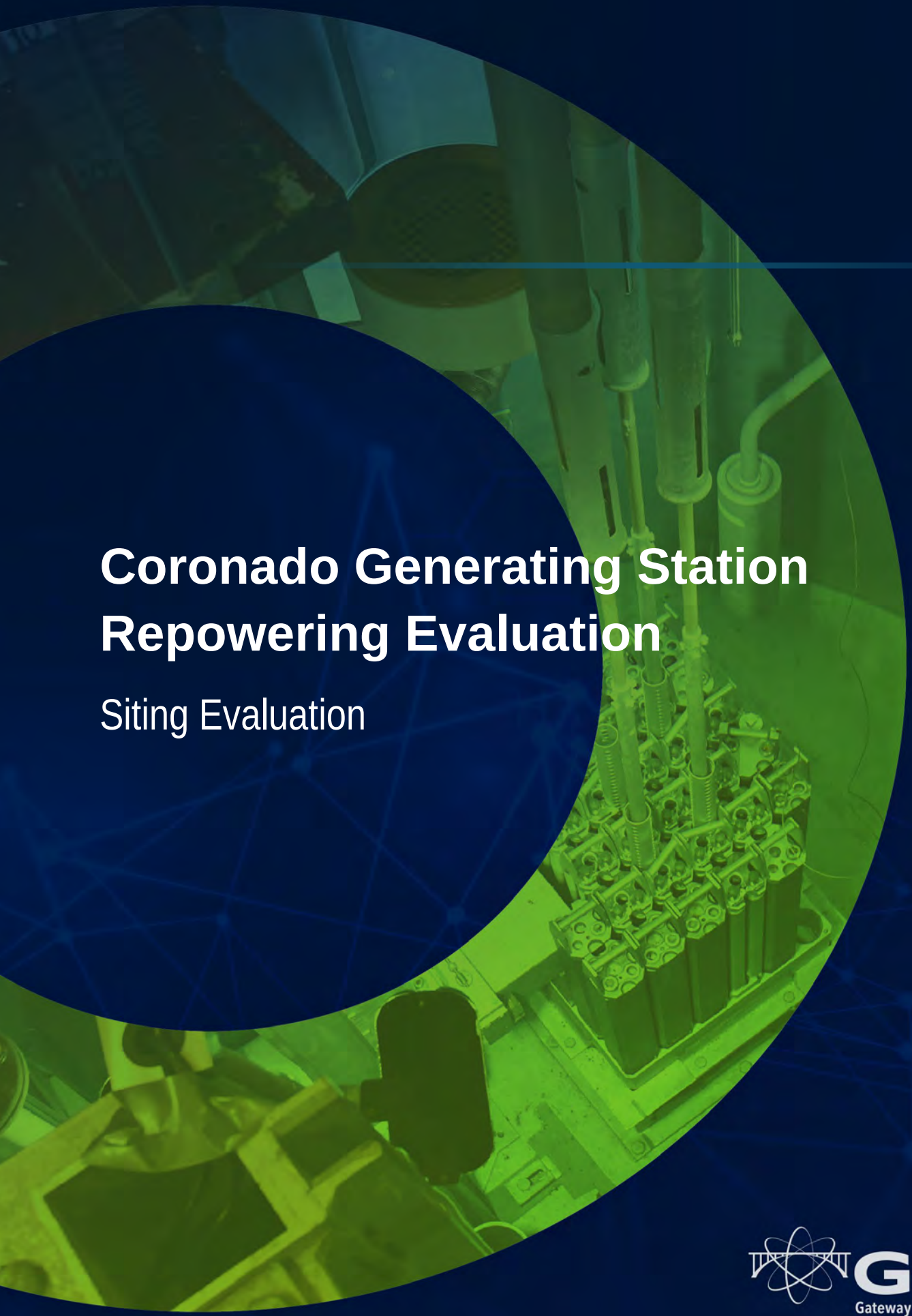
INL/RPT-23-72654
Revision 0



Coronado Generating Station Repowering Evaluation

Siting Evaluation

GAIN
Gateway for Accelerated Innovation in Nuclear

Coronado Generating Station Repowering Evaluation

Siting Evaluation

Prepared from MPR Report No. 1129-0307-RPT-001 Revision 0

Prepared by:

Douglas Hardtmayer, MPR Associates, Inc. (MPR)
Amanda Stewart, MPR Associates, Inc. (MPR)
Sophie MacDonald, MPR Associates, Inc. (MPR)
Anson Tran, MPR Associates, Inc. (MPR)
Robert Coward, MPR Associates, Inc. (MPR)
George Griffith, Idaho National Lab (INL)
Christine King, Gateway for Accelerated Innovation in Nuclear (GAIN)
Emily Nichols, Gateway for Accelerated Innovation in Nuclear (GAIN)

CONTENTS

Coronado Generating Station Repowering Evaluation Siting Evaluation

EXECUTIVE SUMMARY

Siting any energy project can involve factors specific to the technology. In the case of repowering/repurposing, the evaluation benefits from what is already known and can compare that information to criteria necessary for the new technology. An initial siting evaluation, focused on criteria specific to siting a nuclear generating station, was conducted for the Coronado Generating Station (CGS) site and surrounding Salt River Project Agricultural Improvement and Power District (SRP) owned land. CGS is in Apache County, Arizona, near the town of Saint Johns. This initial siting evaluation used both publicly available information and information from SRP. Information gathered was reviewed leveraging industry recognized siting criteria and applicable regulatory guidance.

While the formal siting process for a nuclear reactor requires a great level of time (i.e., multi-year), effort, and detail, the purpose of this initial siting evaluation was to assess if the CGS site has characteristics that could preclude nuclear or present challenges leading to increased cost and/or risk. These characteristics are referred to as exclusionary and avoidance factors, respectively.

No exclusionary or avoidance factors were identified at CGS. However, there are several siting characteristics that require additional investigation by SRP if nuclear siting is to be pursued at CGS. Key siting characteristics to consider include:

1. **Water Availability**: Given the scarcity of water in the southwestern region of the United States and SRP's water reduction goals, special consideration to different cooling options, including air-cooled cooling, is recommended at CGS. SRP should evaluate water consumption needs/limits and impacts of different cooling options on overall plant efficiency before selecting a cooling option.
2. **Ecological Impacts on Endangered or Threatened Species**: Arizona is home to over 72 endangered, threatened or candidate species. CGS is not currently situated on land reserved for endangered or threatened species. SRP coordinates with state and federal agencies to track species distributions and recovery efforts across Arizona, and currently monitors and comments on proposals by the U.S. Fish and Wildlife Service to list species as threatened or endangered or designate critical habitats. SRP should continue to track federal listing proposals and work to minimize regulatory impacts to current operations or future generation options at CGS.

3. **Adjacency to Native Lands and Local Communities**: CGS is sited on privately owned land but is situated in the same county as the Zuni Reservation and Navajo Nation. SRP has and should continue to engage with local tribal and community leaders on decisions related to future generation options at CGS. Stakeholder engagement is an essential part of nuclear generating station site selection, project planning, and execution. Local communities, including nearby native populations, should be engaged early and often to provide input and influence decisions.

Based on the findings from this initial siting evaluation, SRP may want to continue to consider nuclear as a viable replacement technology at CGS. If SRP pursues the next steps and assesses replacement technologies, SRP should continue to engage with local stakeholders and focus on developing a site layout and deployment timetable for nuclear deployment or alternative CGS uses. This includes identifying reusable infrastructure, determining the effect of construction on CGS operations, and assessing environmental liabilities. Additional insights regarding nuclear technologies were provided to SRP in a complementary GAIN report focused on identifying candidate nuclear technologies for the CGS site that align with SRP's mission and business objectives. GAIN's approach and insights applicable to other coal sites and utilities will be shared in a public report.

PURPOSE AND BACKGROUND

Purpose

The purpose of this initial siting evaluation is to consider the suitability of the Salt River Project (SRP) owned land at/near Coronado Generating Station (CGS) for a nuclear generating station (including advanced light water reactors, light water small modular reactors, and non-light-water designs[1]) and to assess if there are any exclusionary or avoidance factors associated with coal to nuclear repowering at CGS.

This initial siting evaluation considers several characteristics (e.g., environmental conditions, seismic concerns, site footprint, water use, etc.) and highlights favorable/preferred characteristics as well as potential risks to feasibility. The results are intended to inform SRP on the strengths and weaknesses associated with the CGS site and inform the selection of candidate nuclear technologies for the CGS site that align with SRP's mission and business objectives.

This report relies on industry-recognized siting guidance, including Electric Power Research Institute's (EPRI's) Siting Guide (Reference 1) [2] and Nuclear Regulatory Commission's (NRC's) Regulatory Guide (RG) 4.7 (Reference 3), as well as nuclear domain expertise within the Gateway for Accelerated Innovation in Nuclear (GAIN), MPR Associates, Inc. (MPR), and the Idaho National Laboratory (INL).

[1] Nuclear Innovation Alliance's Advanced Nuclear Reactor Technology Primer (Reference 25) provides a high-level overview of advanced reactors.

[2] EPRI's Siting Guide (Reference 1) includes consideration of advanced reactors beyond light water small modular reactors and gigawatt scale light water reactors, new reactor missions beyond baseload electricity, and the potential of reuse of existing sties and facilities (e.g., coal plants). The 2022 EPRI Siting Guide applies to advanced light water reactors, light water small modular reactors, and non-light-water designs.

Background and Motivation

GAIN Coal Transition Research

Between 2015 and 2020, the United States, on average, retired 11 GW of coal capacity each year (Reference 26). Coal retirements are expected to continue for the foreseeable future as the industry moves to achieve carbon emission reduction goals and shift to a clean energy economy. Communities, government, utilities, and researchers across the United States are seeking options to reduce carbon emissions by repowering coal power stations. Options that utilize past investments in the facilities, supporting infrastructure and local staff are being considered and evaluated. A potential option is to repower these coal stations with nuclear generating stations. Depending on the age and condition of the infrastructure, nuclear generating stations may be able to utilize some existing infrastructure, as well as provide similar high paying jobs, contribute to a greener energy portfolio, and reduce local pollution. These nuclear generating stations also will contribute to resiliency of the electric grid through the distributed siting of firm, dispatchable sources of electricity generation.

Evaluating, planning for, and successfully completing the deployment of an advanced nuclear generating station is a complex task for a power company. These nuclear generating station projects require the right partnerships/consortium to ensure the nuclear technology options, and licensing pathways are available as well as meet the business and community goals. Critical to the evaluation and planning is engagement with the community to understand and incorporate their vision for a successful transition of the coal station.

The Gateway for Accelerated Innovation in Nuclear (GAIN) is working with a diverse group of participants to evaluate several specific sites in different regions to establish a broad foundation and framework for successful coal to nuclear repowering projects across the United States.

GAIN serves as an independent resource for coal to nuclear repowering, without bias towards site location and/or technology selection. GAIN engages with DOE, industry, and communities and decision-makers on a regular basis to strengthen and optimize the program and resulting products.

CGS is one of several sites undergoing a GAIN coal to nuclear repowering evaluation. This (initial siting) evaluation is one part of the larger CGS coal to nuclear repowering evaluation. GAIN is also working with SRP and the town of Saint Johns to complete a nuclear technology assessment and economic impact study. The objective of the overall CGS coal to nuclear repowering evaluation is to enable SRP's decision-making process about future generation options and reduce uncertainty associated with the potential for coal to nuclear repowering at CGS.

Salt River Project

The Salt River Project Agricultural Improvement and Power District (SRP), an agricultural improvement district organized and existing under the laws of the State of Arizona is a community-based, not-for-profit organization that provides affordable water and power to more than 2 million people in central Arizona. SRP has a diversified set of electricity generation assets (see Figure 1), where coal fired stations supplied 8,500 GWh in 2021 (Reference 8). SRP owns shares in the coal-fired power stations in the list shown in Table 1. SRP is the sole owner and operator of the CGS, the focus of this initial siting evaluation.

To continue to meet the electricity needs of their customers, SRP is investigating alternative low carbon or carbon-free generating sources to replace retiring coal generating assets and is considering nuclear power as one such alternative. SRP is also evaluating non-nuclear alternatives (via a separate work scope, independent from GAIN), while GAIN is focused solely on evaluating nuclear power as a replacement technology.

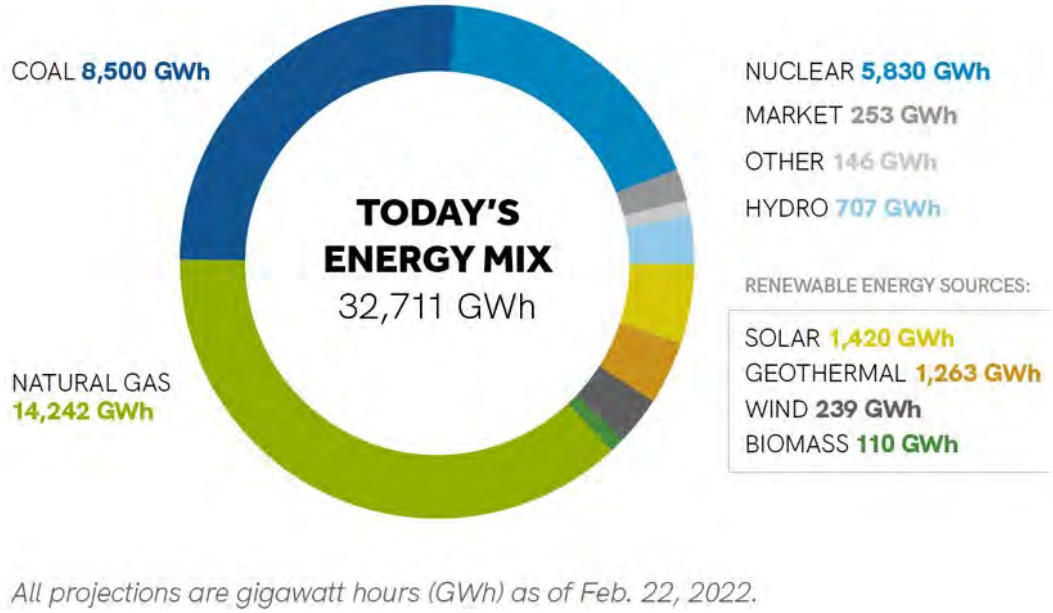


Figure 1. SRP Delivered Energy by Asset (Reference 8).[3]

Table 1. SRP Owned or Partially Owned Coal Generating Stations.

Station Name	Location	Planned Retirement	Total Capacity [MW] (1)	SRP Role
Coronado Generating Station	Saint Johns, AZ	December 2032	762	Owner and Operator
Craig Generating Station	Craig, CO	Unit 1 2025 Unit 2 2028 Unit 3 2029	1283	29% share of Units 1&2 only
Four Corners Power Plant	Farmington, NM	2031	1500	10% share of all Units
Hayden Generating Station	Hayden, CO	Unit 1 2028 Unit 2 2027	446	50% share of Unit 2 only
Springerville Generating Station	Springerville, AZ	Unit 1 2027 Unit 2 2032 Units 3&4 TBD	1560	100% share of Unit 4 only

Notes:

1) Total capacity is the net generating capacity for each plant. SRP receives a share of the total capacity based on total percentage of units owned.

[3] SRP's partial ownership of Palo Verde is the sole contributor to SRP's nuclear generation portfolio. SRP does not currently operate any nuclear power plants.

The electric power industry is undergoing a significant transition driven by changes in technology, economics, and customer demands. Like the rest of the industry, SRP is taking action to significantly reduce its carbon footprint while maintaining the ability to provide reliable, sustainable, and affordable power. To enable this transition, SRP anticipates retiring its coal generating stations in the coming years (as highlighted in Table 1).

Coronado Generating Station

Coronado Generating Station (CGS) is a two-unit, coal-fired power station located in Apache County near Saint Johns, Arizona (Reference 8) (see Figure 2). Unit 1 and Unit 2 have net capacities of 382 MW and 380 MW, respectively. Units 1 and 2 are scheduled to begin seasonal operation in 2025 and to fully retire no later than year-end 2032.

According to Apache County (Reference 19), SRP owns approximately 7,000 acres of land around and including the CGS site. Figure 3 shows the site layout for CGS, which consists of the power station, switchyard, ash ponds, cooling towers, rail access, and parking/office space. The CGS site itself occupies roughly 700 acres (see Figure 4). The station is equipped with emission controls including electrostatic precipitators to reduce particulate emissions, scrubbers to remove sulfur dioxide (SO_2), and a water reservoir to recover and contain process waste. Unit 2 has a selective catalytic reduction (SCR) system, which uses a catalytic chemical reaction to convert nitrogen oxides (NOx) into nitrogen, water, and small amounts of carbon dioxide (CO_2). An SCR system is planned for Unit 1 by the end of 2025 (Reference 8). Additionally, SRP has plans to close the evaporation pond southwest of the current CGS site. Closure plans include dewatering, installation of a final cover, and measures to prevent run-on or run-off from the closed evaporation pond.

Figure 2. Map of Arizona Counties and Saint Johns / CGS.

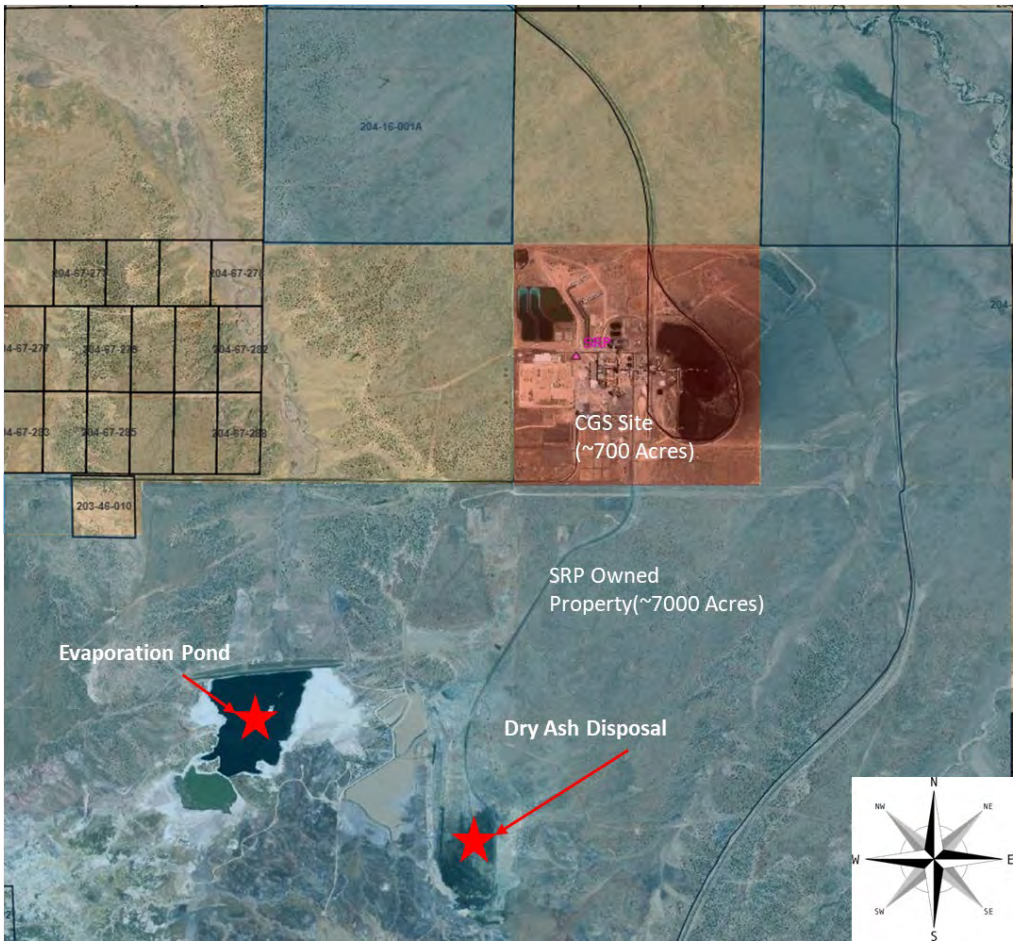


Figure 3. SRP-Owned Parcels (Blue) and CGS Site (Red) (Reference 19).

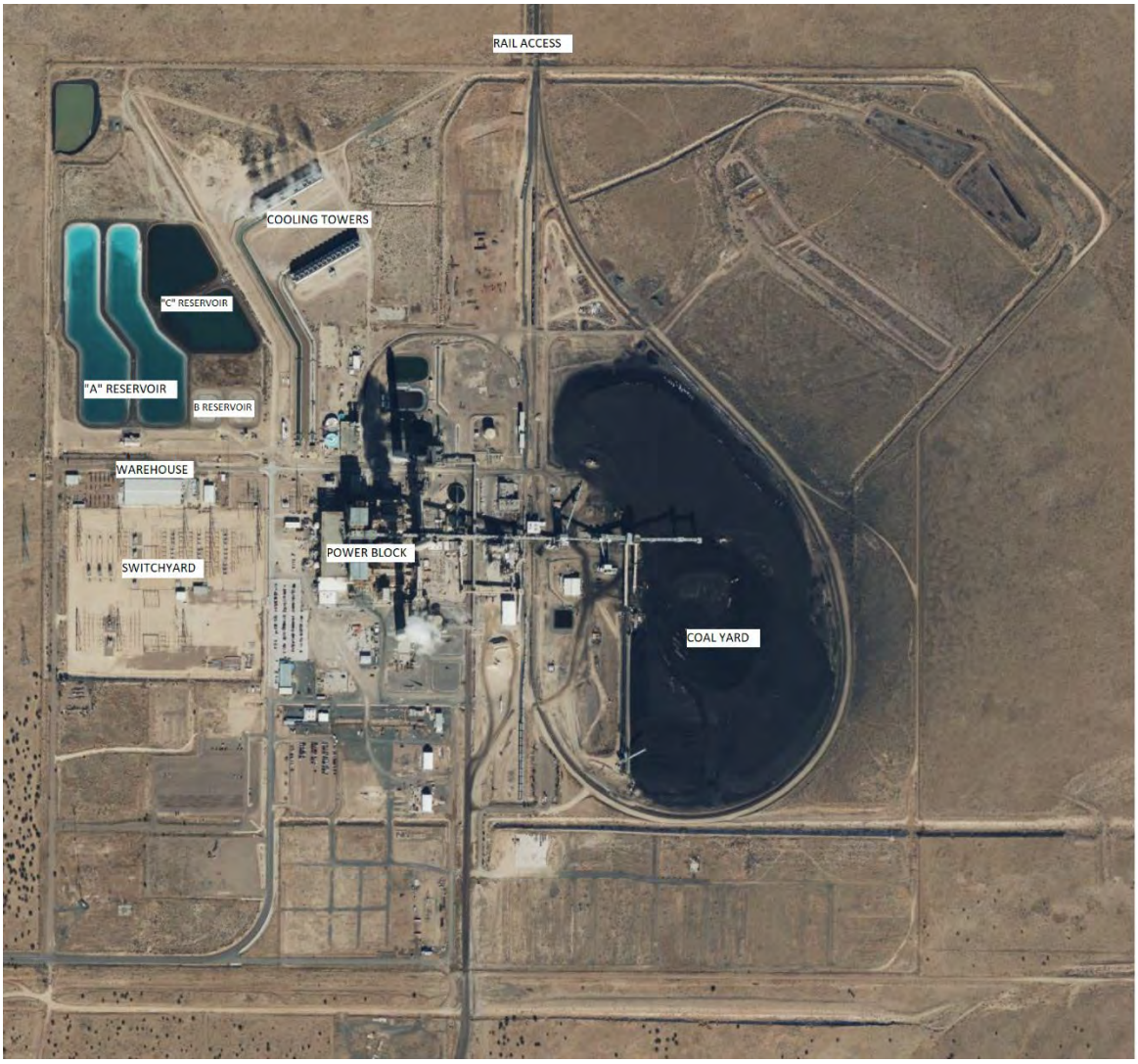


Figure 4. SRP Property Map and Key Features.

Available Siting Guidance

As industry interest in nuclear generating stations grows, numerous siting guidance documents are being made available to assist utilities and communities in evaluating site suitability. These guidance documents are best used early in the siting process and provide high-level overviews of exclusionary and avoidance criteria, as well as guidance on more detailed nuclear siting considerations. A primary objective of the guidance is to confirm high-level site suitability. Guidance documents also identify detailed nuclear siting aspects (e.g., future adjacent land usage, housing availability to support construction/operations, etc.) that will be required if a utility decides to continue the nuclear siting process and to pursue an early site or construction

permit. Ultimately, a combination of proprietary knowledge/data, publicly available records, market research, and use of industry siting guidance will best inform a utility on site selection.

The GAIN/MPR team leveraged the following siting guidance to assess the suitability of the CGS site/nearby SRP owned land.

1. **"Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities (Siting Guide)" (Reference 1)**: This guide was published by EPRI and provides siting guidance to prospective utilities throughout the lifecycle of the siting process. This guide combines both regulatory guidance, as well as business related considerations for siting purposes, and is a good starting point for any siting activities and comprehensive reference.

2. **Coal Repowering – A White Paper Series (Reference 2):** This white paper series published by EPRI discusses some of the high-level benefits, drawbacks, and considerations for repowering coal-fired power stations with nuclear generating stations. Information in the whitepaper series complements siting considerations in the EPRI Siting Guide.

3. **Nuclear Regulatory Commission (NRC) Regulatory Guide 4.7 (Reference 3):** This NRC guidance document provides explanations of the NRC's specific siting criteria and defines specific requirements for siting a nuclear reactor. This guide is limited in scope to NRC related requirements.

4. **The Department of Energy's (DOEs) "Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants" (Reference 4):** This report specifically considers the transition of coal-fired power stations to nuclear generating stations and addresses some of the key pros and cons associated with converting. This report also highlights some of the economic aspects to consider when converting coal-fired power stations into a nuclear generating station.

5. **Previous Early Site Permit Applications:** To date, six early site permits (ESPs) have been approved by the NRC to utility companies considering building nuclear generating stations. The ESPs themselves are the end-product to siting related work and can be leveraged to (1) identify and scope the level of effort required related to siting a nuclear generating station, and (2) provide inputs to use for scoping purposes for early siting activities when leveraging the above guidance documents. ESPs can be viewed on the NRC website directly (Reference 5).

CGS SITING EVALUATION RESULTS

An initial siting evaluation, focused on criteria specific to siting a nuclear generating station, was conducted for the CGS site and surrounding SRP owned land. CGS is in Apache County, Arizona, near the town of Saint Johns. This evaluation used both publicly available information and information from SRP. Information gathered was reviewed leveraging industry recognized siting criteria and applicable regulatory guidance.

The formal siting process for a nuclear reactor is a multi-year process requiring a great level of time, effort, and detail. the purpose of this initial siting evaluation was to assess if the CGS site has characteristics that could preclude nuclear or present challenges leading to increased cost and/or risk. These characteristics are referred to as exclusionary and avoidance factors, respectively.

No exclusionary or avoidance factors were identified at CGS. However, there are several siting characteristics that require additional investigation by SRP if nuclear siting is to be pursued at CGS. The specific results of the CGS siting evaluation are included in the CGS Siting Evaluation section and summarized below.

1. **Water Availability:** CGS currently draws from wellfields to supply CGS with water. Given the scarcity of water in the southwestern region of the United States and SRP's water reduction goals, special consideration to different cooling options, including air-cooled cooling, is recommended at CGS. Many reactor designs are moving away from conventional, once-through cooling systems in favor of less water intensive cooling (e.g., closed loop cooling, air-cooled cooling, etc.). However, there are tradeoffs associated with cooling options (i.e., water usage vs. overall thermal efficiency) which can impact economic considerations of the plant and compete with community needs (e.g., agriculture, local industries, etc.). SRP should evaluate water consumption needs/limits and impacts on overall plant efficiency before selecting a cooling option. Additional insights regarding cooling options and associated pros and cons will be provided in a complementary GAIN report focused on identifying candidate nuclear technologies for CGS.

2. **Ecological Impacts on Endangered or Threatened Species:** The Nuclear Regulatory Commission (NRC) stipulates that potential impact to endangered or threatened species should be evaluated prior to nuclear power construction and operation. Arizona is home to over 72 endangered, threatened or candidate species, although CGS is not currently situated on land reserved for endangered or threatened species. SRP coordinates with state and federal agencies to track species distributions and recovery efforts across Arizona, and currently monitors and comments on proposals by the U.S. Fish and

Wildlife Service to list species as threatened or endangered or designate critical habitat. SRP should continue to track federal listing proposals and work to minimize regulatory impacts to current operations or future generation options at CGS.

3. **Adjacency to Native Lands and Nearby Communities:** CGS is sited on privately owned land but is situated near the community of Saint Johns and in the same county as the Zuni Reservation and Navajo Nation. SRP has and should continue to engage with local community and tribal leaders on decisions related to siting a nuclear generating station at CGS. Community engagement is an essential part of nuclear generating station site selection, project planning, and execution. Local communities, including nearby native populations, should be engaged early and often to allow the local communities to provide input and ask questions to influence decisions. When engaging with local communities, it is important to understand the needs and perspectives of community members as well as the community's experience with the nuclear industry (e.g., power generation, waste management, uranium mining, etc.). Engagement model and conversations should be catered to individual group(s) and their interests/needs. The economic impact study, as part of the overall GAIN study, will provide insights on the economic impacts (e.g., increased tax revenue, high paying jobs, etc.) associated with repowering the CGS site with a nuclear generation station.

Based on the findings from this initial siting evaluation, SRP may want to continue to consider nuclear as a viable replacement technology at CGS. If SRP pursues the next steps and assesses replacement technologies, SRP should continue to engage with local stakeholders and focus on developing a site layout and deployment timetable. This includes identifying reusable infrastructure (e.g., switchyards, cooling towers, etc.), determining the effect of construction on CGS operations, and assessing environmental liabilities. The results are intended to inform SRP on the strengths and weaknesses associated with the CGS site and support technology selection.

Note that the above considerations are anticipated to be applicable to most candidate sites in Arizona and New Mexico with adequate footprints, as these siting considerations are largely applicable to the region. Stations in Colorado will have some overlap with stations in Arizona and New Mexico but will require an additional site assessment to demonstrate nuclear siting feasibility. If SRP elects to develop at a site other than CGS, the methodology used in this report should be repeated to ensure site viability.

CGS SITING EVALUATION APPROACH

As recommended in the EPRI Siting Guide, the evaluation leveraged a graded approach when assessing the suitability of the CGS site and nearby SRP owned land for a nuclear generating station[4].

The siting criteria identified in available industry guidance (References 1 and 2) can be grouped into three stages of assessment:

1. **Exclusionary/Avoidance Factor Assessment (Main focus of this initial siting evaluation):** During this stage, utilities determine if the site(s) of interest have any exclusionary factors or nuclear siting-related criteria that would preclude the construction of a nuclear reactor. The Exclusionary/Avoidance Factor Assessment will also identify any avoidance factors that should be considered/further assessed as part of Decision Planning (see Stage 2). The EPRI Siting Guide (Reference 1) defines exclusionary and avoidance factors as:

    - **Exclusionary** – Factors that preclude nuclear construction (e.g., located within 10 miles of a major airport, situated on federally protected land, etc.)
    - **Avoidance** – Factors that are not exclusionary, but may present challenges during either licensing or construction/operation that could lead to undesirable costs and /or risks (e.g., situated near active fault lines or in high probability flood plains, etc.)

    Sites that do not have any exclusionary nuclear siting factors should be studied further in the subsequent stages. Typically, Exclusionary/Avoidance Factor Assessments can rely on publicly available data, or limited utility information (e.g., water usage rights, insights on community support, etc.).

2. **Decision Planning:** During this stage, more detail/investigation is required to assess siting considerations and develop a deployment schedule to plan/coordinate information gathering and siting activities. At this point of the process, utilities have confirmed that the site(s) of interest do not have any exclusionary factors and have plans to assess risks associated with any avoidance factors identified during the Exclusionary/Avoidance

[4] It is important to note that this initial siting evaluation is focused on a site of interest (i.e., the CGS site) versus a region of interest due to the unique opportunities associated with repowering the CGS site. As a result, to satisfy NRC requirements, SRP will need to evaluate alternative sites to justify the selection of CGS during future stages (see Reference 3).

Factor Assessment. While criteria addressed in this stage are not exclusionary factors, the assessed criteria in this stage will help a utility down select to the "best" site and preferred site layout, from regulatory and business perspectives. Where information is available, this initial siting evaluation qualitatively assesses Decision Planning criteria. Note that Decision Planning criteria will require further investigation in subsequent siting evaluations if SRP decides to pursue future stages.

3. **Licensing:** During this stage, a utility has selected the site for hosting a nuclear generating station, has developed a deployment schedule/plan, and is applying for either an ESP[5] or construction permit from the NRC. Activities during this stage often involve site specific work, such as geotechnical assessments, meteorological and environmental monitoring, and stakeholder engagement.

The scope of the CGS initial siting evaluation is focused on the criteria in the Exclusionary/Avoidance Factor Assessment stage and selected Decision Planning criteria. Criteria were assessed on a pass/fail/more investigation required basis. Note that the Decision Planning criteria spans a wide range of the siting process and will likely involve a more formal siting evaluation process as outlined in NRC Regulatory Guide 4.7 (Reference 3). For this initial siting evaluation, Decision Planning criteria where data either publicly exists, or was provided by SRP is included in this report. Insights regarding future stages (e.g., later stages of Decision Planning and Licensing) are also provided for SRP's review/consideration.

Table 2 lists the scope of siting considerations/criteria to be evaluated at each stage, by order of appearance in the EPRI Siting Guide (Reference 1). Criteria from these references are suitable for conducting an Exclusionary/Avoidance Factor Assessment and early Decision Planning investigations. However, the Licensing criteria in Table 2 are highly condensed versions. If SRP advances to a Licensing stage of planning, siting related industry experts should be consulted for further clarity on specific requirements required for licensing.

[5] An Early Site Permit (ESP) is a siting permit granted by the NRC and can be technology agnostic. Once approved, an ESP is valid for 10-20 years, and can be renewed for an additional 10-20 years.

Table 2. Nuclear Siting Considerations by Planning Stage.

Category	Siting Guide Section	Exclusionary/Avoidance Factor Assessment (Focus of the CGS Initial Siting Evaluation)	Decision Planning	Licensing
Geology Seismology	3.1.1.1	• Exclude areas where peak ground acceleration exceeding 0.3gs at a probability of exceedance of 2% in 50 years		• Quantify: o Vibratory Ground Motion o Capable Tectonic Structures/Sources o Surface Faulting/Deformation o Geologic Hazards o Soil Stability
Cooling Water Supply	3.1.1.2.1	• Ensure water availability for potential technology	• Quantify water source low flow conditions	• Develop water supply plan
Ambient Air Requirements	3.1.1.2.2	• Evaluate ambient air temperatures as it relates to cooling options (i.e., water cooled, air-cooled, or hybrid methods) to support more detailed analyses later in siting process		• Quantify: o Minimum and maximum ambient air temperatures on site o Annual average monthly dry-bulb temperatures o Consideration of general climate conditions and effects of climate change
Flooding	3.1.1.3	• Avoid high probability floodplains	• Determine flooding potential with 100- and 500-year flood zone • Subjectively characterize other flooding hazards (e.g., tsunamis, dam breaks, etc.)	• Evaluate other flooding hazards (e.g., tsunamis, dam breaks, etc.) • Evaluate cost of engineered flood-mitigation structures

Table 2. Nuclear Siting Considerations by Planning Stage.

Category	Siting Guide Section	Exclusionary/Avoidance Factor Assessment (Focus of the CGS Initial Siting Evaluation)	Decision Planning	Licensing
Nearby Hazardous Land Uses	3.1.1.4	• Exclude Department of Defense reserved land • Ensure no major airport is within 10 miles of station • Avoid areas that may incur additional liabilities to a nuclear reactor (e.g., coal ash ponds)	• Maximize distance (greater than 5 miles) from nearby hazardous land usage (e.g., mining, chemical processing, fossil fuel operations, heavy manufacturing, etc.) (2)	• Evaluate all adjacent hazardous land uses [2]
Extreme Weather Conditions	3.1.1.5	• Quantitatively assess extreme weather conditions on site, and effects of climate change increasing frequency of extreme weather events		• Quantify: o Fastest Wind Mile Speed o Number of Tornadoes (per 10,000 sq. mi) o Number of Hurricanes o Maximum 24-hour precipitation values
Population	3.1.2.1	• Exclude areas with greater than 300 persons per sq. mile • Minimize nearby population centers (>25,000 persons per sq. mi)	• Ensure that distance to population density centers meets Exclusion Area (EA)/Low Population Zone (LPZ) requirements	• Quantify: o Transient populations o Proximity to densely populated areas o Population growth rates

Table 2. Nuclear Siting Considerations by Planning Stage.

Category	Siting Guide Section	Exclusionary/Avoidance Factor Assessment (Focus of the CGS Initial Siting Evaluation)	Decision Planning	Licensing
Emergency Planning	3.1.2.2			• Evaluate area egress limitations (e.g., water crossings, physical barriers, etc.) • Evaluate distance to the nearest major US interstate • Evaluate institutions which require special evacuation considerations (e.g., schools, prisons, nursing homes, etc.) • Characterize any natural hazard impediments (e.g., flash flooding, hurricanes, etc.)
Atmospheric Dispersion	3.1.2.3	• Subjectively characterize nearby topographical features which may lead to atmospheric dispersion (e.g., hills, valleys, etc.)		• Calculate atmospheric dispersion function using either: 1. On-site meteorological monitoring 2. Atmospheric data
Radionuclide Pathways	3.1.3(1)	• Exclude siting on and avoid siting near Environmental Protection Agency (EPA) Class I (special groundwater) sources		• Quantify o Dilution Capacity o Baseline Loadings o Proximity to Consumptive Users o Agricultural statistics (e.g., irrigation activity nearby)

Table 2. Nuclear Siting Considerations by Planning Stage.

Category	Siting Guide Section	Exclusionary/Avoidance Factor Assessment (Focus of the CGS Initial Siting Evaluation)	Decision Planning	Licensing
Transportation Safety	3.1.3.6			• Evaluate transportation hazards (e.g., fog, blizzards, etc.) that can affect hazardous material transport to site
Effects on Surrounding Ecology	3.2[(1)]	• Exclude areas designated as critical habitats for endangered/ threatened species. • Exclude major, high-quality wetlands • Exclude areas where cooling water/other operational affects may affect endangered/threatened species • Avoid ecologically sensitive and special designation wildlife/wetland/aquatic areas	• Evaluate the number of rare, threatened, or endangered species which may migrate to future sites, and what effect station operations will have on them • Define the total area and boundary of each potential site	• Quantify: o The extent of possible contamination to water sediments and grain size of the sediments in the area o The effect on state or local protected species o Areas within the site boundary which can be reserved for protected species. o All information regarding wetlands within the site boundary, and surrounding aquatic habitats where station construction/ operations might affect

Table 2. Nuclear Siting Considerations by Planning Stage.

Category	Siting Guide Section	Exclusionary/Avoidance Factor Assessment (Focus of the CGS Initial Siting Evaluation)	Decision Planning	Licensing
Socio-economic Considerations	3.3 (1)	• Exclude public amenity areas established by federal, state, and local agencies • Exclude national parkland • Exclude national wildlife refuges • Exclude wilderness areas • Exclude National Marine Sanctuaries • Exclude cultural resources, such as American Indian lands, national/historic landmarks, etc. • Maximize distance, to the extent practical, to the above criteria	• For sites nearby exclusionary or avoidance criteria, engage stakeholders early on plans regarding nuclear siting/planning • Evaluate labor requirements and the region's ability to support nuclear labor pool • Assess local community support for project. • Quantify local/state/federal future adjacent land uses, including zoning	• Engage with local communities regarding construction/operations plans, and the positive and negative effects to the community. • Collect and compare population data for minorities and low-income populations

Table 2. Nuclear Siting Considerations by Planning Stage.

Category	Siting Guide Section	Exclusionary/Avoidance Factor Assessment (Focus of the CGS Initial Siting Evaluation)	Decision Planning	Licensing
Engineering and Cost-Related Considerations	3.4 (1)	• Maximum pumping distance (3)	• Qualitatively evaluate associated engineering and regulatory costs associated with water supply, pumping distance, seismic, civil works, environmental remediation, heavy transport access, transmission costs, topography (grading), land rights, and labor rates for each potential site	

Notes:

1. Multiple subsections in the EPRI Siting Guide for noted section are applicable. Consult the EPRI Siting Guide (Reference 1) for specifics.
2. This requirement is applicable to gigawatt scale light water reactors. See Section 3.1.1.4 in Reference 1, or "Industrial, Military, and Transportation Facilities" in RG 4.7 (Reference 3) for examples of hazardous land uses. This requirement is not expected to be as applicable to smaller advanced reactors currently in development. For example, nuclear developers are currently considering potential use cases for co-generation (e.g., process heat, hydrogen production, etc.) leveraging nuclear power. These use cases would require a nuclear reactor close/adjacent to potentially "hazardous land uses".
3. Maximum pumping distance is typically a cost consideration for greenfield sites. Because CGS already has pumping infrastructure, this criterion was not assessed. It is assumed that the existing piping infrastructure will be reused, or that new piping infrastructure will not be cost prohibitive due to the proximity of the water source to the site.

CGS SITING EVALUATION

The following sections outline the results of the CGS initial siting evaluation, including detailed information regarding health and safety criteria, ecological considerations, socio-economic considerations, and engineering cost considerations. This section provides an evaluation of the exclusionary and avoidance factors listed in Table 2.

Health and Safety Criteria

Criteria in this section assess a site's feasibility to host a reactor within its design limits. Any site should seek to minimize both natural and manmade hazards to a potential nuclear generating station. All nuclear power plants come with a "standard design", which has a set of design features that can be compared against a specific site. Once a site has been identified, a "site specific design" will be developed to address any unique site attributes which are not included in the standard design and will rely on engineering to address/mitigate any site driven health and safety considerations.

Because this evaluation is the first step in evaluating the CGS site, health and safety criteria in this section focus on site features that cannot be exclusively addressed or mitigated by engineering going from standard to site specific design (e.g., local population, extreme weather, etc.). Specific plant attributes such as reactor design, spent fuel storage, and others are not evaluated from a health and safety perspective, as these specific attributes are not influenced by siting factors that cannot be mitigated with engineering.

Geology/Seismology

There are no exclusionary or avoidance factors as it relates to geology/seismology for CGS.

Geology and seismology considerations during nuclear regulatory siting often require extensive investigation and technical considerations from a design perspective. At a high level, areas which have a greater than 2% probability of exceedance (PE) chance of exceeding 0.3g of ground acceleration in 50 years should be excluded from consideration. While new reactors are designed to take on higher seismic loading, accommodating for higher, site-specific seismic loading may become cost prohibitive. Therefore, nuclear generating station sites should seek to minimize seismic loading potential to the extent practical.

The United States Geological Service (USGS) publishes hazard maps assessing seismic activities. According to the USGS Unified Hazard Tool, the CGS site has a 2% PE between 0.08g and 0.1g (Reference 18), which is well below the exclusionary consideration defined by EPRI (Reference 1). The CGS site is well below this limit, as shown in Figure 5

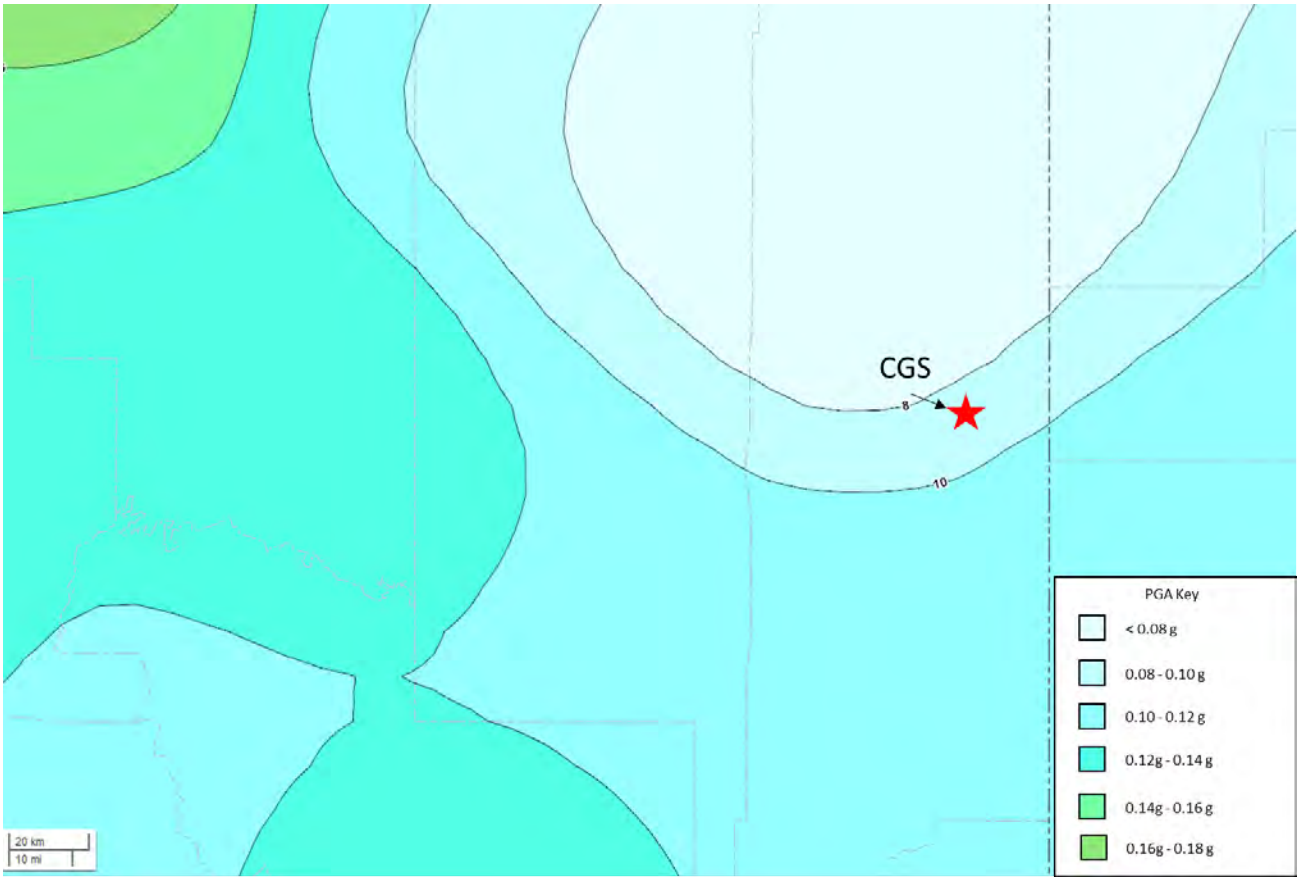


Figure 5. USGS 2% PE Map over 50 Year Timespan (Reference 18).

Other geologic/seismologic siting considerations occur during later stages of evaluation (i.e., licensing), and require extensive use of geologic/seismologic specialty subcontractors, who quantify credible geologic/seismologic threats in the area.

Cooling Water Requirements

Although there are no exclusionary factors related to available water supply for nuclear siting at CGS, further evaluation will be required to assess potentially competing water resource needs in the area. In addition, special attention must be given to balance of plant (BOP) systems and their implicit tradeoffs between water usage and overall efficiency from an economics and electrical output perspective.

Water supply is a key consideration when it comes to siting a nuclear generating station. There are several methods for utilizing cooling water at a nuclear generating station, and as such, water supply availability is a key influencer of the BOP design. The most limiting configuration (e.g., the configuration which consumes the most water) is a once-through cooling system using water

cooled condensers and is not available at the CGS site. More water efficient systems use the atmosphere as a final cooling source/heat sink.

Given the scarcity of water in the southwestern region of the United States and SRP's water reduction goals, special consideration to different cooling options is required for CGS. GAIN will consider CGS's current maximum water usage as a bounding case for subsequent investigation of cooling system options. Additional insights regarding potential site layouts, including potential cooling system alternatives, will be provided in a complementary GAIN report focused on identifying candidate nuclear technologies for CGS.

To address water usage considerations for a potential nuclear site, CGS should consider:

1. Selecting a technology and design option which minimizes water usage for cooling while maintaining reasonable thermal efficiency (i.e., air cooling for condensers, closed loop cooling systems, etc.).
2. Identifying additional sources of water to supply a potential nuclear site.
3. Securing water usage rights for the duration of the nuclear generating station's operating life.

Ambient Air

Ambient air temperatures are not used as exclusionary or avoidance criteria. Rather, publicly available temperature information should be used to inform station cooling considerations at later stages of planning.

The objective of this criterion is to rate sites with respect to specific cooling system requirements related to ambient air characteristics. Ambient air characteristics of a potential site affect the design of heat removal systems. Ambient temperature levels found at sites evaluated in recent siting studies have not been a major concern, and it has not been necessary to apply this as either an exclusionary or avoidance factor in the early phases of site selection (Reference 1).

High-level temperature data for the CGS site are provided in this section for reference during the Decision Planning stage. Figure 6 summarizes average high and low temperature data from the National Oceanic and Atmospheric Administration (NOAA) (Reference 11).

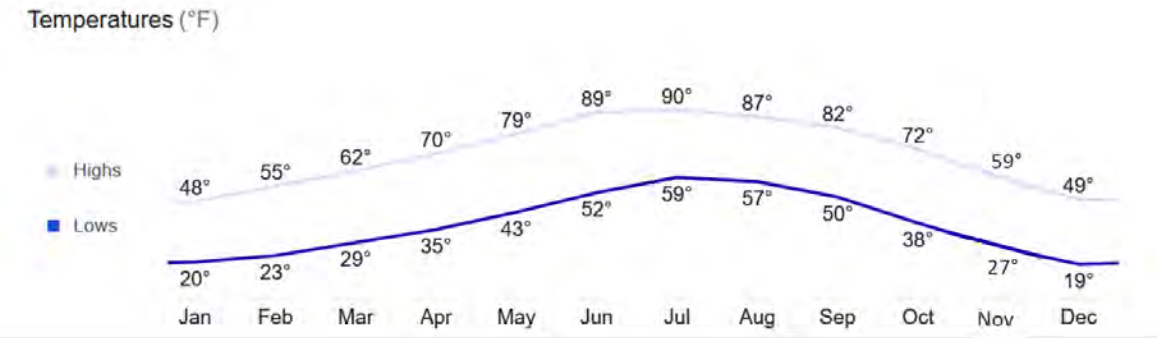


Figure 6. Average Ambient High and Low Temperature by Month for Saint Johns, AZ.

Flooding

There are no exclusionary or avoidance factors related to potential CGS flooding considerations, as CGS is not situated on a high probability floodplain. Some SRP-owned land near CGS is classified as a "Zone A" floodplain, and SRP should take care to avoid these regions when developing a nuclear site layout/plot plan. Zone A floodplains have a 1 percent chance of flooding per year (i.e., base flood, or the 100-year flood). Zone X floodplains have less than a 1 percent chance of flooding per year and are considered low risk floodplains. The majority of SRP owned property is situated on a Zone X floodplain.

The Federal Emergency Management Agency (FEMA) provides flood maps for insurance related purposes. Figure 7 shows potential flood risks in blue, which are defined as special flood hazard areas (SFHAs). SFHAs are defined as "100-year flood zones" which are areas that have a 1% chance of experiencing or exceeding "base flood" conditions per year. The main flooding pathway for the CGS site is the Corrizo Wash.

While not exclusionary, SRP will need to evaluate flash flooding considerations associated with the Corrizo Wash, and what engineering measures will need to be taken (if any) to mitigate the risk of site flooding (Reference 13).

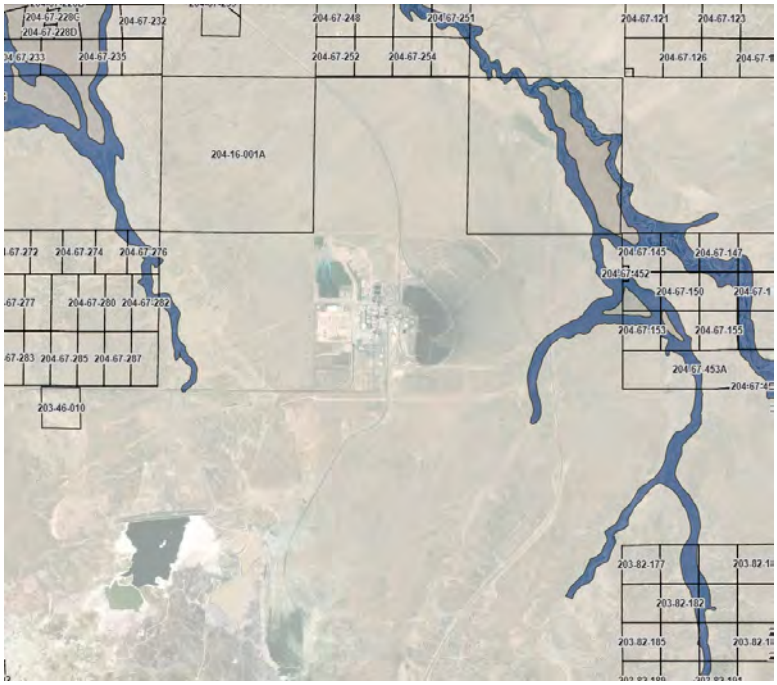


Figure 7. Apache County FEMA Flood Map of CGS Site, with Zone "A" Floodplains in Blue and Zone "X" Floodplains in Gray. (Reference 19).

Nearby Hazardous Land Uses

There were no exclusionary or avoidance factors identified as it relates to nearby hazardous land uses for CGS.

Historically, the NRC required applicants to characterize nearby hazardous land uses (i.e., land used by external stakeholders which may pose a threat to nuclear station construction and operation) when assessing site feasibility. For more information regarding hazardous land uses, see Section 3.1.1.4 of Reference 1 or "Industrial, Military, and Transportation Facilities" in RG 4.7 (Reference 3). Hazardous facilities are those which may produce missiles, shock waves, flammable vapor clouds, toxic chemicals, or incendiary fragments which may affect nuclear station operations (Reference 3). Ideal candidate sites had suitable distance (i.e., greater than 5 miles) between the site and potential hazardous land uses.

This requirement is applicable to gigawatt scale light water reactors and is not expected to be as applicable to smaller advanced reactors currently in development. Currently, nuclear developers are considering potential use cases for co-generation (i.e., process heat, hydrogen production, etc.) in addition to electricity leveraging nuclear power. These use cases would require a nuclear reactor close/adjacent to potentially hazardous land uses. To be conservative, GAIN leveraged the existing guidance when evaluating CGS.

For the Exclusionary/Avoidance Factor Assessment, nuclear generating stations cannot be sited on DOD reserved land or be located within 10 miles of a major international airport (exclusionary factors). Figure 8 shows DOD reserved land and major airports in the state of Arizona (Reference 9). Additionally, the two largest airports near Saint Johns, AZ, are Phoenix Sky Harbor Airport and Albuquerque International Airport, both located more than 10 miles away from CGS (Reference 10).

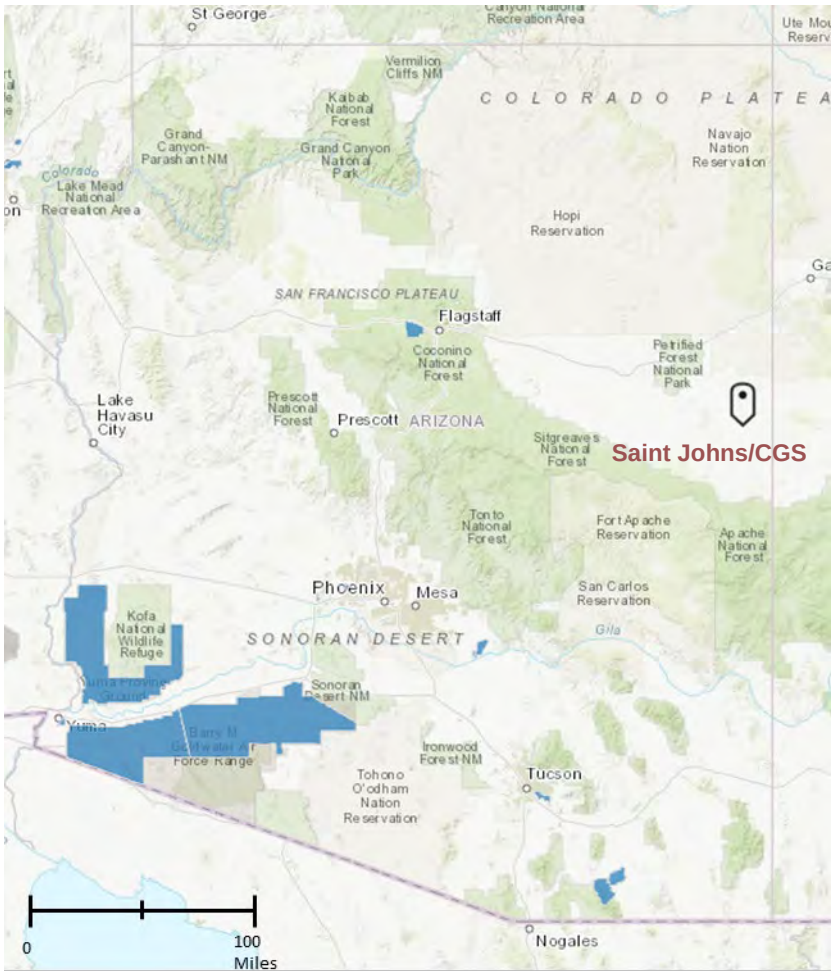


Figure 8. Overview of Arizona based DOD military installations (Blue) (Reference 20).

Table 3 summarizes the results of the CGS potentially hazardous land use initial siting screening assessment. Because ample data is publicly available, Table 4 provides observations regarding Detailed Planning phase criteria. These observations are provided for convenience. All criteria in Table 4 to some degree depend on local development plans and should be monitored.

Table 3. CGS Nearby Potentially Hazardous Land Use Assessment.

Criteria	Planning Stage	Acceptance Criteria	Assessment	Notes
DOD Military Installations	Exclusionary/ Avoidance Factor Assessment	Reactor should not be sited on DoD reserved land	Satisfactory	CGS site property boundary not situated on DoD reserved land (Reference 9).
Major Airports	Exclusionary/ Avoidance Factor Assessment	At least 10 Miles from the nearest major airport	Satisfactory	No major airport situated within 10 miles of CGS site (Reference 10).

Table 4. CGS Detailed Planning Phase Criteria.

Criteria	Observations
Other Airports	The Saint Johns Airport is located approximately 7 miles from CGS (Reference 10). Further investigation of potential aircraft traffic should be characterized.
Mining	The USGS lists several past mining features near CGS (i.e., within 5 miles), but their status is either shutdown or unknown (Reference 22). It is likely that these mines are shutdown, or do not meet the definition of a “hazardous” facility. The USGS also shows no major mineral deposits near CGS, meaning mining operations near CGS are unlikely for the foreseeable future. Further investigation is needed to verify if any current or future mining activity is under consideration.
Nearby Power Stations	No other power stations are located within 5 miles of the current CGS site (Reference 14). The coal plant retirement date should be considered early in the planning process. Risks associated with operating a coal plant while constructing a nuclear generating station need to be defined, evaluated, and mitigated as part of early planning efforts/strategy development.
Dams	No water reservoir or hydroelectric dams are located within 5 miles from CGS (Reference 14). However, an evaporation pond is situated approximately 2 miles from the CGS site. Future evaluation of this evaporation pond may be required (i.e., will this pond be drained prior to nuclear construction/operation, if not, does it present a credible risk for flooding?) (Reference 1).
Projected Facilities	Discussions with SRP and the town of Saint Johns, AZ reveal no immediate plans for hazardous facilities within 5 miles of CGS. However, SRP should monitor local activities to assess if hazardous facilities will be constructed soon.
Distance from Oil and Gas Fields	Several (likely defunct) gas fields are located near CGS (Reference 24). These wells are located further than 5 miles from the CGS site.

Table 4. CGS Detailed Planning Phase Criteria.

Criteria	Observations
Buried Pipelines	No buried natural gas pipelines are within 5 miles of CGS (Reference 14).
Major Manufacturing	The only manufacturing facility located near Saint John's AZ listed on Dun and Bradstreet (Reference 23) is O.E.A Backhoe and Materials, LLC, which does not constitute major manufacturing (Reference 15).
Chemical Facilities	No chemical facilities are located within 5 miles of CGS (Reference 15).
Rail Lines	BNSF has a rail line situated within 5 miles of the CGS site. Further investigation should quantify if this line actively transports any hazardous materials (Reference 14).
Major Ports/ Docks	No major ports/docks are located within 5 miles of CGS site (Reference 15).
Refineries	No refineries are located within 5 miles of CGS (Reference 15).

Based on publicly available information, CGS has no nearby hazardous land use that would preclude the siting of a nuclear generating station. There are a few nearby potential land hazards that require additional investigation in the Decision Planning stage (e.g., Saint Johns Airport potential air traffic, evaporation pond remediation, adjacent railway usage, and potential mining activities). Additionally, SRP should monitor local plans for potential future hazardous land use.

When siting a nuclear generating station on land near an operational or former coal fired power station, it is important to consider the status and location of the ash pond and/or evaporation pond on the site property. There are potential siting considerations for the ash pond and/or evaporation pond.

Several currently operating nuclear plants have evaporation ponds that store significant volumes of water and have successful flood mitigation structures in place. The current presence of an evaporation pond is not an exclusionary or avoidance factor. SRP manages CGS Coal Combustion Residuals (CCR) in two active facilities, a dry ash landfill and a surface impoundment known as the evaporation pond. The CCR Rule, first issued in April 2015, regulates the safe disposal of coal ash in landfills and surface impoundments under Subtitle D of the Resource Conservation and Recovery Act. Closure of the evaporation pond and the dry ash land fill will be in accordance with applicable regulations. Currently, CGS is selling some of its ash to other users. CGS should continue to do this to reduce overall ash inventory on site. Additionally, if SRP decides to pursue nuclear siting at CGS, baseline radionuclide loadings will need to be carefully characterized, as coal contains naturally occurring radioactive material that

may be concentrated from the combustion process. Some consideration to radiation monitoring from a traceability standpoint will be required.

Extreme Weather Conditions

There are no exclusionary or avoidance factors as it relates to extreme weather conditions for CGS.

A site's meteorological attributes are seldom used as an exclusionary factor for siting. A power station is typically engineered to withstand extreme weather conditions and as such, designing a nuclear generating station for extreme weather is more a matter of cost. Where meteorological considerations are important is when comparing candidate sites to one another.

During the Licensing stage, SRP will need to collect on-site meteorological data to quantify the potential for extreme weather conditions. To provide an assessment on CGS weather conditions, Table 5 shows publicly available meteorology data for CGS. To compare CGS weather data to an approved nuclear generating station siting permit, CRN PPE/ESP values and NRC regulatory requirements are provided for context.

Table 5. CGS Extreme Weather Observations and Comparison.

Assessment Criteria	CGS Information [CRN PPE/ESP Values]
Fastest mile speed (peak wind gusts)	The peak gust recorded between 1999-2021 is ~70 mph in 2012 (Reference 12). [CRN: 73 MPH]
Number of tornadoes per 10,000 square miles (state average)	Arizona averages less than 1 tornado per 10,000 sq. miles a year (Reference 21). Per Reg Guide 1.76 (Reference 6), CGS falls into intensity region III, the least intense region for tornadoes, where maximum tornado windspeeds are not expected to exceed 160 MPH. [CRN Location: between 1 and 3 tornadoes per 10,000 sq. mi.]
Number of hurricanes making landfall, direct hits on state	Saint Johns has been in the direct path of two tropical cyclones making landfall since 1965, with maximum sustained wind speeds of 39 mph (Reference 7). This sustained wind speed is well within design limits for other wind speed considerations (e.g., fastest mile speed) (Reference 7). [CRN: 1 tropical cyclone]

Table 5. CGS Extreme Weather Observations and Comparison.

Assessment Criteria	CGS Information [CRN PPE/ESP Values]
24-hour precipitation values	Saint Johns' 24-hour precipitation record is 3.0 inches. This is much less than outlined in the CRN PPE and is therefore not expected to be an issue (Reference 11). [CRN: 18.8 in/hr]

Population

There are no exclusionary or avoidance factors as it relates to population for CGS.

The purpose for evaluating the surrounding population is to minimize the effect to surrounding communities for inadvertent radioactive release. Population is a driving consideration for general nuclear generating station siting, since relocating surrounding population to a host site is something that cannot be resolved with engineering solutions.

From a safety perspective, CGS has no immediate concerns regarding local populations for nuclear generating station siting.

There are three main parameters that must be defined when it comes to considering siting for nuclear generating stations.

1. Exclusion Area (EA) Boundary (EAB) – Reg Guide 4.7 (Reference 3) states the EAB as where the station owner (s) "have authority to determine all activities within that area, including removal of personnel and property".

2. Low Population Zone (LPZ) – The LPZ is an area immediately beyond the EAB where population should be limited. Reg Guide 4.7 defines the LPZ boundary: "… the distance to the nearest boundary of a densely populated center containing more than about 25,000 residents ("population center distance") must be at least one-and-one-third times the distance from the reactor to the outer boundary of the LPZ."

3. Population Center Distance (PCD) – Population centers, as defined by 10 CFR 100.3, are densely populated clusters containing more than 25,000 people. The boundary of the population center should be determined based on population distribution, not political boundaries (Reference 3).

Table 6 shows the population screening criteria for the CGS site.

Table 6. CGS Population Assessment.

Criteria	Planning Stage	Acceptance Criteria [1]	Assessment	Notes
Densely Populated Regions	Exclusionary/ Avoidance Factor Assessment	Areas must not have more than 300 people per square mile	Satisfactory	No permanent population located within hypothetical EA or LPZ surrounding CGS (Reference 15).
Population-center Distance	Exclusionary/ Avoidance Factor Assessment	At least 1.33x the distance from exclusion area boundary to the outer boundary of LPZ (i.e., area with greater than 25,000 residents)	Satisfactory	No population centers located within hypothetical EA or LPZ surrounding CGS (Reference 15).

1. Current reactor designers are working to reduce the size of exclusion areas and low populations zones given the inherently safe nature of their designs (i.e., passive safely systems). If EA and LPZ sizes are reduced, nuclear generating stations could be sited closer to population centers.

Emergency Planning

Emergency planning factors are not evaluated during the Exclusionary/Avoidance Factor Assessment stage. Emergency planning details often emerge during the Licensing stage of nuclear generating station siting, and often required specialized subcontractor support to develop emergency planning procedures, and coordination with local communities.

CGS's remote location is a net benefit from an emergency planning perspective. It is also important to note that new reactor designs are currently planning for emergency planning zones to extend only to the site boundary. This greatly simplifies emergency planning efforts during licensing and allows some plant designs to be sited closer to population centers.

Atmospheric Dispersion

There are no exclusionary or avoidance factors as it relates to atmospheric dispersion for CGS.

CGS is situated on a plateau approximately 5,800 feet above sea level (Reference 15), with no obvious topographical features nearby (e.g., hills, valleys) that would lead to short-term atmospheric dispersion events. The presence of topographic features can add to dose modeling uncertainty during the Licensing stage. To minimize uncertainty, it is preferred that a site minimizes the presence of topographical features. Therefore, the CGS site is considered satisfactory from an exclusionary/avoidance factor standpoint for atmospheric dispersion events.

One consideration for CGS is the frequency of atmospheric inversion events. Because of Arizona's dry climatology and rapid temperature variations throughout the day, terrain in Arizona is subject to an atmospheric phenomenon known as atmospheric inversion (Reference 27). This occurs when air near the ground cools faster than the air above it, which can

trap particulate matter closer to the ground. Atmospheric inversions are common events, and not considered an exclusionary factor for siting, but should be evaluated during more detailed siting phases.

Like emergency planning, atmospheric dispersion events are quantified by specialized subcontracting firms leveraging on-site monitoring information and historical atmospheric data during the Licensing stage.

Radioactive Release Pathways

There are no exclusionary or avoidance factors as it relates to radioactive release pathways for CGS. Per current EPA mapping systems, CGS is not situated on or near any Class I (special groundwater) sources (Reference 16).

Radioactive release pathways (both atmospheric and hydrologic) must be well characterized and well understood and often require the support of specialty contractors to quantify potential radioactivity release pathways during the Licensing stage.

Transportation Safety

Transportation safety is commonly evaluated during detailed siting phases and is therefore not characterized in this siting evaluation. Transportation safety aspects (e.g., fog, icy conditions) are seldom evaluated as exclusionary or avoidance factors. During a detailed siting evaluation, maps detailing heavy fog (<0.25 miles of visibility) around the site should be quantified. Icy conditions should also be considered.

Effects on Surrounding Ecology

For initial siting evaluations focused on assessing exclusionary and avoidance factors, nuclear generating stations must exclude or avoid areas reserved for critically endangered or threatened species and high-quality wetlands. Additionally, nuclear generating stations must exclude or avoid areas where cooling water, nuclear generating station construction, and nuclear generating station operational activities threaten local protected wildlife and wetlands.

During the Exclusionary/Avoidance Factor Assessment stage, ecological effects are difficult to characterize, as federal and state wildlife agencies continuously update threatened or endangered species and wetlands lists, and publicly available viewers often lag behind these decisions. Additionally, migratory behavior of potentially endangered or threatened species are difficult to assess without consulting federal and state wildlife agencies and are therefore consulted during Decision Planning stage of siting evaluations.

Using available data, CGS is not situated near any endangered or threatened species habitats, or any protected wetlands (Reference 15), and therefore as of this writing, the CGS site is considered satisfactory from an exclusionary/avoidance factor standpoint. However, because Arizona is home to 72 threatened, endangered, or candidate species (Reference 17), surrounding animal populations to CGS may change in the future. Therefore, SRP should continue to coordinate with state and federal agencies to track species distributions and recovery efforts across Arizona. SRP should also continue to monitor and comment on proposals by the U.S. Fish and Wildlife Service to list species as threatened or endangered or designate critical habitat to minimize potential regulatory impacts on current or future operations and options at CGS.

Socio-Economic Criteria

Socio-economic criteria include a wide array of considerations, including the effects on marginalized communities, access (or ability) to engage in meaningful involvement and minority populations, environmental justice, and effects on nearby land reserved for recreational purposes. Most of the criteria in this section rely on external stakeholder engagement and their support of a potential nuclear generating station.

The siting of a nuclear generating station can have beneficial impacts on local populations and economies while also placing potential strain on available workforce and existing infrastructure. The strain from nuclear generating station construction and operation can have effects on both the plant location (i.e., operations/decommissioning activities at the coal station depending on timing) and surrounding communities, but for regulatory purposes, emphasis is placed on the strain placed on local communities. For example, during construction, construction personnel may increase traffic in local communities, or limit short-term housing/hotel availability, and influence business. For regulatory siting purposes, the consequences, and effects on the surrounding population from a socio-economic perspective must be evaluated and documented. Insights regarding economic impacts associated with repowering CGS with a nuclear generating station (i.e., increased tax revenue, high-paying jobs, etc.) will be provided in a complementary GAIN report.

Adjacent land use is the principal socio-economic consideration in the Exclusionary/Avoidance Factor Assessment. Nuclear generating stations cannot be sited on publicly reserved lands (e.g., national parkland, historic and culturally significant locations, etc.), and developers should avoid siting nuclear generating stations near these reserved lands, noting that “near” is defined by potential radionuclide release pathways. Per publicly available maps (Reference 15), CGS is situated near (within 50 miles) of reserved land (i.e., Petrified National Forest, Apache-Sitegraves National Forest) that should be consulted during the Decision Planning stage. SRP would need to either develop a list of appropriate stakeholders, or review a list of existing

potential stakeholders, who should be made aware of the potential for nuclear generating station construction/operation.

When engaging with local communities, including nearby native populations, it is important to understand the needs and perspectives of community members as well as the community's experience with the nuclear industry (e.g., power generation, waste management, uranium mining, etc.). Engagement model and conversations should be catered to individual group(s) and their interests and needs.

The town of Saint Johns, AZ, is a relatively small town which could experience effects due to an increase in population to support the construction or operation of a nuclear generating station should SRP decide to continue nuclear siting efforts. Preliminary discussions with the City of Saint Johns show a general sense of enthusiasm around the potential for a nuclear generating station. Continued engagement between Saint Johns and SRP would be an essential step during all future stages of a project lifecycle.

The CGS site is in close proximity to native land. The Navajo Nation and the Zuni Reservation both have a significant presence in Apache County. SRP has and should continue to engage with local community and tribal leaders on any decisions related to siting a nuclear generating station at CGS.

Engineering Cost Related Criteria

Typically, engineering and cost related considerations come during the Detailed Planning stage, as at this stage, the owner typically has a better understanding of:

1. The technology (or types of technologies) that may be deployed and their approximate costs.
2. Commercial operational dates for the new nuclear generating station, thus informing the scope of remaining work to complete, and capital investment rates required by the utility.
3. Preliminary financing plans for deploying a nuclear generating station.
4. Water usage/ultimate heat sink decisions on net cost and operational performance.
5. Schedule and cost for civil works to accommodate site-specific siting challenges.

Once the above items are understood, engineering cost considerations are typically factored into deployment planning as a means of optimizing anticipated costs.

It should be noted that this study evaluates siting a nuclear generating station as a complete unit (e.g., the reactor, spent fuel storage, balance of plant, etc.). There are no unique siting attributes

to CGS that would benefit one piece of the plant over another (i.e., the geologic features of the CGS site make it easier to store spent nuclear fuel onsite, etc.). Spent fuel storage is incorporated into the standard plant design. If a site has no exclusionary or avoidance factors, spent fuel storage is likely not a concern from a siting perspective.

Although the existing infrastructure at CGS is aging, certain site attributes (e.g., the switchyard, cross flow cooling towers, groundwater well pumping infrastructure) should be evaluated for potential reuse as infrastructure for a nuclear generating station (References 2 and 4). During the Decision Planning stage, SRP should evaluate any potential cost savings associated with existing coal infrastructure on site and where appropriate leverage existing infrastructure as a means of reducing overall costs. GAIN will provide additional insights related to nuclear technologies and site infrastructure reuse in the complementary GAIN nuclear technology assessment report.

REFERENCES

1. Electric Power Research Institute, “Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities (Siting Guide),” EPRI Report No 3002023910, 2022.

2. Electric Power Research Institute, “Coal Repowering – A White Paper Series – Repowering Coal-Fired Power Plants for Advanced Nuclear Generation,” EPRI Report No. 3002025482, October 2022.

3. Nuclear Regulatory Commission, “General Site Suitability Criteria for Nuclear Power Stations,” NRC RG 4.7, Revision 3, March 2014.

4. Hansen, J., et. al., “Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants,” U.S. Department of Energy, INL/RPT-22-67964, Revision 1, September 13, 2022.

5. Nuclear Regulatory Commission “Early Site Permit Applications for New Reactors,” https://www.nrc.gov/reactors/new-reactors/large-lwr/esp.html, accessed November 30, 2022.

6. Nuclear Regulatory Commission, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” RG-1.76, Revision 1, March 2007.

7. National Oceanic and Atmospheric Administration, “Tropical Cyclones in Arizona,” https://www.wrh.noaa.gov/twc/tropical/tropical.php, accessed November 30, 2022.

8. Salt River Project, “SRP Power Generation Sources,” https://www.srpnet.com/grid-water-management/grid-management/power-generation-stations, accessed November 30, 2022.

9. US Department of Transportation “Military Bases,” https://data-usdot.opendata.arcgis.com/datasets/fb5aff99c6e74ed99cd8b36dfae1c469/explore?filters=eyJTVEFURV9URVJSIjpbIkFyaXpvbmEiXX0%3D&location=34.439529%2C-111.062937%2C7.00, accessed November 30, 2022.

10. SkyVector “SkyVector Aeronautical Charts,” https://skyvector.com/, accessed November 30, 2022.

11. NOAA, “National Centers for Environmental Information,” https://www.ncei.noaa.gov/, accessed November 30, 2022.

12. WeatherSpark, “2012 Weather History in Saint Johns,” https://weatherspark.com/h/y/2996/2012/Historical-Weather-during-2012-in-Saint-Johns-Arizona-United-States#Figures-WindSpeed, accessed November 30, 2022.

13. FEMA, “Flood Maps,” https://www.fema.gov/flood-maps, accessed November 30, 2022.

14. Energy Information Administration, “Electricity Energy Infrastructure and Resources,” https://atlas.eia.gov/apps/895faaf79d744f2ab3b72f8bd5778e68/explore, accessed November 30, 2022.

15. National Reactor Innovation Center, “Siting Tool for Advanced Nuclear Development (STAND),” https://nric.inl.gov/stand-tool/, accessed November 30, 2022.

16. Environmental Protection Agency, “Sole Source Aquifers,” https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b, accessed November 30, 2022.

17. US Fish and Wildlife Service, “Arizona Ecological Services Field Office,” https://www.fws.gov/office/arizona-ecological-services, accessed November 30, 2022.

18. United States Geological Survey, “Unified Hazard Tool,” https://earthquake.usgs.gov/hazards/interactive/, accessed November 30, 2022.

19. Apache County GIS Department, “Apache County GIS,” https://apache-co.maps.arcgis.com/apps/webappviewer/index.html?id=2fdb74d76b734d4c98869038eae12aea, accessed November 30, 2022.

20. Department of Homeland Security, “Homeland Infrastructure Foundation-Level Data (HIFLD),” https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::dod-sites-boundaries-public/explore?location=32.531972%2C-111.766813%2C5.76, accessed November 30, 2022.

21. Vivid Maps, “Tornado activity in the United States Mapped,” https://vividmaps.com/untied-states-tornadoes/, accessed November 30, 2022.

22. USGS, “Mineral Resources Online Spatial Data,” https://mrdata.usgs.gov/general/map-us.html, accessed November 30, 2022.

23. Dun & Bradstreet, “Manufacturing Companies in Saint Johns, Arizona, United States of America,” https://www.dnb.com/business-directory/company-information.manufacturing.us.arizona.saint_johns.html, accessed November 30, 2022.

24. FracTracker Alliance, “National Energy and Petrochemical Map”, https://ft.maps.arcgis.com/apps/webappviewer/index.html?appid=0cdff7e116c0425fa55d1226e9204477, accessed November 30, 2022.

25. Nuclear Innovation Alliance, “Advanced Nuclear Reactor Technology, A Primer”, https://nuclearinnovationalliance.org/advanced-nuclear-reactor-technology-primer, July 2023.

26. Energy Information Administration, “Coal and natural gas plants will account for 98% of U.S. capacity retirements in 2023”, https://www.eia.gov/todayinenergy/detail.php?id=55439, accessed February 7, 2023.

27. Arizona Department of Environmental Quality, “Cracking the AQ Code: Temperature Profiles, Inversions, and NO BURN DAYS”, Volume 1, Issue 5, December 2015.

GAIN MANAGEMENT TEAM

Christine King, GAIN Director
Andrew Worrall, GAIN Deputy Director
Chris Lohse, GAIN Innovation and Technology Manager
Holly Powell, GAIN Operations Manager
Donna Kemp-Spangler, GAIN Communications Director
Emily Nichols, GAIN Project Coordinator
Rachel Taow, GAIN Process Modernization
Lori Braase, GAIN Senior Advisor
Hussein Khalil, GAIN Senior Advisor

Prepared for the
U.S. Department of Energy
Office of Nuclear Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

INL/RPT-23-72654
November, 2023