Pacific Northwest
NATIONAL LABORATORY

PNNL-33678

Large-scale Hydrogen Storage – Risk Assessment Seattle City Light and Port of Seattle (Abstract)

CRADA 554 (PNNL 79121/79430/79429)

November 2022

Arun Veeramany

Sandia National Laboratory
Seattle City Light
Port of Seattle

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service
5301 Shawnee Rd., Alexandria, VA 22312
ph: (800) 553-NTIS (6847)
email: orders@ntis.gov <https://www.ntis.gov/about>
Online ordering: http://www.ntis.gov

PNNL-33678

Large-scale Hydrogen Storage – Risk Assessment Seattle City Light and Port of Seattle (Abstract)

CRADA 554 (PNNL 79121/79430/79429)

Abstract

November 2022

Arun Veeramany

Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99354

Abstract

This CRADA presents the strategy that Pacific Northwest National Laboratory (PNNL) and Sandia National Laboratories (SNL) will take to support Seattle City Light (SCL), and the Port of Seattle (Port) in performing a risk assessment of large-scale hydrogen storage. Risk assessment is often used to ensure that adequate measures are taken to protect workers and the public, the environment, infrastructure, and assets. A detailed risk assessment can also be used to direct funding and upgrades, to specific components and sub-systems in order to mitigate risks to the larger system. In this way risk assessments are often employed as a part of a larger risk management strategy, with the goal of minimizing the occurrence of hazards and to identify means to limit their consequences.

Risk assessment is often used to engage and inform regulators, and to communicate how specific regulations are being met. However, it is important to note that the proposed work is not intended for SCL and the Port to use in order to gain regulatory acceptance for their proposed activities. The work performed as a part of this effort will be a preliminary risk assessment for early-stage component and system designs and should be considered research and development (R&D). As such, the proposed work will be performed to a quality level and design maturity consistent with R&D and is not considered appropriate for final safety analysis and regulatory compliance purposes.

Previous and on-going work at SCL and the Port demonstrated the utility of deploying hydrogen systems at the Port. The deployment of hydrogen at the Port is a part of a larger vision of using hydrogen to address a range of issues for SCL and the Port. These include large-scale fueling of MD/HD vehicles, cargo-handling equipment (CHE), and harbor vessels to reduce emissions; support of adjacent LD vehicles; support of critical port operations during extreme events (i.e., resiliency); deferral of more capital- and time-intensive electrical distribution system upgrades while still supporting evolving port operations and decarbonization efforts; facilitating electrification by establishing energy storage as a grid resource, starting at strategic port locations; creation of a flexible market resource that can be used by SCL to generate revenue via arbitrage; support of planned future maritime operations that involve heavy use of hydrogen for ocean-going vessels; and future end-use applications involving natural gas pipeline hydrogen injection. Ultimately, the success of these activities is underpinned by the deployed storage capacity. Large-scale deployment of hydrogen systems will require hydrogen storage at a scale that has not been demonstrated. In addition, the ideal location for such multi-use systems is near the end user which will often necessitate deploying into urban and/or industrial areas.

A detailed risk assessment using the Port as a test case is necessary to ensure the deployment of large-scale hydrogen is successful. Many technologies have been proposed for hydrogen storage; however, these technologies need to be analyzed as they apply to an actual site. The physical infrastructure and hydrogen use cases for the Port will be analyzed, and a risk assessment for compressed hydrogen, liquified hydrogen, and Liquid Organic Hydrogen Carrier (LOHC) storage will be performed. These risk assessments will be useful for understanding how each of these technologies would perform in terms of facility and public safety. The operating states of the proposed hydrogen systems at the Port will be analyzed and incorporated into the storage risk assessment. Scalability will also be analyzed to understand how future port uses would affect the overall risk assessment. Finally, using the risk assessment as a tool to inform engagement and to gain stakeholder acceptance will be explored.

Pacific Northwest National Laboratory

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99354
1-888-375-PNNL (7665)

www.pnnl.gov