery time and cost. Examples of actions by utilities to increase resilience include enhancing vegetation management programs, contracting resources to be readily available for wildfire response, increasing energy efficiency to reduce electricity demand, and diversifying resource portfolios to minimize risk from impacts to any one resource.
4. **Retreat:** Retreating involves relocating a facility from an exposed location. Retreating can also be applied to objectives or power resources. Objectives could be abandoned if they are unlikely to be achievable given climate impacts. Resources could be sold if they are unlikely to provide sufficient benefits in a changing climate. Retreating is potentially the most extreme action and it

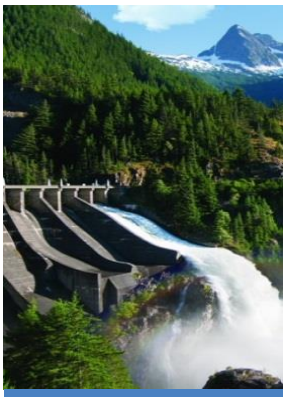
is typically considered as a long-term solution, in response to an extreme event, or if other actions are unlikely to sufficiently reduce vulnerability. Retreating can be less politically or socially acceptable, so it may be feasible only in extreme cases. An example of a retreat action by electric utilities is to sell coastal property and move infrastructure out of flood plains in areas with high exposure to sea level rise.

Key Findings: Impacts and Adaptation Actions

Below is a brief description of the impacts on hydroelectric project operations and the transmission and distribution system.

Hydroelectric Project Operations

Seattle City Light's power resources are 90 percent hydropower, 50 percent of which is supplied by five hydroelectric projects owned and operated by the utility. The remaining hydropower is purchased from Bonneville Power Administration's Columbia River hydropower system. In addition to hydropower, City Light operates hydroelectric projects for flood control, instream flows for fish, reservoir recreation, and coordinates the operation of two projects with Seattle Public Utilities for municipal water supply. All these objectives are dependent on snowpack and the seasonal timing of streamflow. The Boundary and Skagit Projects (49 percent of power resources) and the BPA hydropower resources (40 percent) are located in high-elevation, snow-dominated watersheds for which impacts will be slower to emerge but significant by mid-century. The Cedar Falls and South Fork Tolt Projects (1.5 percent) are located in mid-elevation, mixed-rain-and-snow watersheds that will be more exposed to changes in snowpack and streamflow timing in the near-term.



Hydroelectric Project Operations

Summary of Impacts

- Less snowpack and earlier snowmelt will affect seasonal operations of hydroelectric projects that are based on historical conditions of water storage in snowpack and snowmelt timing in spring.
- Higher peak flows could increase the frequency of spilling at hydroelectric projects in fall and winter for flood control, which can have financial consequences associated with lost revenue.

  Higher peak flows also challenge operations to protect fish, because more frequent spilling directly causes fish mortality and higher flows scour fish eggs and damage fish habitat downstream of the projects.

- Lower streamflow in summer will decrease water availability for reservoir recreation, instream flows for fish protection, and hydropower generation, leading to financial consequences for the utility associated with lost revenue from surplus sales and more wholesale purchases to meet summer demand.

Potential Adaptation Actions

- Update and expand the utility's analyses of how operations of the Skagit and Boundary Projects could be adapted to reduce impacts associated with less snowpack, changes in the seasonal timing of streamflow, lower streamflow in summer, and higher peak flows in fall and winter.
- Collaborate with stakeholders to address climate change impacts during relicensing.

- Consider further diversification of Seattle City Light's power resources by increasing non-hydro renewable energy sources that have a seasonal pattern of generation complementary to expected changes in seasonal hydropower generation.

Transmission and Distribution

Transmission and Distribution

Seattle City Light owns and operates a transmission system consisting of over 650 miles of transmission lines and towers connected to the utility's five hydroelectric generation facilities. The utility also owns and operates a distribution system in the Seattle area consisting of 14 distribution substations, 2,337 distribution circuit miles (1,763 overhead and 574 underground circuit miles), and a downtown network system of 220 underground circuit miles. Many miles of transmission lines pass through rural, forested areas in Western Washington with steep, rugged topography. Transmission to and from City Light's distribution system also depends on the western regional transmission system, particularly for transmission from the Boundary hydroelectric project in northeast Washington and wholesale market purchases and sales.

Summary of Impacts

- More frequent tidal flooding and salt water corrosion of distribution equipment could reduce the life expectancy of equipment, increasing costs for maintenance, repair, and replacement.
- Slower outage restoration times due to more intense precipitation and more frequent major storms, particularly when inadequate drainage creates areas of standing water that prevent safe access to repair storm-related outages.
- Increased risk of wildfires causing increase damage to transmission lines and interruptions of transmission and generation at hydroelectric facilities.
- Increased risk of landslides damaging transmission towers and access roads
- Increased risk of river flooding in Western Washington damaging transmission towers, erosion near towers, and damage to access roads.

Potential Adaptation Actions

- Monitor and consider replacing equipment in the transmission and distribution system that is more sensitive to corrosion by salt water in areas that are projected to experience more frequent tidal flooding or will be inundated by sea water within the life expectancy of the equipment.
- Expand the use of the Outage Management System (OMS) to quantify trends in the impacts of extreme weather on outages by specifically documenting additional weather-related causes of outages. This information can be used in cost-benefit analysis of infrastructure upgrades to increase resilience to extreme weather.
- Raise awareness of increasing wildfire risk among staff and increase the capacity of employees to prepare for and respond to this risk through additional wildfire training, upgrading infrastructure with fire-resistant materials, and maintaining defensible space around critical infrastructure.
- Collaborate with adjacent land owners to reduce vegetation fuels and wildfire hazard along the transmission lines and near critical infrastructure at the hydroelectric projects.
- Collaborate with state resource management agencies and academic institutions to map landslide risk along City Light's transmission line rights-of-way.

- Upgrade current transmission infrastructure to be resilient to higher peak flows and flood hazard in locations that currently experience flood-related damage. Consider projected increases in flooding in the design of new transmission projects located in or near historical floodplains.

Case Studies on Climate Impacts

Oso Mud Slide – March 22, 2014

The 300-acre landslide in Oso, Washington, that killed 30 people and destroyed a local community, occurred during a March that was the wettest in history, a condition likely exacerbated by climate change and the geology of the area (soft soils and logging). The slide which occurred to the north of Seattle City Light's transmission line from its Skagit Hydropower Project caused minor damage to one tower and came within feet of causing significant damage to our transmission line (see attached map).

The Oso slide is an example of some of the impacts that we are concerned about with climate change. As the frequency and intensity of heavy precipitation increases, these loose, sedimentary soils are more likely to slide. If the Oso slide had happened on the south side of the valley, our transmission lines would have been destroyed for about a mile at minimum and potentially more. In anticipation of this becoming an increasing risk, City Light has applied twice for a Federal Emergency Management Act grant to retrofit six "dead-end" towers in this area to limit the amount of damage that could occur from a similar, or smaller, slide. We have been unsuccessful to date but look forward to more engagement from federal agencies on the importance of climate resiliency mitigation regarding critical infrastructure.

While the proximity of Seattle City Light's transmission line constituted a significant risk to the utility, it also provided an opportunity for the electric utility to be of major assistance to the community when the main arterial, Washington State Route 530 between the cities of Darrington and Arlington was destroyed in the slide. A single-lane gravel road known as the Seattle City Light Access Road was able to be used to bypass the section of State Route 530 blocked by the landslide. This saved the local community, including emergency vehicles, logging trucks and busses transporting students, hours of commuting and hundreds of additional miles on the odometer

Photo: Oso Mudslide Extent – 2014

until the Route 530 was reconstructed in October.

Goodell Creek Fire – August 2015

Multiple wildfires began on June 28, 2015, in Washington State. For the first time in Washington State history, officials asked residents to volunteer to assist in fighting the wildfires. By early September as many as 3,000 firefighters were deployed against fires that had burned over 900,000 acres of land and President Barack Obama declared the fires a federal emergency.

Photo: A steel tower of Seattle City Light's Skagit transmission line and debris deposited by the landslide near Oso, Washington in March 2014. The debris caused minor damage to a tower.

Photo: Goodell fire near Newhalem, WA, August 2015

The Goodell Creek fire started on August 10, 2015 and spread to the woods near the Skagit Hydroelectric project a few days later. Seattle City Light operates three dams and powerhouses at the Ross, Diablo and Gorge reservoirs in this area. These facilities produce about 20 percent of the power consumed by our customers and are served by transmission lines owned by Seattle City Light. The fire changed direction suddenly and burned under the lines; debris from the fire caused the lines to start arcing, forcing the utility to shut down the transmission lines that carry electricity from the hydroelectric project. Spillgates at all three dams were opened to maintain river flows to protect fish. With 15 minutes of warning, City Light needed to replace 20% of the power needed to serve load. The inability to deliver electricity from the Skagit cost the utility about $100,000 per day. The company town of Diablo was evacuated and Newhalem reduced to only essential personnel. City Light firefighters worked to protect our assets – the powerhouses and residences and other structures in Newhalem. While no structures were lost at Newhalem, a fiber optic cable and several wood poles and the penstock for one small project were destroyed. Total cost to the utility was estimated at $5.3 million.

Wildland fire risk was one the utility's climate scientist had identified well before the Goodell Creek fire last August. More, and longer lasting, fires have been occurring on the west side of the Cascades over the past few years. Seattle City has already

completed "Firewise" projects to protect buildings, and while the fire worked its way to one of the projects, it stopped before damaging the nearby buildings. The utility is also applying for mitigation funds with FEMA as part of the repairs following Goodell Creek to replace the existing heavy timber saddles, or supports, for the Newhalem power plant penstock with concrete saddles. The fire damaged five of the saddles and took the penstock out-of-service over the winter until the replacements could be installed. In addition, City Light plans to train its firefighters in wildfire fighting.

Photo: Goodell fire near Newhalem, WA, August 2015

In addition to the physical threat to the infrastructure at our Skagit Hydropower Project, during the course of the Goodell fire the week of August 17th, 2015 when we had to cease generation operations at Skagit, and de-energize the power houses and main transmission lines, the utility's Balancing Area Authority (BA) requirement had to be moved to the Boundary project, with a single unit partially loaded to allow for regulation (varying generation up or down to match the variations in our customers' loads). Unfortunately, Boundary has only very limited storage as a "run of river" project. As a result of this, the water available at Boundary was limited and we projected we would run out of water at Boundary and be at risk of placing the System Operations Center in a position of having to declare a capacity emergency with Peak Reliability due to the lack of ability to reliably carry reserves on behalf of our BA. However, staff anticipated this and successfully obtained water from parties upstream of Boundary to allow us to re-fill the reservoir and continue to successfully carry needed reserves at Boundary. This is an excellent example of utilities providing assistance to another utility in an emergency situation. Early next week City Light was able to re-energize the Skagit project and move our reserves back over to Skagit and resolve the matter.

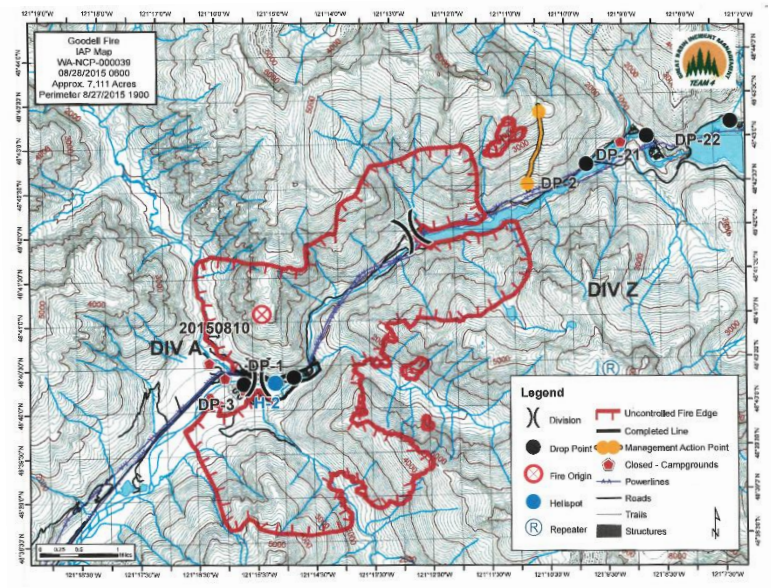


Photo: Goodell Creek Fire Map – 2015

Cyber Security Risk Management

In addition to Climate Adaptation planning, City Light implemented programs to address cyber security and critical infrastructure protection. In partnership with Seattle IT, City Light has instituted processes, training, and controls to protect against cyber threats and maintain reliable operations. Steps taken by City Light include hardening of critical City Light networks and systems; isolating command and control systems from the Internet or hardening security protocols where isolation is not feasible; network surveillance; and controlling access to systems and facilities. City Light is in compliance with the federal cyber security standards mandated by the North American Electric Reliability Corporation, NERC.

Finally, City Light regularly monitors cyber threats and conducts voluntary cyber security assessments with the intent to identify areas for continual improvement. These findings are integrated into a work program that forms the basis of its cyber security program.