SUBMIT OPTION SUBMITTAL FORM BY:
1. EMAIL TO: COLORADORIVERBASINSTUDY@USBR.GOV
2. U.S. MAIL TO: BUREAU OF RECLAMATION, ATTENTION MS. PAM ADAMS, LC-2721, P.O. BOX 61470, BOULDER CITY, NV 89006-1470
3. FACSIMILE TO: 702-293-8418

Option Submittal Form

Contact Information (optional): ☐ **Keep my contact information private.**

Contact Name: ______ Title: ______

Affiliation: ______

Address: ______

Telephone: E-mail Address:

Date Option Submitted: ______

Option Name:

Convert the Navajo Generating Station's wet cooling system to a dry cooling system

Description of Option:

The retrofit would be limited to decommissioning the existing wet cooling system and would require installation of 6 air cooled condenser units. Expansion of the Navajo Generating Station's site footprint would be required to accommodate for the larger dry cooling system equipment.

Location: Describe location(s) where option could be implemented and other areas that the option would affect, if applicable. Attach a map, if applicable.

Navajo Indian Reservation east of Page, Arizona.

Quantity and Timing: Roughly quantify the range of the potential amount of water that the option could provide over the next 50 years and in what timeframe that amount could be available. If option could be implemented in phases, include quantity estimates associated with each phase. If known, specify any important seasonal (e.g., more water could be available in winter) and/or frequency (e.g., more water could likely be available during above-average hydrologic years) considerations. If known, describe any key assumptions made in order to quantify the potential amount.

The Navajo Generating Station's current consumptive water use is approximately 28,000 AFY. Recent studies estimate that switching to dry cooling can reduce consumptive use by 90-95%. In the case of the Navajo Generating Station, this equates to a reduction of approximately 25,000 to 26,500 AFY. Since the Navajo Generating Station is used to meet peak power needs in the Southwest, water consumption is highest during the summer months when peak power is highest.

Additional Information

Technical Feasibility: Describe the maturity and feasibility of the concept/technology being proposed, and what research and/or technological development might first be needed.

The concept is proven technically feasible and has been implemented in power generation plants around the globe. There are; however, some technical obstacles associated with retrofitting an existing wet cooled power plant. These include the effect of air-cooling on plant power output during hot weather periods, effect of air-cooling on plant efficiency, applicability to an existing plant designed for water cooled service, and larger site footprint.

Costs: Provide cost and funding information, if available, including capital, operations, maintenance, repair, replacement, and any other costs and sources of funds (e.g., public, private, or both public and private). Identify what is and is not included in the provided cost numbers and provide references used for cost justification. Methodologies for calculating unit costs (e.g., $/acre-foot or $/million gallons) vary widely; therefore, do not provide unit costs without also providing the assumed capital and annual costs for the option, and the methodology used to calculate unit costs.

The following costs are based on U.S. Environmental Protection Agency dry cooling cost curves developed based on the flow rate of an equivalent once-through wet-cooling system (USEPA, 2002).

Dry Cooling Retrofit Capital Costs estimates are in $2007

- $254 million for decommissioning of existing wet cooled system and installation of 6 air cooled condenser units

Annual cost (include operations, maintenance, repair, and replacement)

- $7.2 million for air cooled condenser unit operations, etc.

(see attached for more detailed cost breakdown)

Permitting: List the permits and/or approvals required and status of any permits and/or approvals received.

This option reduces consumptive use in the Colorado River basin so no water rights permits are required; however, water use permitting issues could arise depending upon the new use of the saved water. Other permits that would be required are related to waste discharge, hazardous material handling, and public health. Another permitting challenge being faced by the Navajo Generating Station is the potential that the EPA will selective catalytic reduction as the best available retrofit technology for nitrogen oxide emissions. This would entail capital expenditures of $660 million and would raise the price of energy to users such as CAP as the Navajos.

Legal / Public Policy Considerations: Describe legal/public policy considerations associated with the option. Describe any agreements necessary for implementation and any potential water rights issues, if known.

Legal Considerations: There are few if any legal issues with converting existing power plants from water-based cooling to air-based cooling.

Public Policy Considerations: Conversion to dry cooled systems reduce plant efficiency which has the effect of increasing air emission per unit of energy produced. It is anticipated that some groups would take issue with increased air pollution and carbon emissions and possible increased price of electricity (see comment on Permitting).

Implementation Risk / Uncertainty: Describe any aspects of the option that involves risk or uncertainty related to implementing the option.

Carbon legislation may be a risk due to increased carbon dioxide emissions resulting from decreased plant efficiency. Capital costs are about $254 million and securing sufficient funds could be a risk. This is particularly significant for the Navajo Generating Station as the Federal government is the largest owner of the facility and would not be exempt from the requirements of the American Clean Energy and Security Act requiring caps on greenhouse gas emissions. If carbon dioxide allowances were required for the portion of the energy used to pump CAP water, the energy costs per acre-foot of water pumped could be multiples of the current $50.

Reliability: Describe the anticipated reliability of the option and any known risks to supply or demand, such as: drought risk, water contamination risk, risk of infrastructure failure, etc.

The reliability of the augmented water would be expected to follow the same trends as the Colorado River.

Water Quality: Identify key water quality implications (salinity and other constituents) associated with the option in all of the locations the option may affect.

The water quality of augmented water would be expected to be equivalent to existing water quality.

Energy Needs: Describe, and quantify if known, the energy needs associated with the option. Include any energy required to obtain, treat, and deliver the water to the defined location at the defined quality.

Energy Required	Source(s) of Energy
The energy requirements would remain approximately the same.	The source of energy would remain the Navajo Generating Station

Hydroelectric Energy Generation: Describe, and quantify if known, any anticipated increases or decreases in hydroelectric energy generation as a result of the option.

Location of Generation	Impact to Generation
Glen Canyon Dam/Hoover Dam	Water reduction at the Navajo Generating Station could reduce the need to divert flow at Lake Powell. Therefore, it may be possible to generate more power at hydropower facilities at either Glen Canyon Dam or Hoover Dam, but only if this amount of water is not diverted by others. Simplest to say, this option is not likely to have negative impacts to generation and might possibly have positive impacts.

Recreation: Describe any anticipated positive or negative effects on recreation.

Location(s)	Anticipate Benefits or Impacts
Lake Powell/Lake Mead	Water reduction at the Navajo Generating Station could reduce the need to divert flow at Lake Powell. Therefore, it may be possible to have more water in Lake Powell or Lake Mead, but only if this amount of water is not diverted by others. Simplest to say, this option is not likely to have negative impacts to recreation and might possibly have positive impacts.

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Environment: Describe any anticipated positive or negative effects on ecosystems within or outside of the Colorado River Basin.

Location(s)	Anticipated Benefits or Impacts
Colorado River/ Lake Powell	decreased use of water resources could benefit the ecosystems within and around the Lake Powell, Lake Mead, or this general stretch of the Colorado River.
	Increase Air/Carbon Emissions -during hot weather periods, dry cooled power plants experience a reduction in plant efficiency, which results in an increase of air/carbon emissions per unit of energy produced.

Socioeconomics: Describe anticipated positive or negative socioeconomic (social and economic factors) effects.

Because this option is a reduction in consumptive water use from the Colorado River and does not take water away (via a transfer) from another user or another region, this option is not anticipated to have negative socioeconomic impacts to those outside the region. See comment under Implementation Risks/Uncertainty. If allowances for greenhouse gas emissions associated with pumping CAP water were required, the economic impacts to CAP water users would be significant.

Other Information: Provide other information as appropriate, including potential secondary benefits or considerations. Attach supporting documentation or references, if applicable.

Noise Pollution-The noise associated with the larger fans in dry cooling system used to increase the air flow is at least equal to or perhaps greater than cooling tower noise associated with wet cooled systems.

Visual Pollution-The heat transfer equipment required for air cooling is larger, which can be considered to be a negative visual impact.