Attachment H
Chattahoochee Operations Modeling Summary

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Technical Memorandum

Date:	Wednesday, November 13, 2024
Project:	Chattahoochee Hydroelectric System
To:	Georgia Power Company
From:	HDR
Subject:	**Georgia Power Company Chattahoochee Operations Modeling Scenarios Summary**

Purpose and Background

The Bartletts Ferry Project (Federal Energy Regulatory Commission [FERC] No. P-485) and the Middle Chattahoochee Project (FERC No. P- 2177), which consists of the Goat Rock, Oliver, and North Highlands Developments, are owned and operated by Georgia Power Company (GPC), a subsidiary of Southern Company. The two Projects consist of four power generating Developments on the Chattahoochee River, listed in order from upstream to downstream: Bartletts Ferry, Goat Rock, Oliver, and North Highlands.

Georgia Power Company retained HDR Engineering, Inc. (HDR) to update an existing operations model for the Projects and to utilize this model to simulate alternative operations of the Projects to support GPC's energy portfolio investment planning efforts. The operations model for the Projects has been developed using HDR's Computerized Hydro Electric Operations Planning Software (CHEOPS™) software platform. CHEOPS is specifically designed to evaluate the effects of operational changes and physical modifications at hydroelectric projects. Over the past 30 years, the CHEOPS Model has been utilized to simulate operations at more than 300 water resource developments, 95 of which were used to evaluate physical and operational changes considered during the Federal Energy Regulatory Commission (FERC) relicensing of the developments. One of the many strengths of CHEOPS is the degree of customization each individual model contains. CHEOPS models are tailored to meet the demands of the particular system being modeled. CHEOPS models are also custom configured based on specific system constraints such as flow requirements, target reservoir elevations, and powerhouse equipment constraints. Utilizing a daily average inflow dataset as primary input, CHEOPS simulates operations to allocate water between reservoir storage and required outflow constraints (physical, environmental, and operational) while permitting generation.

Alternative Operations Scenarios

Six alternative operations scenarios were developed to show results of simulated operations associated with potential incremental changes from Baseline operations. These scenarios were developed to simulate removal of North Highlands and Goat Rock Dams and the potential cascading removal of remaining upstream dams, where applicable, as well as a simulation of the removal of Bartletts Ferry units 5 and 6 from service.

The entire stretch of river from Bartletts Ferry to North Highlands is approximately 15 river miles, a relatively small distance from the first to the last plant, which makes these plants operational relationship interrelated with each other. The tailwater levels of each plant from Bartletts Ferry to North Highlands are the elevation of the next plants headwater level with relatively little natural riverbed or riverine habitat between each plant.

Significantly changing the tailwater elevation of a hydroelectric station would have adverse effects on the turbine performance and operational range of that station. Decreasing tailwater elevations removes the turbine required design "back pressure" effect tailwater provides to hydroelectric units. Turbines (or units) are designed with specific operational head ranges, and a loss of the tailwater back pressure would change the actual operational head of the turbine. Once this takes place the unit will be subject to operational stress

which would likely result in severe vibrations affecting the bearings and alignment of the unit and negatively impacting the operational capabilities of the units. Additionally, a decrease in tailwater levels would likely subject the unit runner to excessive cavitation, potentially resulting in significant damage to the unit runner blades and risking catastrophic failure of the runner from metal loss in high stress areas. Significant annual repairs and extensive rehabilitation would likely be required, if possible due to runner integrity, to maintain an operational unit experiencing this type of modified hydraulic conditions regime. There is also the potential that the decrease in tailwater elevation would be such that the unit draft tube exit becomes exposed to air. Exposure of the draft tube to air would cause violent surging of the water exiting the draft tube to the river. This surging would result in vibrations above safe unit operation and cause the units to be taken offline to protect from catastrophic failure.

A possible option to mitigate a decrease in tailwater level, which may not be practical or effective at all stations, would be to install a tailrace level retaining weir, effectively re-creating a tailwater pool to maintain the water level and back pressure on the units. In the example of the removal of North Highlands dam, the significant cost of tailwater mitigation may not be economically justified and may result in the decision by Georgia Power to remove the upstream dam as well. The removal of one dam most likely results in the cascading removal of all remaining upstream dams in the system. Consequently, the renewable energy produced by this river system would be removed from the grid.

Considering potential cascading dam removal, the following five scenarios were simulated:

- **No North Highlands –** Three scenarios were simulated to support evaluating removal of North Highlands dam. Additionally, as noted above, without civil infrastructure related investment, the removal of North Highlands dam may result in the cascading removal of all remaining upstream dams in the system. Consequently, the renewable energy produced by these four developments would be removed from the grid. The three scenarios simulated include:

    - **NoNorthHighlands** - This scenario represents the removal of North Highlands dam, including the associated storage operations, operational requirements, and powerhouse. This scenario assumes civil infrastructure related investment to retain tailwater levels of Oliver powerhouse at or near existing levels.
    - **NoNorthHighlands-Oliver** - This scenario represents the removal of North Highlands and Oliver dams, including the associated storage operations, operational requirements, and powerhouses. This scenario assumes civil infrastructure related investment to retain tailwater levels of Goat Rock powerhouse at or near existing levels.
    - **NoNorthHighlands-GoatRock** - This scenario represents the removal of North Highlands, Oliver, and Goat Rock dams, including the associated storage operations, operational requirements, and powerhouses. This scenario assumes civil infrastructure related investment to retain tailwater levels of Bartletts Ferry powerhouse at or near existing levels.

- **No Goat Rock** – Two scenarios were simulated to support evaluating removal of Goat Rock dam. Additionally, as noted above, without civil infrastructure related investment, the removal of Goat Rock dam may result in the cascading removal of Bartletts Ferry. Consequently, the renewable energy produced by these two developments would be removed from the grid. The two scenarios simulated include:

    - **NoGoatRock** - This scenario represents the removal of Goat Rock dam, including the associated storage operations, operational requirements, and powerhouse. This scenario assumes civil infrastructure related investment to retain tailwater levels of Bartletts Ferry powerhouse at or near existing levels.

- **NoGoatRock-BartlettsFerry** - This scenario represents the removal of Goat Rock, and Bartletts Ferry dams, including the associated storage operations, operational requirements, and powerhouses at or near existing levels.

The following scenario was simulated for the removal of Bartletts Ferry Units 5 and 6:

- **NoBartletts56** – This scenario represents the removal of Bartletts Ferry generating units 5 and 6 from service.

The simulated removal of Bartletts Ferry generating units 5 and 6 indicates an overall loss in system total generation; however, the modeling indicates potential incremental increases at the individual downstream developments due to the disproportionate sizing of the Bartlett's Ferry generating station compared to the downstream stations. With all units operating, the Bartlett's Ferry Station hydraulic capacity is about 70 percent greater than the simulated existing Goat Rock generating station (units 3, 6, 7, and 8 in operation), and about 40 percent greater than simulated existing Oliver (assumes units 1 through 3 upgraded) and North Highlands generating stations. This disproportionate relationship results in the downstream generating station operating at less that peak efficiency at time to compensate for the higher Bartletts Ferry capacity, especially during high flows.

Table 1. Simulated No Bartletts Ferry 5 and 6 Generation Summary (simulated for 1965 through 2023)

Scenario	Station	Average Annual Generation (MWh)
No Bartletts Ferry 5 and 6	**Bartletts Ferry**	
	Difference from Baseline (%)	***-12.0%***
	Goat Rock	
	Difference from Baseline (%)	***2.7%***
	Oliver	
	Difference from Baseline (%)	***1.5%***
	North Highlands	
	Difference from Baseline (%)	***1.3%***
	System Total	
	Difference from Baseline (%)	***-4.2%***

Table 2 summarizes the simulated Project (System) total generation for each alternative scenario as compared to the simulated Baseline scenario. The following list summarizes the overall average annual generation loss for each scenario as compared to the Baseline scenario.

Simulated System Total Average Annual Generation Loss (1990-2023) as compared to Baseline:

- NoNorthHighlands – 13.5%
- NoNorthHighlands-Oliver – 37.9%
- NoNorthHighlands-GoatRock – 55.9%
- NoGoatRock – 19.4%
- NoGoatRock-BartlettsFerry – 62.2%
- NoBartletts56 – 4.2%

Table 2. Simulated Generation Summary (simulated for 1965 through 2023)

Scenario		Average Generation (MWh)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Baseline	***System Total Generation***	***105,000***	***108,900***	***121,000***	***96,100***	***81,000***	***65,100***	***65,900***	***61,500***	***56,000***	***54,400***	***68,300***	***91,300***	***974,500***
No North Highlands	*System Total Generation*	***90,900***	***94,500***	***105,000***	***83,100***	***70,000***	***56,200***	***57,000***	***53,000***	***48,400***	***47,000***	***59,100***	***79,200***	***843,400***
	Difference from Baseline (MWh)	*-14,100*	*-14,400*	*-16,000*	*-13,000*	*-11,000*	*-8,900*	*-8,900*	*-8,500*	*-7,600*	*-7,400*	*-9,200*	*-12,100*	*-131,100*
	Difference from Baseline (%)	*-13.4%*	*-13.2%*	*-13.2%*	*-13.5%*	*-13.6%*	*-13.7%*	*-13.5%*	*-13.8%*	*-13.6%*	*-13.6%*	*-13.5%*	*-13.3%*	*-13.5%*
No North Highlands and Oliver	*System Total Generation*	***65,100***	***68,200***	***75,700***	***59,400***	***50,000***	***40,100***	***41,000***	***37,800***	***34,800***	***33,500***	***42,400***	***57,100***	***605,100***
	Difference from Baseline (MWh)	*-39,900*	*-40,700*	*-45,300*	*-36,700*	*-31,000*	*-25,000*	*-24,900*	*-23,700*	*-21,200*	*-20,900*	*-25,900*	*-34,200*	*-369,400*
	Difference from Baseline (%)	*-38.0%*	*-37.4%*	*-37.4%*	*-38.2%*	*-38.3%*	*-38.4%*	*-37.8%*	*-38.5%*	*-37.9%*	*-38.4%*	*-37.9%*	*-37.5%*	*-37.9%*
No North Highlands, Oliver and Goat Rock	*System Total Generation*	***48,200***	***51,700***	***57,300***	***42,500***	***34,600***	***26,700***	***27,900***	***24,900***	***23,000***	***22,000***	***29,400***	***41,500***	***429,700***
	Difference from Baseline (MWh)	*-56,800*	*-57,200*	*-63,700*	*-53,600*	*-46,400*	*-38,400*	*-38,000*	*-36,600*	*-33,000*	*-32,400*	*-38,900*	*-49,800*	*-544,800*
	Difference from Baseline (%)	*-54.1%*	*-52.5%*	*-52.6%*	*-55.8%*	*-57.3%*	*-59.0%*	*-57.7%*	*-59.5%*	*-58.9%*	*-59.6%*	*-57.0%*	*-54.5%*	*-55.9%*
No Goat Rock	*System Total Generation*	***86,200***	***90,500***	***100,400***	***77,600***	***64,400***	***51,000***	***52,000***	***48,200***	***43,900***	***42,500***	***54,700***	***74,500***	***785,900***
	Difference from Baseline (MWh)	*-18,800*	*-18,400*	*-20,600*	*-18,500*	*-16,600*	*-14,100*	*-13,900*	*-13,300*	*-12,100*	*-11,900*	*-13,600*	*-16,800*	*-188,600*
	Difference from Baseline (%)	*-17.9%*	*-16.9%*	*-17.0%*	*-19.3%*	*-20.5%*	*-21.7%*	*-21.1%*	*-21.6%*	*-21.6%*	*-21.9%*	*-19.9%*	*-18.4%*	*-19.4%*
No Goat Rock and Bartletts Ferry	*System Total Generation*	***40,200***	***41,200***	***46,000***	***36,900***	***30,600***	***24,700***	***24,500***	***23,400***	***20,800***	***20,400***	***25,700***	***34,000***	***368,400***
	Difference from Baseline (MWh)	*-64,800*	*-67,700*	*-75,000*	*-59,200*	*-50,400*	*-40,400*	*-41,400*	*-38,100*	*-35,200*	*-34,000*	*-42,600*	*-57,300*	*-606,100*
	Difference from Baseline (%)	*-61.7%*	*-62.2%*	*-62.0%*	*-61.6%*	*-62.2%*	*-62.1%*	*-62.8%*	*-62.0%*	*-62.9%*	*-62.5%*	*-62.4%*	*-62.8%*	*-62.2%*
No Bartletts Ferry 5 and 6	*System Total Generation*	***98,200***	***98,700***	***110,500***	***92,200***	***80,400***	***65,500***	***64,100***	***62,500***	***55,400***	***54,100***	***66,500***	***85,000***	***933,100***
	Difference from Baseline (MWh)	*-6,800*	*-10,200*	*-10,500*	*-3,900*	*-600*	*400*	*-1,800*	*1,000*	*-600*	*-300*	*-1,800*	*-6,300*	*-41,400*
	Difference from Baseline (%)	*-6.5%*	*-9.4%*	*-8.7%*	*-4.1%*	*-0.7%*	*0.6%*	*-2.7%*	*1.6%*	*-1.1%*	*-0.6%*	*-2.6%*	*-6.9%*	*-4.2%*

Conclusions

As stated above, the removal of one dam most likely results in the cascading removal of all remaining upstream dams in the system. Consequently, the renewable energy produced by this river system would be removed from the grid. Additionally, removal of storage operations also has the potential to increase spilling and downstream flooding due to the inability to buffer high inflows to the System.

The removal of North Highlands dam has the highest potential impact. As noted above, without civil infrastructure related investment in the upstream dams, the removal of North Highlands dam may result in the cascading removal of all dams in the system. The next highest potential impact would be the removal of Goat Rock dam, which may result in the cascading removal of all remaining upstream dams (Bartletts Ferry) in the system.

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