Meeting Summary
Harris Action Team (HAT) 1 Meeting
May 3, 2021
9:00 am – 10:00 am
Microsoft Teams Meeting

Participants:
Angie Anderegg – Alabama Power Company (Alabama Power)
Dave Anderson – Alabama Power
Jeff Baker – Alabama Power
Jason Carlee – Alabama Power
Keith Chandler – Alabama Power
Max Chang – Synapse Energy (Synapse)
Allan Creamer – Federal Energy Regulatory Commission (FERC)
Jim Crew – Alabama Power
Amanda Fleming – Alabama Power
Todd Fobian – Alabama Department of Conservation and Natural Resources (ADCNR)
Chris Goodman – Alabama Power
Stacey Graham – Alabama Power
Jim Hancock – Balch and Bingham
Jennifer Haslbauer – Alabama Department of Environmental Management (ADEM)
Martha Hunter – Alabama Rivers Alliance (ARA)
Kelly Kirven – Kleinschmidt Associates (Kleinschmidt)
Carol Knight – Downstream Property Owner
Matthew Marshall – ADCNR
Lisa Martindale – Alabama Power
Donna Matthews – Downstream Property Owner
Ashley McVicar – Alabama Power
Tina Mills – Alabama Power
Jason Moak – Kleinschmidt
David Moore – ADEM
Kenneth Odom – Alabama Power
Alan Peeples – Alabama Power
Jennifer Rasberry – Alabama Power
Grant Redding – Southern Company
Sarah Salazar – FERC
Kelly Schaeffer – Kleinschmidt
Sheila Smith – Alabama Power
Thomas St. John – Alabama Power
Andrew Takasugi – Synapse
Monte Terhaar - FERC
Sandra Wash – Kleinschmidt
Jack West – ARA
David White – Synapse

NOTE: A copy of the May 3, 2021 Battery Energy Storage System HAT 1 presentation is attached.

Meeting Summary:

Angie Anderegg (Alabama Power Company (Alabama Power)) opened the meeting with a safety moment and stated the meeting purpose: to present a summary of the Battery Energy Storage System (BESS) study. Grant Redding, Renewables and Battery Storage Planning and Development Manager for Southern Company, introduced himself to the meeting participants and noted his team supports the retail electric operating companies in their planning and development in renewables and battery storage. This support includes surveying the market annually as well as working with internal and external partners to develop performance and cost estimates. Grant noted that Mississippi Power Company recently received approval from the state commission to deploy a solar plus battery storage hybrid facility in Walnut Grove, Mississippi, and noted that his team is supporting the development of an 80-megawatt (MW) battery storage in the Georgia Power territory.

Tina Mills (Alabama Power) presented an overview of the current Harris operations followed by the summary of the BESS study. The presentation included information on study background and scope, assumptions, economics, estimated costs, fixed operation and maintenance (O&M) with augmentation, battery replacement, asset value, efficiency, dispatch, charging, battery siting and interconnection, changes in turbine-generator units, and effects on resources.

Angie noted that Jack West (Alabama Rivers Alliance (ARA)) had sent a list of questions prior to the meeting and asked if there were any follow-up questions on Harris operations following the presentation. Jack noted that only an outright battery purchase for the cost analysis was presented in the report and asked if Alabama Power reviewed any published Power Purchase Agreement (PPA) rates or considered any other approach besides an outright purchase. In addition, Jack asked how this approach compares to what Southern Company subsidiaries are doing in other markets, like in Georgia and Mississippi. Grant replied that Alabama Power did not review PPA pricing and noted that the National Renewable Energy Laboratory (NREL) pricing used to develop the cost estimate in the BESS study is in line with the market in terms of turnkey Engineering/Design, Procurement, and Construction (EPC) pricing for projects and exhibit similar size points.

Monte Terhaar (FERC) asked how the two-acre required land area estimate was determined for the battery storage. Grant replied that the acreage was based on current development efforts for a four-hour duration battery. Monte thought the required land would be more than two acres. Grant stated that as noted in the report, the two-acres would need to be on flat, contiguous land. Monte stated he is comfortable stating a minimum of two acres. Grant noted that siting in an urban area has additional National Fire Protection Association (NFPA) requirements and the acreage estimates account for buffers. Monte stated there are lot of considerations when it comes to siting, with some projects not having additional Project lands available and noted interconnection challenges for off-site battery storage. Sarah Salazar (FERC) asked if it was possible to estimate the battery replacement costs in 2045 dollars, since 2045 is when the battery is estimated to be replaced. Grant confirmed it could be and noted the estimates provided by NREL are in real dollars and use a 2.5 percent inflation rate to convert. Sarah asked if projected declines in battery costs were considered in the cost analysis. Angie confirmed that declining battery costs were considered. Monte asked if Alabama Power reduced the estimated costs of replacement batteries to account for projected battery price decreases in the future. Grant explained that based on NREL's projections and inflation curves, the 2045 nominal value is greater than the 2025

nominal value. Angie confirmed that the battery replacement cost estimate considers NREL's projected declining battery costs.

Max Chang (Synapse Energy (Synapse)) asked if multiple battery locations were evaluated within Alabama Power's distribution system or potentially tying to other renewable projects to capture Investment Tax Credits (ITC). Grant confirmed Alabama Power did not conduct this evaluation. Donna Matthews (Downstream Property Owner) asked if the solar project in Randolph County utilizes a BESS. Chris Goodman (Alabama Power) confirmed it was a PPA and does not have a BESS. Donna noted the project could be a potential way to tie-in energy. Donna added that Alabama Power's cost analysis appeared appropriate after comparing the costs of Walnut Grove in Mississippi and asked if these estimates were considered. Grant confirmed that the estimates presented for the Harris Project were dictated solely by NREL's projections. Donna noted her appreciation that Alabama Power is working towards their 2050 clean goal.

Max asked if HEC-ResSim model outputs could be provided. Angie noted that the HEC-ResSim model was developed by the U.S. Army Corps of Engineers (USACE) and was available to the public when USACE issued the new Water Control Manual (WCM) for the Alabama-Coosa-Tallapoosa (ACT) Basin. Stacey Graham (Alabama Power) confirmed that the model is not currently available for download. Angie noted that HEC-ResSim model includes the current operations for all Alabama Power and USACE projects in the ACT basin and could be shared, but Alabama Power would determine the best way to do so, potentially through the Harris Relicensing Website (www.harrisrelicensing.com).[1]

Max asked if the broader benefits of a BESS were analyzed, such as benefits to Alabama Power's distribution system, peak capacity, or voltage during periods of non-generation. Angie stated these were not analyzed. With regard to charging the BESS, Max asked if Alabama Power analyzed how the battery could be charged during off-peak hours from the grid and discharging during peak hours. Angie replied that Alabama Power did analyze if inflows were sufficient to charge the BESS. Angie added that Harris is a storage project with no water regulation above the project. Angie noted that since reliable inflow is not sufficient to charge the 60 MW battery or 20 MW battery, the battery would be charged from the grid regardless. Grant confirmed that system production cost modeling was not performed in this study. Max asked for confirmation that if a minimum flow option were proposed at Harris, it would not make a difference because the battery would be charged from the grid and not from a minimum flow. Angie confirmed.

Monte noted that only qualitative assessments on resources were provided in the report. Tina noted that the models used in the Downstream Release Alternatives Phase 2 study to provide quantitative analyses were not applicable to BESS, as the models included peaking operations. Max noted he had additional questions and asked if Alabama Power would prefer them to be submitted in writing. Tina replied that written comments on the draft report would be preferred and stakeholders have until May 26, 2021 to submit comments to harrisrelicensing@southernco.com.

Monte asked why the flows cannot be variable at Harris Dam. Kenneth Odom (Alabama Power) noted the spinning part of the plant is at least 361 tons, thus requiring a lot of force. Kenneth

[1] Following the BESS meeting, Angie consulted with the Alabama Power modeling group and it was determined that the HEC-ResSim and HEC-RAS models, along with outputs, would be shared with stakeholders in the Final License Application in November 2021.

added that the design of the runner (designed to avoid vortex cores, cavitation, and/or pressure oscillations) does not allow for variable flows. Monte noted that the report stated that 6,500 cubic feet per second (cfs) is best gate with a maximum gate flow of 8,000 cfs. Monte asked what minimum flow could be provided by the existing units. Kenneth replied the minimum is not known as the turbines move very quickly from the spinning/condensing mode (with no water flowing across) to the 6,500 cfs-flow zone to avoid cavitation. Kenneth added that he would not expect the flow to be much less than that to avoid vibrations. Sarah noted that she had read that it took approximately 45 seconds from turbine start to best gate. Kenneth confirmed that was accurate.

Monte noted that interest regarding battery storage at hydropower facilities is increasing and that as part of the relicensing process, FERC requested additional information for a BESS at the Harris Project. Monte stated that FERC has licensed a few BESS projects, but all were smaller projects and initiated by the licensee, as it was determined by the licensee to be cost-effective. Monte noted that the Harris Project is different as it is a large storage project, and the feasibility of a BESS at a large storage project is not yet determined. Monte noted that Alabama Power does not feel a BESS is a feasible alternative that should require a detailed analysis. Monte noted that FERC expected a fairly cursory study from Alabama Power at this point, and FERC will be analyzing the applicability of a BESS at the Harris Project.

Max asked if the Francis turbines were replaced with the Kaplan turbines, could the Kaplan turbines be operated under the same synchronous condenser mode or would operations have to change entirely. Kenneth noted that there would likely be operational changes, but the numerous structural changes would be an even greater consideration. Kenneth noted that the entire Harris plant was constructed for a Francis runner and that the Kaplan runner has a completely different structure. Jack noted that there was discussion of installing a theoretical continuous minimum flow turbine (and generating from that flow) at Harris during the recent Updated Study Report (USR) meeting. Jack stated that Alabama Power noted that generating some continuous minimum flows resulted in less water available for peak. Jack stated that pairing a small battery system with that theoretical minimum flow unit would preserve energy generated by the flow and could be used for peak.

Tina reminded participants to submit written comments on the draft BESS and Phase 2 reports (Operating Curve Change Feasibility Analysis and Downstream Release Alternatives) by May 26, 2021 and concluded the meeting.

HAT 1 Meeting
Battery Energy Storage System

R.L. Harris Dam Relicensing
FERC No. 2628

May 3, 2021

Meeting Etiquette

- ❑ Be patient with technology issues
- ❑ Follow the facilitator's instructions
- ❑ Phones will be muted during presentations
- ❑ Follow along with PDF of presentations
- ❑ Use the "chat" feature in Microsoft Teams or write down any questions you have for the designated question section
- ❑ Facilitator will ask for participant questions following sections of the presentation
- ❑ Clearly state name and organization when asking questions
- ❑ Meeting will be recorded to assist with meeting notes

HARRIS DAM RELICENSING

Safety and Roll Call

- Effects
  - Skin Cancer
  - Wrinkles
  - Freckles
  - Cataracts
- Prevention
  - Sun Protective Clothing
  - Sunscreen
  - Wear Sunglasses
  - Seek Shade
  - Wear a HAT

Meeting Purpose and Agenda

❖Present a summary of the BESS study

- Background
- Assumptions
- Economics of Batteries
- Change in Generator Units
- Estimated Costs
- Effects on resources
- Questions

Harris Operations

135 MW
- Two hydroelectric units at 67.5 MW each

Headwater Project

Storage Project
- Operated in accordance with USACE Harris Water Control Manual
- Maintained at or below the elevations specified by the Harris operating curve, except when storing floodwater

Peaking Plant
- Both units designed as peaking units
- Initially no intermittent flows between peaks
- 2005 – pulsing scheme known as Green Plan

HARRIS DAM RELICENSING

BESS Study Background

June 11, 2020 – ARA filed comments on Initial Study Report (ISR) and requested a BESS study

- **Study Goal:** determine whether BESS could be economically integrated at Harris to mitigate impacts of peaking, while retaining full system peaking capabilities

July 10, 2020 – Alabama Power responded to ISR comments, respectfully declining to conduct the proposed BESS study

August 10, 2020 – FERC issued *Determination on Requests for Study Modifications for the R. L. Harris Project* and **recommended** a BESS study

FERC's Recommended Study Scope

- Include costs and also potential benefits to both developmental and non-developmental resources

- Two release alternatives:
  - Option A = a 50% reduction in peak releases associated with installing one 60 MW battery unit
  - Option B = a proportionately smaller reduction in peak releases associated with installing a smaller MW battery unit

- Include cost estimates for
  - installing a BESS
  - structural changes
  - changes in turbine-generator units
  - costs needed to implement each battery storage type

- Evaluate effects on recreation and aquatic resources at Harris Project

- Incorporate the BESS Study into the Downstream Release Alternatives Study

BESS Study Scope

- For this study, peaking operations = one unit operating for 4 hours during peak energy demand
  - Consistent with operations in HEC-ResSim Daily Model in DRA Phase 1 Report

- BESS Alternatives
  - 60 MW battery with 240 MWh capacity that can provide the equivalent generation of one unit at best gate for 4 hours per day/every day.
  - 20 MW battery with 80 MWh capacity that can provide the equivalent generation of one-third of one unit at best gate for 4 hours per day/every day.

Assumptions

- BESS related cost projections were based on the National Renewable Energy Laboratory (NREL) data
- Analysis focused solely on Lithium Ion battery chemistry
  - Power quality and stability not considered
- Preliminary transmission impacts - screening level effort
- High potential for variability exists for siting and environmental permitting; site-specific details were not vetted
- Analyses assume an initial in-service date of 2025
- Power supplied to the grid is unchanged
- Turbine/unit modifications required to meet goal of the study

Assumptions, cont.

- NREL data used in report also incorporates oversizing to accommodate energy losses
- Option A - the same daily volume of flow is released, but the amount of flow that would have been released from one unit at best gate is now dispersed throughout the day
- Option B – a peak release would still be required because 40 MW is still required for hydropower unit during peak

Economics

- BESS
  - BESS estimated installation costs
  - Fixed operation & maintenance with augmentation
  - Battery replacement
  - Asset Value
  - Battery efficiency, dispatch, and charging
  - Battery siting
  - Interconnection

- Changes in Turbine-Generator Units

Estimated BESS Installation Costs

- Installation Costs include:
  - BESS System
  - Interconnection
  - Internal Overheads
  - Contingency
  - Financing

- Option A Total Installed Cost (2025$) $96.6M

- Option B Total Installed Cost (2025$) $39.0M

Fixed O&M with Augmentation

❖All Li-ion systems degrade over time, losing capacity

❖Due to degradation, suppliers offer augmentation programs to maintain the nameplate capacity of a system.
- Typically performed every 2 to 3 years

- Option A
  - $1.79M annually for first twenty years
  - $1.94M annually following battery replacement

- Option B
  - $0.597M annually for first twenty years
  - $0.647M annually following battery replacement

Battery Replacement Costs

- Li-ion battery storage asset life is typically no more than 20 years

- Replacement Costs include:
  - BESS System
  - Internal Overheads
  - Contingency
  - Financing

- Option A Total 2045 Replacement Costs (2025$) $56.4M

- Option B Total 2045 Replacement Costs (2025$) $19.7M

Asset Value

- When adding an asset to the Southern Company system, the potential value of the asset relative to the alternative must be considered, in addition to its costs.
  - Compare hydro peaking unit and BESS peaking unit

- Deferred generation capacity credit
  - Existing hydro peaking unit – full deferred generation credit due to its ability to provide full-rated capacity for at least 8 hours
  - 4–hour energy storage asset – approximately 76% annual deferred generation capacity credit

- Energy production cost savings
  - Hydro asset is greater due to its zero-cost fuel source; not reasonable or necessary to locate a BESS near the hydro asset
  - BESS transfers energy from one time to another while overcoming its efficiency losses; only attributed with the incremental energy production savings; requires greater production of energy to overcome the efficiency losses

Efficiency, Dispatch, and Charging

- A BESS is a net energy consumer, as it requires more energy to charge than is discharged; is typically oversized.
- Southern Company dispatches generating assets to serve customers at the lowest cost while maintaining required reserve margins for reliability purposes.
- BESS can be charged using several configurations; can be independently sited or charged by a co-located generator
- Charging a BESS with hydropower unit is dependent on a reliable reservoir inflow.
  - Inflow into Harris Reservoir is insufficient to fully charge both Option A and Option B on daily basis

Battery Siting & Interconnection

Siting

- 60 MW / 240 MWh BESS would typically require approximately two acres of contiguous flat land to be cost effective.
  - Cursory review or proposed area around Harris Dam – adequate property exists
  - Additional due diligence to determine siting availability and development feasibility as well as environmental review

Interconnection

- Not currently adequate space and/or a spare terminal at Harris Dam or Crooked Creek Transmission System to connect to BESS
- New substation would be necessary
- Estimated screening level costs
  - Capital Costs - $9M
  - Long-term, O&M costs - $173k per year

Changes in Turbine-Generator Units

- Existing turbines are not designed to operate at flows lower than best gate.
- Upgraded unit must maintain ability to pass 8,000 cfs to operate during flood conditions
- Unit would need to operate at much lower flows for Options A and B
  - Option A requires a variable flow turbine capable of low flows to current full gate flow
  - Option B requires a newly designed Francis turbine capable of flows from approximately 4,300 cfs to current full gate flow
- Turbine Replacement Costs
  - Option A: unknown
  - Option B: $20M

HARRIS DAM RELICENSING

Estimated Costs

- Summary of costs over a 40-year license term
- Would require battery replacement during that term

	Option A	Option B
Total Installed Cost (2025$)	$96.6M ($1,610 / kW)	$39.0M ($1,950 / kW)
Fixed O&M (including augmentation) (2025-2044)	$1.77M * 20 years	$0.597 * 20 years
Total Replacement Cost (2025$)	$56.4M ($941 / kW)	$19.7M ($984 / kW)
Fixed O&M (including augmentation) (2045-2064)	$1.94M * 20 years	$0.647M * 20 years
Turbine Replacement Cost	Undetermined	$20M
Interconnection O&M (based on current OATT rate and subject to periodic adjustments)	$173,000 * 40 years	$173,000 * 40 years

Effects on Resources

- Scoping-level qualitative assessment

- Recreation – Lake Harris
  - No effect to recreation if BESS would result in releasing same daily volume of water as current operations
  - Adverse impact on recreation if BESS affected ability to maintain operating curve

- Recreation – Tallapoosa River downstream of Harris Dam
  - Option A – under certain assumptions, may benefit recreationists launching in tailrace and for the first few miles below Harris Dam
  - Option B – recreation based activities would still occur as they do under current operations, although peak release would be smaller

- Aquatic Resources – Tallapoosa River downstream of Harris Dam
  - Option A – could potentially benefit aquatic resources first 7 miles downstream
  - Option B – would not have same benefits as Option A as peak is still required; similar to Pre-Green Plan operations

BESS Discussion

Q & A time