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Highlights: Siting Considerations for Co-Locating Nuclear Power Plants with Industrial Facilities

December 2023

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Idaho National Laboratory

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Idaho National Laboratory
Idaho Falls, Idaho 83415

http://www.inl.gov

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Integrated Energy Systems

Siting Considerations for Co-Locating Nuclear Power Plants with Industrial Facilities

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Report highlights

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Purpose of the study

Context

- Decarbonizing industrial facilities with clean nuclear heat, steam, and hydrogen will require nuclear power plants (NPPs) to be sited on or near an industrial site.
- To license and operate a colocated NPP, traditional siting procedures must be followed, but additional considerations apply to safely operate both facilities.

Objectives and impact

- Determine how the current regulatory structure will impact colocation.
- Describe the advantages and challenges to using advanced reactors for industrial applications.
- Investigate current research on siting, safety, and regulatory considerations for colocation.
- Results will be used to assess technical feasibility of colocation and cost estimation.

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Methodology

- Literature review
  - Regulatory documents and recommendations from Nuclear Regulatory Commission (NRC), Electric Power Research Institute (EPRI), TerraPower, Idaho National Laboratory (INL), etc.
  - Colocation and integration research studies from Sargent & Lundy, INL, International Atomic Energy Agency, other research centers and universities, etc.
- Specific Siting Study
  - Demonstrate the siting process for collocating a nuclear reactor with hydrogen production from high temperature steam electrolysis (HTSE)
  - Employ the STAND* tool to explore and measure site attributes for colocation feasibility.

*STAND: web-based geographic information system (GIS) tool that provides a systematic way for siting nuclear power plants based on user preferences and priorities. It was developed by Idaho National Laboratory, the University of Michigan, Oak Ridge National Laboratory and Argonne National Laboratory.

Main results and conclusions

- Colocation of NPPs with industrial applications (specifically hydrogen, pulp and paper) is technically feasible but will require additional considerations for regulatory, security, safety, and operational aspects.
- There is historical precedence for the benefits and use of steam extraction from NPPs for process and district heating.
  - The Gösgen NPP in Switzerland provides steam to two nearby paper mills to replace fossil fuel boilers. Using NPPs for district heating and electricity are overall more efficient and cheaper than operating for heat or electricity only.
- In the case of existing light water reactors, adding heat extraction for process use is not expected to impact safety or licensure of the plant.
- NRC Part 52 licensure supports the regulatory separation of the NPP and the industrial application to make operating the collocated plants possible.
- The improved safety benefits of advanced reactor designs make them suitable for colocation with industrial applications

Next Steps

- Complete a preliminary siting analysis using STAND and EPRI Siting Guide* for an existing methanol plant, pulp and paper plant, and petroleum refinery.
- Determine hazards from the industrial plant that could affect the NPP and vice versa.
- Determine appropriate stand-off distances for NPPs in relation to the industrial site.

*For applicants seeking to deploy new nuclear power facilities, the EPRI Siting Guide provides the methodology and framework for developing a detailed, specific process for new plant site selection that can withstand regulatory review.