Benefits of Siting a Borehole Repository at a Non-Operating Nuclear Facility

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INTRODUCTION

This work evaluates a potential solution for two pressing matters in the viability of nuclear energy: spent fuel disposal and power plants that no longer operate. The potential benefits of siting a borehole repository at a shut down nuclear power plant facility are analyzed from the perspective of myriad stakeholders. Preliminary results indicate that integrated siting will make economic use of the shut down power plant, take advantage of spent fuel handling infrastructure at those sites, help to empty the crowded spent fuel storage pools at nearby reactors, and will do so at sites more likely to have consenting communities.

Motivation

The proposed integrated siting strategy takes advantage of three technical benefits of borehole repository designs: modularity, broad geologic suitability, and footprint efficiency. Modularity enables regional repositories to scale in size according to the local spent fuel burden. Additionally, the necessary geological characteristics required for borehole disposal, crystalline basement rocks at $2,000m - 5,000m$ deep, are relatively common in stable continental regions [1]. Finally, the surface footprint requirements of a borehole repository are comparable to the available footprint of a nuclear power reactor site, with only $30km^2$ required for the total spent nuclear fuel (SNF) amount proposed for Yucca Mountain [2].

Integrated siting also has potential economic benefits. One significant cost inherent to borehole repository concepts is the repacking of spent fuel assemblies into smaller-diameter waste canisters. However, siting a repository at a non-operating power plant facility, especially one with a dry-cask storage site, will take advantage of already existing infrastructure and local human talent for spent fuel handling and packaging. Many candidate non-operating reactor sites, such as those mapped in Figure 1 may be appropriate for integrated siting if they are located above crystalline basement formations and include dry cask packaging facilities.

Preliminary work [4] indicates integrated siting is appealing to many stakeholder groups. For example, a consent-based approval process may be feasible since communities local to power plants may be uniquely receptive to the incentives of hosting a repository.

METHODOLOGY

This work will evaluate the potential impacts of integrated siting from the perspective of 5 stakeholders:

- the federal government,
- the state government,
- the local government,
- the local community,
- and the owner of the non-operating plant.

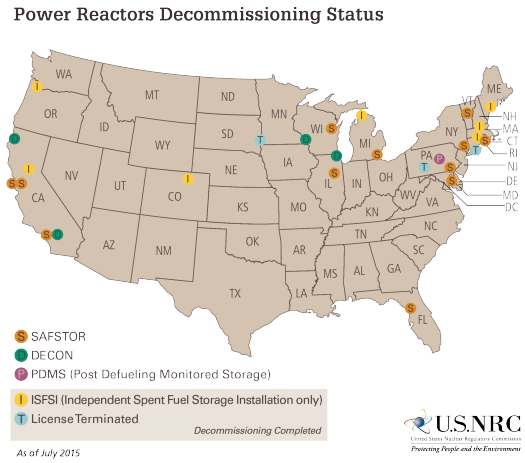

Fig. 1. Non-operating facilities status[3].

Preliminary work [4] suggests that integrated siting will reduce costs, construction, time (both for construction and licensing), transportation distances, and resistence from the local community. The present work will compare the proposal along these axes to a base case: a standalone borehole repository at a similar location to that of Yucca Mountain. Quantification of those stakeholder benefits will be undertaken for two different regions of the US in addition to the base case.

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REFERENCES

1. B. W. ARNOLD, P. VAUGHN, R. MACKINNON, J. TILLMAN, D. NIELSON, P. BRADY, W. HALSEY, and S. ALTMAN, "Research, Development, and Demonstration Roadmap for Deep Borehole Disposal," *SAND2012-8527P. Albuquerque, NM: Sandia National Laboratories* (2012).

2. P. V. BRADY, B. W. ARNOLD, G. A. FREEZE, P. N. SWIFT, S. J. BAUER, J. L. KANNEY, R. P. RECHARD, and J. S. STEIN, "Deep borehole disposal of high-level radioactive waste," *SAND2009-4401, Sandia National Laboratories* (2009).
3. NUCLEAR REGULATORY COMMISSION, "NRC Maps of Decommissioning Sites," (Jul. 2015).
4. A. WALEED, J. W. BAE, R. BALDER, K. BEAR, M. BENEDICT, B. BLECHA, S. BOBBINS, J. BOWMAN, N. BRIDGE, G. CHAPPELL, D. CHUN, K. DÂĂŹSOUZA, M. DOST, E. GILLUM, G. GUSLOFF, B. HE, J. HELCK, H. HERNADEZ, S. JENSEN, J. JOSEPH, P. LOUIE, A. LOUMIS, J. LU, J. LUCAS-LUKOSE, B. MEDINA, J. MITCHELL, T. MURASE, D. OÂĂŹGRADY, P. OTA, J. PACHICANO, P. GUSTAVO, P. POLAK, D. QERIMI, E. RASH, J. RICCIO, E. RIEWSKI, L. ROBY, X. SANG, S. NIRALI, K. SMITH, R. SPREADBURY, A. SPRING, D. STRAT, R. TRIVEDI, J. WEBERSKI, T. WILLIAMS, and C. ZIRCHER, *Regional Deep Borehole Nuclear Fuel Repository: Requirements for a Site License Application*, [DRAFT], University of Illinois at Urbana-Champaign (May 2015).