Nuclear Power in the Pacific Northwest

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The Pacific Northwest is endowed with an abundant supply of natural flowing water. The mighty Columbia River cascades through the region, generating thousands of megawatts of power on its way to the Pacific Ocean. Hydropower generated in the Pacific NW serves the majority of power needs in the region. However, North West power planners realized in the late 1950's that hydropower would simply not be able to match the demand from increasing population growth. After much consideration it was decided that nuclear power was going to be the pathway to supplying more electricity. Both private and public utilities, along with the federal government, signed on to build 10 nuclear power plants in the region. Most of these ambitious proposals never came to fruition. All that is left of this legacy is the Columbia Generating Station.

Introduction

The Columbia Generating Station (CGS) sits on the Hanford Reservation, where nuclear fuel was processed for the Manhattan project back in the 1940's. This site, located right next to the Columbia River about 20 miles NE of Richland WA, has been home to a variety of nuclear reactors for many decades. CGS was originally one of five proposed reactors to be built around the region and owned and by Washington Public Power Supply System (WPPSS). WPPSS would later be rebranded as Energy Northwest in the 1990s. Construction began on all five proposed plants between 1975 & 1981. By the mid 1980's costs had soared well beyond initial estimates and the only plant to be finished was CGS. Scars on the land from all the abandoned construction still loom today, like two 500 foot tall cooling towers never once used in Grays Harbor County. CGS finally came online in 1984, 7 years late and $2 billion over budget.

The Last Reactor Standing

CGS is the only nuclear power plant left operating in the Pacific NW. The only other nuclear plant to operate in the region was the Trojan plant in Rainer Oregon, which was shut down back in 1993. CGS is a boiling water reactor; nuclear fission generates heat in the core of the reactor which boils water to generate steam. The steam generated in the core of the reactor is directly used to power a steam turbine. CGS is equipped with a 1.15 GW steam turbine, enough to power around 1 million homes. GCS produces uninterrupted base load power, except for refueling which occurs every 18-24 months. CGS renewed its operating license with the Nuclear Regulatory Commission (NRC) in 2012, which extended its operating life to 2043.

A Mismanaged Legacy

Bonneville Power Administration (BPA) buys 100% of the power from CGS. BPA is a federally regulated energy agency which

provides power to over 13 million people, employs around 3000 people, and brings in over $3 billion in revenue each year. On an annual basis, CGS provides 10% of the electricity distributed by BPA. The costs of buying power and paying for all the operations of BPA is funded by rates set by a regulatory process. Rate of return regulation allows for BPA to pass down all of its costs to consumers through the various rate schedules for residential, commercial, & industrial customers. BPA is basically guaranteed to make enough money each year to fund all of its operations, including CGS.

BPA had agreed to buy power from the numerous nuclear plants proposed back in the late 1970's. The legacy of debt from all the abandoned construction still haunts BPA and their rate payers today. Since BPA had agreed to purchase power from these plants, they got stuck with paying off the debt. There is still nearly $6 billion in outstanding debts left from those ambitious days (Jaquiss, 2013). Debt is only one of many factors contributing to a higher than average cost of power for CGS. The plant employs more personal per unit of energy than many other nuclear power plants, mismanagement plagues the communication between Energy Northwest and BPA, and the plant is ageing which has led to higher maintenance costs and increased shut down time. These factors contributed to a price of $39.84 per MWh for fiscal year 2014 (McCullough, 2013). This is compared to the average cost of power for similar nuclear power plants at $22.66/MWh.

This information came to light in an economic analysis of CGS by McCullough Research (2013). The Physicians for Social Responsibility, a national group which campaigns for solutions to climate change, reached out to Robert McCullough to examine the underlying economics of CGS. McCullough was initially reluctant to help out, but the unusually high costs of CGS peaked his interest. McCullough Research found that rate payers spent $418 million in 2012 for power from CGS, where that same amount of power could have been purchased for $218 million. Energy Northwest has even recognized the unusually high cost of power generation at CGS, admitting that natural gas is a cheaper alternative.

No More Nukes

The results of the McCullough report provide compelling economic rationale for shutting down CGS. However, economics are not the only reason people fight for the closure of CGS. Multiple groups, including Heart of America NW, Washington Physicians for Social Responsibility, and Nuclear-Free Northwest are campaigning for the closure of CGS because of a variety of safety concerns. The reactor as CGS is of similar design to the reactors at the Fukushima plant. This is generally voiced as one of the main safety concerns along with spent fuel storage and inadequate handling of nuclear waste. A recent study has found that initial estimate for potential seismic activities near the Hanford site were seriously flawed. The new evidence shows that the region could experience earthquakes 2-3 times as powerful as CGS was designed for (Doughton, 2013). This is a primary concern for anti-CGS activists.

Spent fuel is another large concern with CGS and the nuclear industry in general. When fuel rods are removed from the reactor after being in there for a number of years, they sit in a cooling pond for at least 5 years. After the radioactivity of the spent fuel has come down to

a certain level, it may then be permanently stored in what is called a dry casks. The cooling ponds at CGS were intended to offer temporary storage until the Department of Energy fulfilled their legal obligation to store all spent fuel at a national nuclear waste repository. The plans for a national repository have been delayed since the choice of Yucca Mountain became increasingly controversial. In 2001 Energy Northwest began the construction of an independent spent fuel storage installation. The spent fuel generated at CGS would be stored indefinitely in dry caskets. The total number of dry casks at CGS is now at 27. The casks are designed to handle the most extreme of conditions including earthquakes, tornadoes, hurricanes, floods, and potential sabotage. Natural cooling methods are built into the casks so that they are entirely independent. These casks are monitored regularly for malfunctions or defects. Energy Northwest has spent over $57 million on their independent spent fuel storage installation.

The Future of Nuclear in the Pacific NW

Despite there only being one reactor operating in the Pacific NW and large support for its closure, there is significant interest in development of a future nuclear industry in the region. In June of 2013 a new program was announced that would develop Small Modular Reactor (SMR) technology in the Pacific NW. The Western Initiative for Nuclear (Program WIN) has garnered support from Energy Northwest and the Utah Association of Municipal Power Systems (UAMPS). Program WIN was spearheaded by NuScale Power, one of a few companies leading the way in SMR technology. Based out of Portland Oregon, NuScale has ambition plans of implementing SMR's in and around the region and setting precedent for the world.

The pilot project for program WIN would build a SMR designed by NuScale power in Idaho. This initial project is known as the Carbon Free Power Project and the applications for construction permits and operation licenses will be submitted to the Nuclear Regulatory Commission (NRC) in 2017 (NuScale, 2015). The SMR designed by NuScale is a fully integrated reactor that is built in a factory and transported to the operation site, unlike existing reactors today which are all individually designed and built. NuScale's SMR would provide 50MW from a reactor vessel which is 76 ft tall and 15 ft wide. The vessel could be transported by train, tuck, or barge. The reactor operates on some of the same principles of existing reactors, but integrates new redundant safety features. For example, the water circulates through the reactor without any pumps so that in the case of a power loss the water will continue to cool the reactor core.

Program WIN has long term plans of installing multiple SMR's around the region, including Washington. Energy Northwest has teamed up with NuScale Power in the hopes of utilizing SMR technology in the future, potentially at the Hanford site. The downfall of SMR technology being developed today is the fact that it generates as much waste per unit of power as traditional reactors. If SMR technology is to become a part of the energy transition, solutions must be developed for dealing with the spent fuel. The United States will have to start considering reprocessing of spent fuel, which would help to reduce the volume of nuclear waste. Much of the spent fuel sitting in the cooling ponds and dry caskets could one day be reprocessed into a mixed oxide

fuel which can be used once again as fuel for future reactors. The barriers to doing this are social, political, economic, and technological, but the amount of usable energy stored within what we refer to as ‘nuclear waste’ is quite substantial.

Conclusion

If CGS operates until its current license expires, nuclear power is slated to be a piece of the energy system in Washington until 2043. NuScale Power and Energy Northwest are trying to increase the presence of nuclear power in the region by developing SMR technology. The successful development of this technology would likely keep nuclear around beyond 2043. However, there is large opposition to the operation of CGS and the future development of nuclear power in the region. Many groups have started campaigns to shut down CGS and freeze all development of SMR technology. Nuclear power provides a baseload source of carbon free power generation, but poses issues around the spent fuel and overall safety concerns. Nuclear power has the potential to be an integral piece of the energy transition, but the issues concerning safety and spent fuel must be addressed.

References

Doughton, Sandy (2013). *Hanford nuke plant's earthquake risk underestimated, group says*. Seattle Times.

Energy Northwest (2011). *Used Nuclear Fuel Storage*. Retrieved from http://www.energy-northwest.com/ourenergyprojects/Columbia/Pages/Used-Fuel.aspx

Jaquiss, Nigel (2013). *Costly To The Core, How the nuclear plant no one knows about is wasting your money*. Willamette Weekly.

Lyman, Edwin (2014). *The Future of Nuclear Power in the Northwest 3.5 Years After Fukushima*. Nuclear-Free Northwest. Retrieved from http://nuclearfreenw.org/design.htm

McCullough, Robert (2013). *Economic Analysis of the Columbia Generating Station*. McCullough Research.

NuScale Power (2015). *How NuScale Technology Works.* Retrieved from http://www.nuscalepower.com/our-technology/technology-overview

NuScale Power (2015*). NuScale Power Begins Nuclear Initiative with Governors and Utilities in Western U.S. States*. Retrieved from http://www.nuscalepower.com/our-technology/technology-validation/program-win

Physicians for Social Responsibility (2013). *Columbia Generating Station Nuclear Reactor's Earthquake Risks are Underestimated, Physicians Call for Shutdown*. Retrieved from http://www.psr.org/chapters/oregon/news/homepage-features/columbia-generating-station.html?referrer=http://www.psr.org/chapters/washington/safety-issues-surrounding-cgs.html

United States Nuclear Regulatory Commission (2015). *Columbia Generating Station*. Retrieved from http://www.nrc.gov/info-finder/reactor/wash2.html

World Nuclear Association (2015). *Radioactive Waste Management*. Retrieved from http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Nuclear-Wastes/Radioactive-Waste-Management/