2023 Annual Report on Water Quality and Aeration Operations at the Saluda Project

Saluda Hydroelectric Project

Columbia, South Carolina

Prepared by: Andy Sawyer, Reservoir Environmental Management, Inc

March 2024

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Dominion Energy South Carolina, Inc.
Cayce, South Carolina

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SALUDA HYDROELECTRIC PROJECT

DOMINION ENERGY SOUTH CAROLINA, INC.
CAYCE, SOUTH CAROLINA

1.0 INTRODUCTION

As required by Section 8.5 of the Offer of Settlement on Complaint Regarding Water Quality in the Lower Saluda River ("Settlement Agreement"), submitted to the Federal Energy Regulatory Commission on May 19, 2004 and approved by the Commission in an order issued on July 15, 2004, as modified by an order issued on December 21, 2004, Dominion Energy South Carolina, Inc. ("DESC") (formerly South Carolina Electric & Gas Company ("SCE&G"), as the licensee for the Saluda Hydroelectric Project ("Saluda Project" or "Project") has prepared this annual summary of the following topics:

1. Dissolved Oxygen ("DO") and other water quality monitoring results for Lake Murray and the Lower Saluda River ("LSR");
2. A preliminary evaluation of the implementation of the prior year's Operating Plan; and
3. Preliminary recommendations for the coming year's Operating Plan.

This report will present the results of water quality monitoring, as based on data obtained from the United States Geological Survey ("USGS"),[1] for the period June 1 through November of 2023 which is the timeframe when low DO near the lake bottom can result in low DO releases to the LSR. Then, an evaluation of maintaining the goal of the water quality standard, as expressed in Sections 9.2 and 9.3 of the Settlement Agreement will be presented, subject to the conditions identified in Section 9.3.

[1] As with any *in-situ* continuous monitor, anomalous readings occur from time to time, due to equipment fouling or malfunction. If the USGS determines the data are suspect through their Quality Control/Quality Assurance Program, that data may be ignored, appropriately adjusted, or otherwise dealt with according to their final determination. It is acknowledged that the USGS data is reported initially as "provisional."

The following background considerations are restated from the 2004 Operating Plan, the initial operating plan submitted in compliance with the Settlement Agreement:

- The Company is committed to complying with the DO standard for the Saluda River downstream from Saluda Project to the extent practicable. Factors affecting the ability to ensure continuous compliance include:
    - the limited capability for aeration of water released through the turbine units;
    - the requirement that SCE&G manage water levels in Lake Murray for project safety and other reasons;
    - the need to use Saluda Hydro for the special operating needs specified under Item 9.3 of the Settlement Agreement; and
    - the need to meet SCE&G's reserve obligation to maintain electric load-generation balancing and management of local voltages and system frequency in real time.
- Generators sometimes fail, and generation failures generally are unpredicted and sudden, upsetting the load-generation balance. Because electricity cannot be stored, any sudden reduction in generation cannot be handled by an inventory, as might happen in most other kinds of business. Instead, generation losses must be met by reserve generation that can be dispatched instantly, before voltage sags or frequency excursions lead to local or widespread blackouts. The Company is a member of the Virginia-Carolinas Southeastern Electric Reliability Council sub-region ("VACAR"), whose members are bound in a reserve-sharing agreement by which each has agreed to assist any other member in generation emergencies. As part of its obligations as a member of VACAR, SCE&G must employ its reserves to meet its own generation emergencies before calling on assistance from other VACAR members, and it must be constantly ready to provide reserve generation to other VACAR members. Generally, the reserves required to be maintained by SCE&G are in the range of 190-200 MW, which matches the capacity of the Saluda Project and its ability to respond quickly to any generation outage on its system.

During the low DO period of 2023, DESC implemented the operating plan summarized below, consistent with the guidelines contained in Appendix A:

- The plan addressed the limited objectives identified in the settlement agreement, i.e., doing what reasonably could be done to improve the likelihood that stream-specific DO standards would be met in the LSR, while, at the same time, not constraining in any manner DESC's ability to use the Saluda Project to meet its reserve obligations.

1.1 OVERVIEW OF 2023 AERATION OPERATIONS:

The site-specific DO standard for the LSR was maintained during most of the period June through November.

Positive aspects of the 2023 low DO period were the effort of DESC to maintain tailrace DO at or above 2 mg/L during periods of higher flow. The aeration systems currently in place reflect implementation of best attainable turbine venting systems for the original units at Saluda Hydro.

The DO measured by the water quality monitor (02168504) maintained by the USGS some 760 yards (2280 ft) downstream from the project's powerhouse was less than the state standard on two occasions when the flow through the Saluda Project was greater than flow levels at which current turbine aeration can attain the DO standard:

1. June 21 through June 26, DO less than 4 mg/L for 514 15-minute readings
2. November 15, DO less than 4 mg/L for 24 15-mintue readings

All excursions are summarized in Section 3.0 following the presentation of the excursions.

2.0 SUMMARY OF 2023 OPERATIONS AND WATER QUALITY MONITORING

2.1 WATER MANAGEMENT AND RESERVE OBLIGATIONS

The gauged inflows and pool level elevations of Lake Murray over the period of assessment are presented in Figures 1 and 2, respectively.

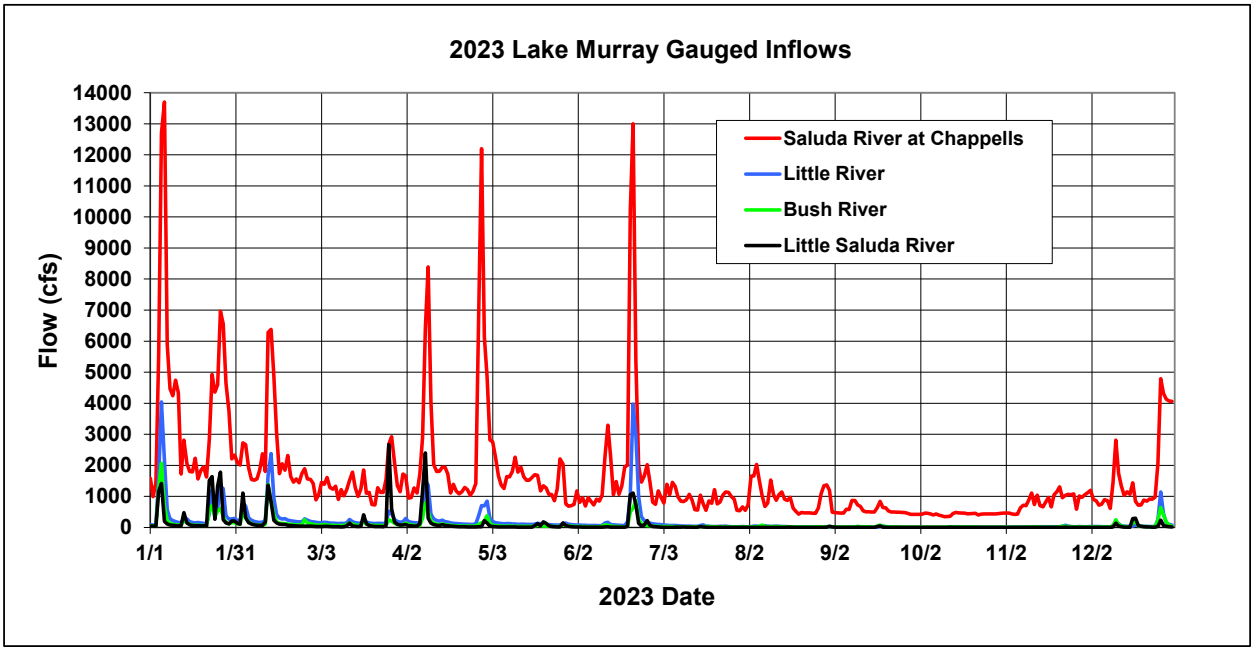


FIGURE 1 2023 LAKE MURRAY GAUGED INFLOWS

To determine the total inflow to Lake Murray, these gauged inflows are scaled to represent flow from each total watershed.

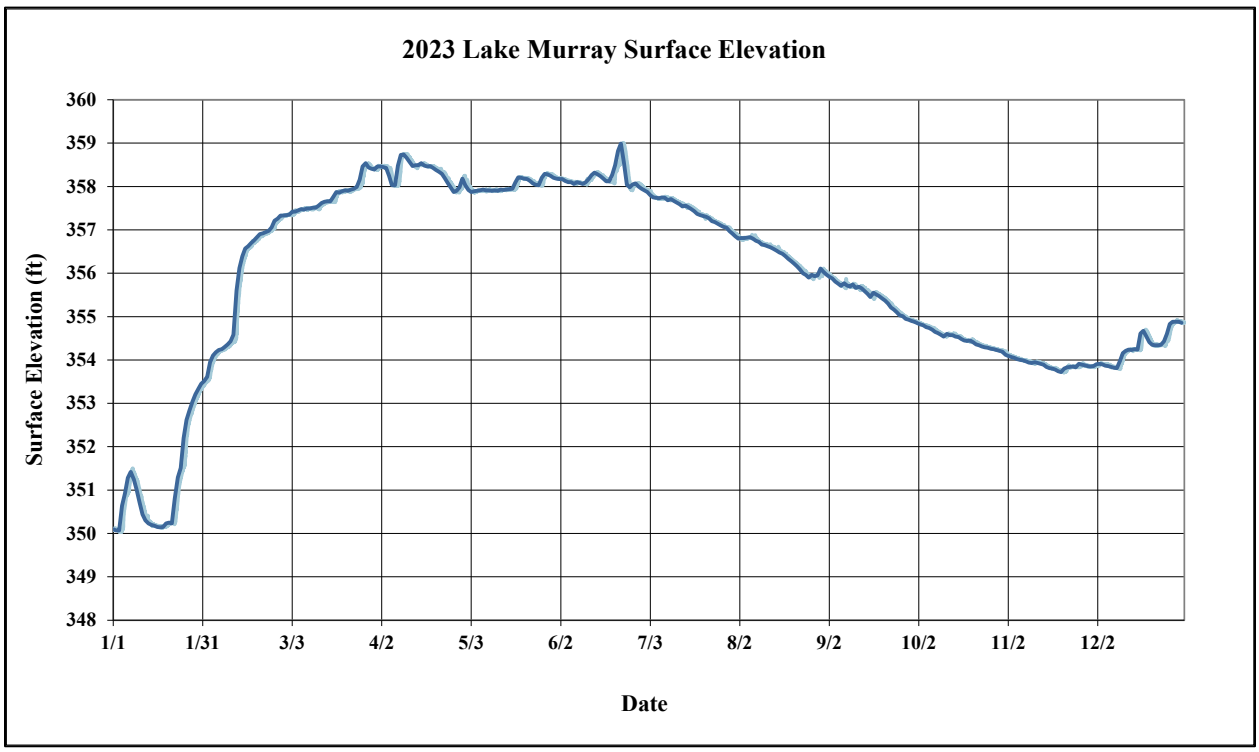


FIGURE 2 2023 POOL ELEVATION OF LAKE MURRAY

The Project was operated for lake level management as well as to maintain downstream flow and DO levels throughout the low DO season. The Saluda Project was called upon to meet the Company's reserve obligation during the low DO period on November 15

The low DO season started in early June and ended in late-November of 2023.

2.2 UNIT OPERATIONS AND AERATION SYSTEMS

The turbine vents on unit 4 were opened 100% on June 10. The valves remained opened on all available units during the rest of the low DO period.

Prior to 2012, aeration testing indicated that for three-unit operations, Unit 2 drew about 50% less air than Unit 1 (the best aerating unit at that time), Unit 3 drew about 67% less air than Unit 1, and Unit 4 drew about 33% less air than Unit 1. For single unit operations, Unit 2 drew about 55% less air than Unit 1 (the best aerating unit at that time), Unit 3 drew about 67% less air than Unit 1, and Unit 4 drew about 45% less air than Unit 1. Unit 5, being of different design and manufacture, drew the least air of any of the units. Larger hub baffles were installed on Unit 5 in 2007, but air flow did not increase significantly.

During August 2012, it was noted that Unit 1 had decreased in aerating effectiveness and was no longer the best aerating unit. Plant operators inspected the air vent valve and piping, and replaced a check valve spring; however, aeration did not improve. A revision to the Condensed Lookup Tables was made to reflect the lower aeration capability of Unit 1, and the revised tables were issued to the System Control operators on August 30, 2012. On May 15 and 16, 2013, Furmanite sealed the Unit 1 head cover. DESC planned to conduct tests during the 2013 low DO season to develop revised Condensed Lookup Tables; however, high inflows required operations using more than one unit most of the season, and the planned tests could not be performed. Therefore, the revised Condensed Lookup Tables used in latter 2012 also were used in 2013 and 2014.

On September 23-24, 2014, aeration tests were conducted on Units 1, 3, and 4 so that aeration results on Unit 1 could be compared to results on Units 3 and 4. These aeration tests are described in Appendix D. The results indicated that Unit 4 aerated the best followed by Unit 1 and then Unit 3 with the lowest DO increase. The data also showed that higher DO occurred at the lower gate settings with DO decreasing as the gate openings increased. The revised 2015 Condensed Lookup Tables are in Appendix C. In 2020, Unit 1 stopped venting effectively and the lookup tables were revised in 2021 to reflect this and to add Unit 5 into the unit combinations. These were used during the 2023 low DO season and are included in Appendix C.

2.3 WATER QUALITY DATA

Figures 3 and 4 present the profiles of temperature and DO collected by DESC Environmental Compliance personnel in the forebay of Lake Murray in 2023. These profiles were collected using a Hydro Lab Surveyor 4A portable water quality instrument with an MS5 sonde. The profiles show that DO in front of the intakes for Units 1-4 was near zero starting in early-July.

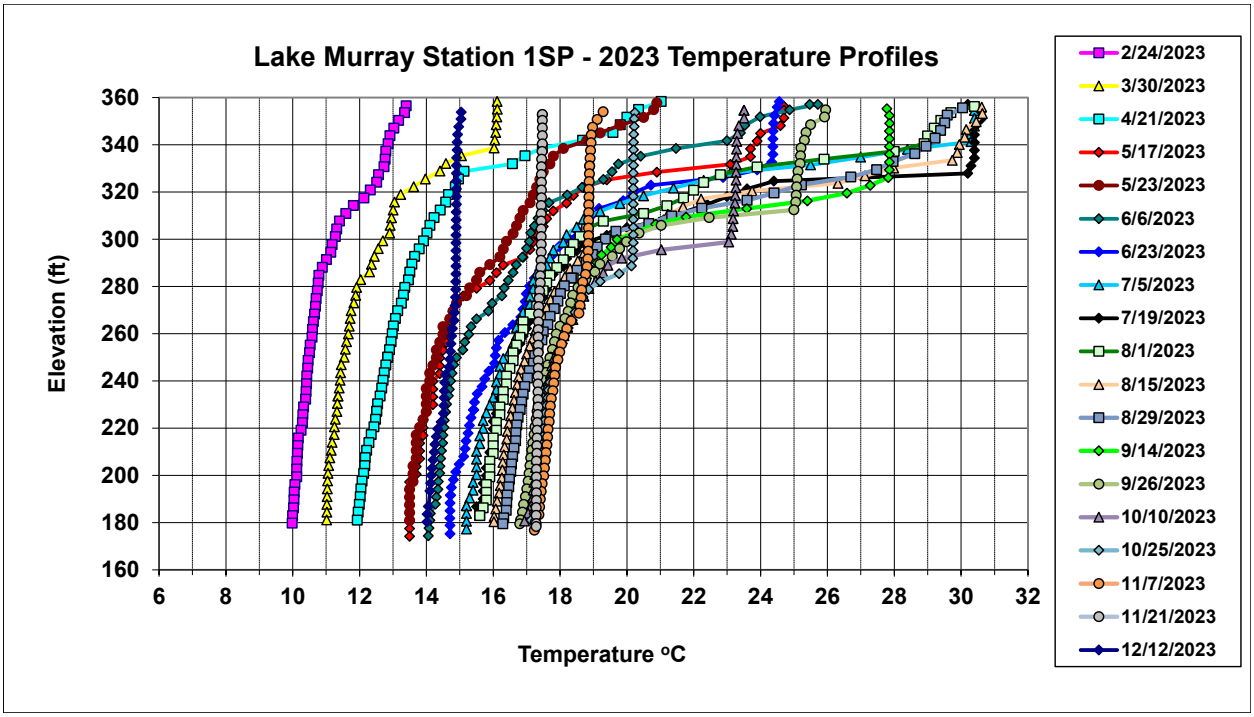


FIGURE 3 2023 FOREBAY TEMPERATURE PROFILES IN LAKE MURRAY

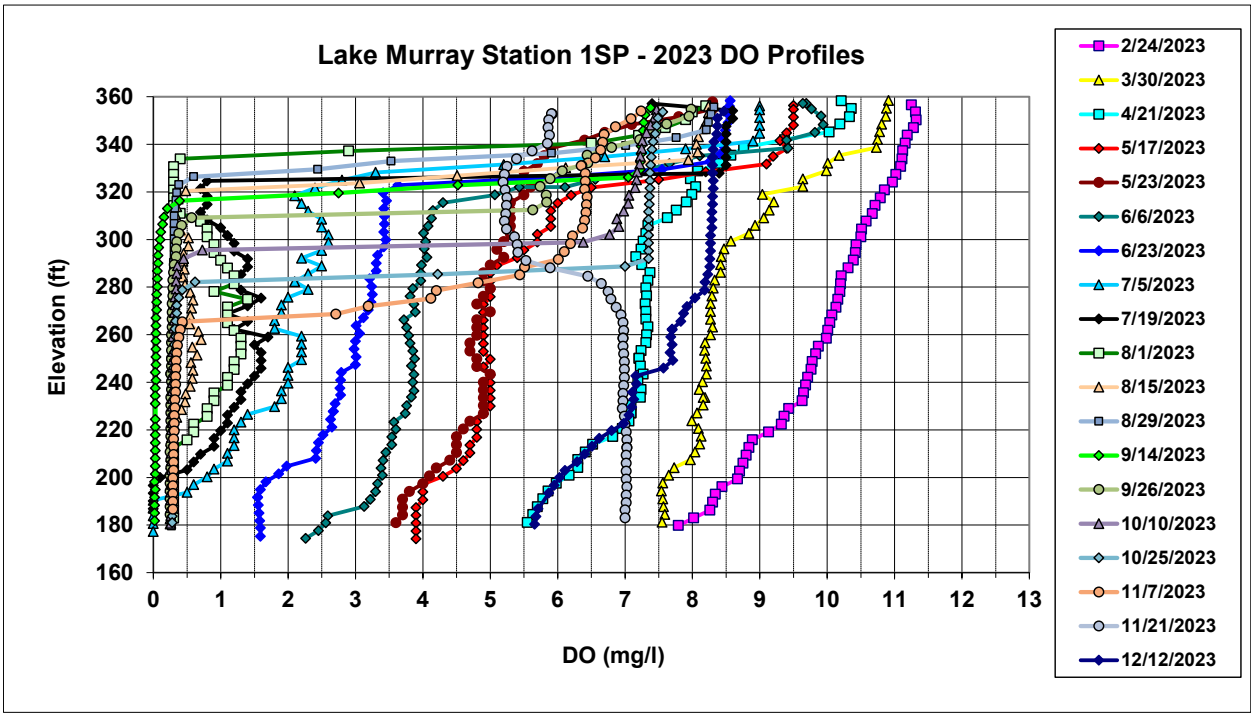


FIGURE 4 2023 FOREBAY DO PROFILES IN LAKE MURRAY

Figure 5 presents the temperature and DO results from the USGS monitors in the forebay of Lake Murray. This figure shows that the temperature and DO at the intake for Unit 5 (i.e., DO-Bottom) increased to about the same level as the surface water in late-November.

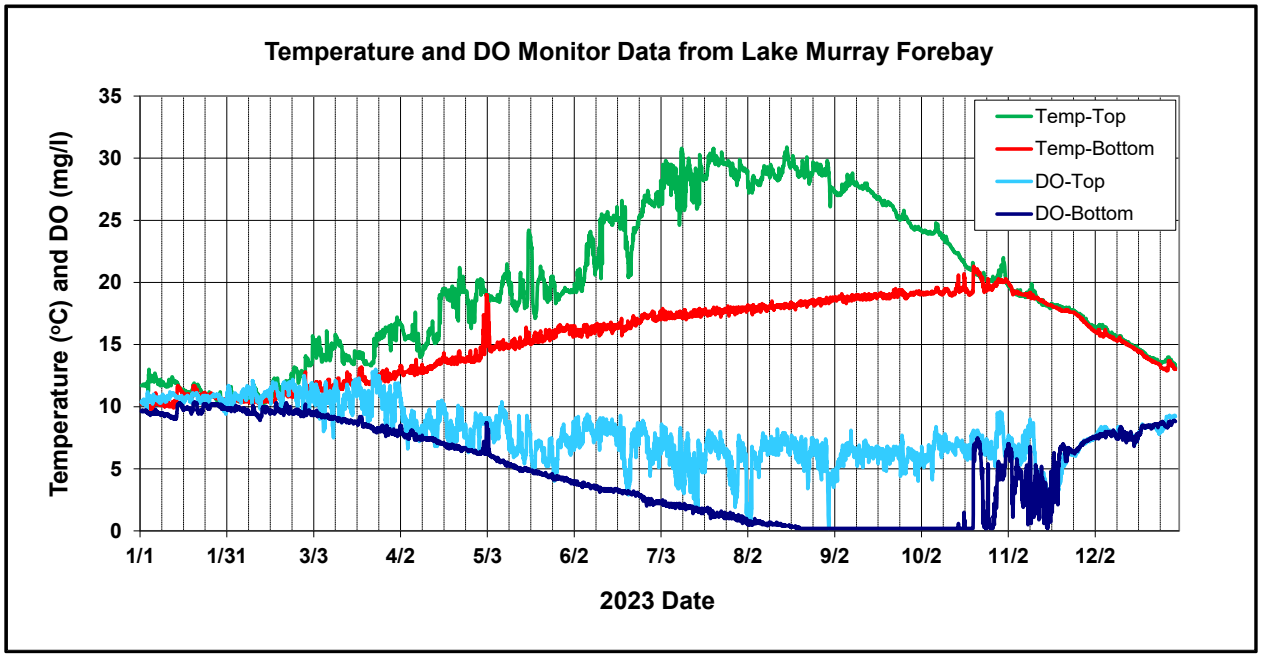


FIGURE 5 TEMPERATURE AND DO MONITOR DATA FROM LAKE MURRAY FOREBAY

Figure 6 presents the results of temperature and DO measurements at the USGS monitor (02168504) immediately downstream from the Saluda Powerhouse. The graph includes the flow measurements measured by the USGS gage as well as the daily average and the rolling 30-day average DO values.

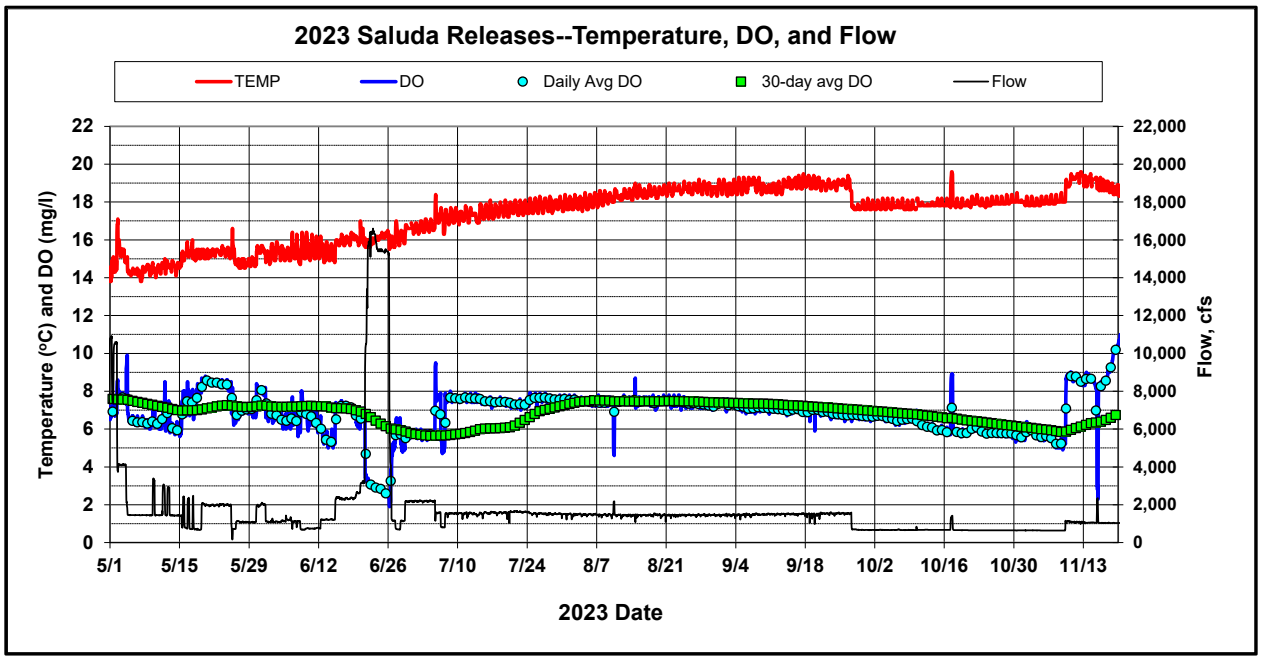


FIGURE 6 2023 SALUDA RELEASES (USGS 02168504) TEMPERATURE, DO, AND FLOW

Figure 7 presents the temperature and DO results of measurements at the USGS monitor (02169000) about eight miles downstream from the Saluda Hydro Powerhouse near the confluence of the Saluda and Broad Rivers. The graph includes the data recorded by the monitor as adjusted by USGS. It also includes the flow measurements by the USGS gage as well as the daily average DO values.

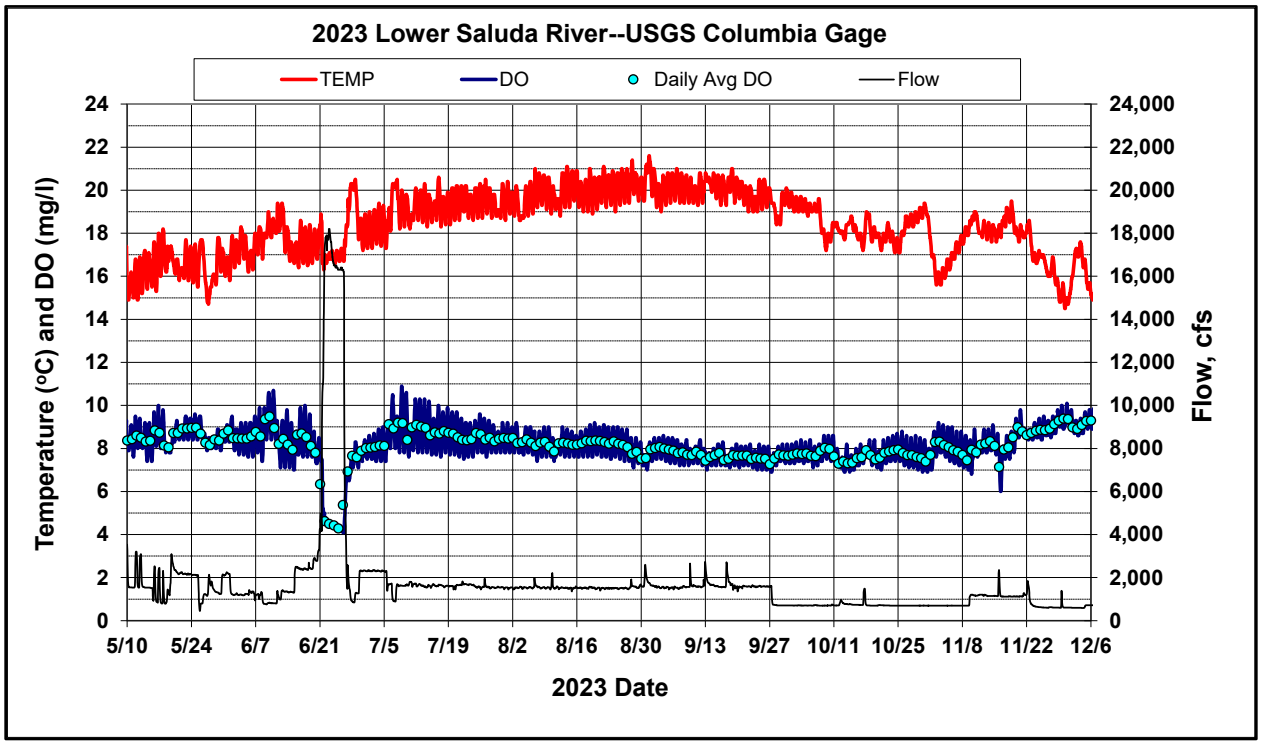


FIGURE 7 2023 LOWER SALUDA RIVER (USGS 02169000) – USGS COLUMBIA GAGE

3.0 EVALUATION OF 2023 OPERATIONS

The levels of DO in the tailrace were at or above state standards for 98.5% in 2023. Since Units 1–4 have declined in DO uptake in the past several years, this was accomplished by using Unit 5 at low output to provide good DO uptake in combination with a smaller unit at low load to discharge cooler water from the lower-level intakes.

Excursions of DO less than the SCDHEC site-specific DO standard occurred during two periods of designated operations. The first period was for lake level management, and the second period was for system reserve. The following email was sent to stakeholders on November 16, 2023 to explain the excursion that occurred on November 15:

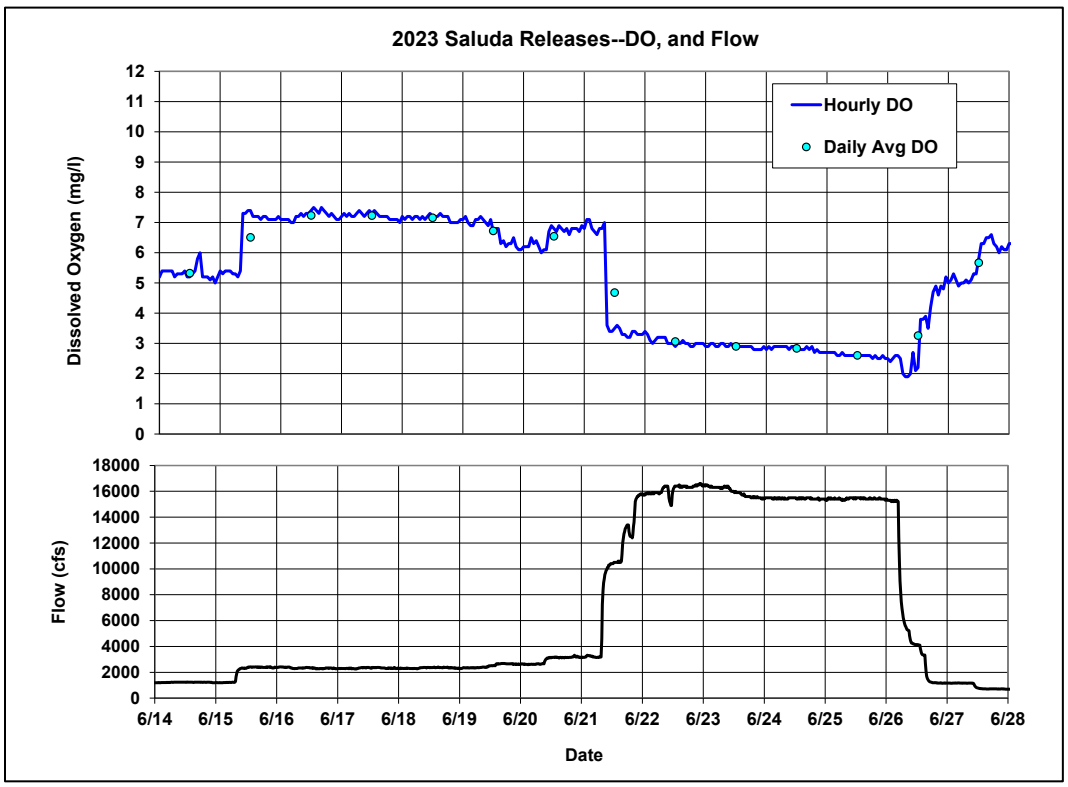
From: Raymond Ammarell (DESC Generation - 8)
To: Elizabeth Miller - SCDNR; Bill Marshall (marshallb@dnr.sc.gov); Jason Bettinger; Rusty Wenerick (weneriwr@dhec.sc.gov); Chuck Hightower - DHEC; Bill Stangler (CRK@congareeriverkeeper.org); Gerrit Jobsis - AR; Peter Raabe - AR
Cc: James Miller (DESC Generation - 8); Henry Delk (DESC Generation - 8); David Tucker (DESC Generation - 8); Amy Bresnahan (DESC Generation - 8); Matt Hammond (DESC Trans Distribution - 7T)
Subject: Saluda DO Yesterday Evening
Date: Thursday, November 16, 2023 9:56:03 AM

Saluda DO Stakeholders,
I wanted to let you know about the DO excursion below 4 mg/l that occurred for several hours yesterday evening. We had to take one of our larger coal fired units offline for several hours to perform a repair, and the water level in Monticello Reservoir is still too low to allow Fairfield Pumped Storage to cover the required reserves for our system as it normally would. Our system operators needed to have the Saluda units 1, 3, and 4 spinning in addition to Unit 5 for rapid start until the coal unit came back on line. This was a reserve operation to maintain system reliability. Unit 5 has been providing DO levels of about 8.5 mg/l, but adding the small units in at minimum load reduced the DO to between 2 and 3 mg/l at the tailrace gage. DO at the Columbia (Zoo) gage has just now dropped to 6 mg/l and it looks like that may be the low reading at that gage that will result from this operation.
This will be documented in the annual Article 31 report and discussed at the review meeting next year. In the meantime, please let me know if you have any questions.

Raymond R. Ammarell, P.E.
DESC Power Generation
Dam Safety & Hydro Compliance

Additional correspondence between DESC, stakeholders and SCDNR is enclosed in Appendix E.

Figure 8 presents an enhanced view of the DO and flow conditions during the time periods in which the excursions occurred, and Table 1 summarizes the cause of the excursions.



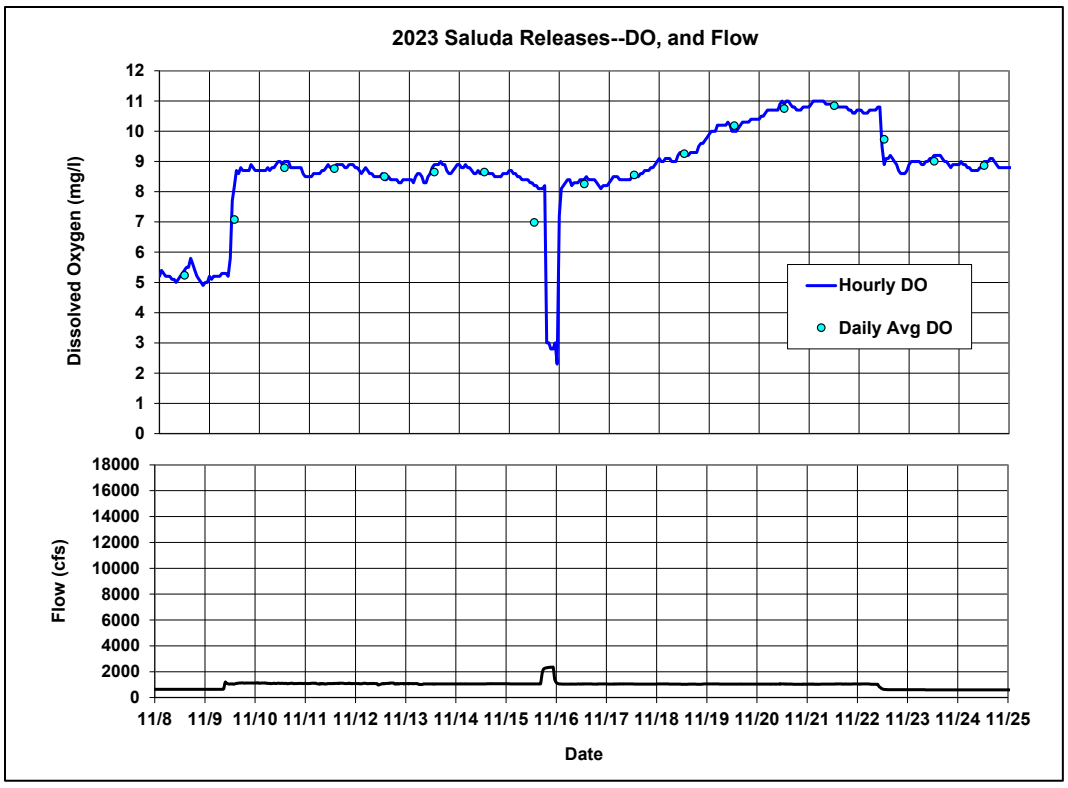


FIGURE 8 2023 SALUDA RELEASES – PERIODS WHEN EXCURSION OCCURRED

SUMMARY OF EXCURSIONS IN 2023

SALUDA RELEASES GAGE (USGS 02168504)

The summary of excursions is presented in Table 1. There were 514 15-minute data excursions of the minimum DO due to lake level management and maintaining downstream flow and DO levels and there were 24 15-minute data excursions of the minimum DO due to system reserve in November. Dissolved oxygen levels in the LSR, measured below Saluda Hydro, met or exceeded the instantaneous minimum standard of 4.0 mg/L 98.5% of the time in 2023. There were 6 excursions of the daily average DO of 5 mg/L and no excursions of the 30-day average DO of 5.5 mg/L in 2023.

COLUMBIA GAGE (USGS 20169000)

There were no excursions of the minimum DO and four excursions of the daily average DO at the USGS gage near Columbia (20169000) in 2023.

TABLE 1 SUMMARY OF EXCURSIONS OF DO LESS THAN THE SC SITE-SPECIFIC DO STANDARD (INSTANTANEOUS, DAILY, AND 30-DAY STANDARDS). PERCENT VALUES REPRESENT PERCENT OF ENTIRE YEAR.

Summary of Excursions for 2023--Causes and Metrics, based on USGS indicated DO monitor readings										
Saluda Releases Gage										
Causes	**Dates**	**Number of 15-minute Observations < 4 mg/L**	**% of Time < 4 mg/L**	**Average DO during Excursions**	**Minimum DO during Excursion**	**Number of Days Avg DO < 5 mg/L**	**% of Time < 5 mg/L Daily Avg**	**Number of Days 30-day Avg DO < 5.5 mg/L**	**% of Time < 5.5 mg/L 30-day Avg DO**	**Comments**
Operations	June 21 - June 26	514	1.47	2.90	1.8	6	1.6	0	0.0	Lake level management
Operations	Nov 15	24	0.07	2.94	2.3	0	0.0	0	0.0	Reserve
Totals		**538**	**1.54**			**6**	**1.6**	**0**	**0.0**	
Columbia Gage										
Causes	**Dates**	**Number of Hours < 4 mg/L**	**% of Time < 4 mg/L**	**Average DO during Excursions**	**Minimum DO during Excursion**	**Number of Days Avg DO < 5 mg/L**	**% of Time < 5 mg/L Daily Avg**	**Number of Days 30-day Avg DO < 5.5 mg/L**	**% of Time < 5.5 mg/L 30-day Avg DO**	**Comments**
N/A	June 22 - June 25	0	N/A	4.82	4.1	4	1.1	0	N/A	
Totals		**0**	**0.00**			**4**	**1.1**		**0.0**	

Additional comments about excursion periods:

1. Due to low flows on the Broad River, Fairfield Pumped Storage was not available to cover reserves for the system. Saluda Hydro units were generating at a minimum load during this period to be available for system operators should a rapid start be necessary for a reserve call. Stakeholders were notified in an email dated 11/16/23 of the excursion.

3.1 PERFORMANCE OF THE LOOK-UP TABLES

The LUTs that were developed for 2008 reflected the effects of the hub baffles that were added to Units 1-5 and the repairs to the headcover seals for Units 1-4. As noted in Section 2.2 above, revisions to the Condensed Lookup Tables were made in August 2012 and 2015. See Appendix D regarding the 2014 aeration study. These revised Condensed Lookup Tables appeared to perform well until the smaller units' venting performance began to decline in 2020. DESC revised the Condensed Lookup Tables in 2021 to put Unit 1 last in the dispatch sequence until it is repaired and to add Unit 5 to the unit combinations. A new nose cone and hub baffles were installed on Unit 3 in Spring 2024, so DESC revised the 2024 Condensed Lookup Tables to put Unit 3 ahead of Unit 4 in the dispatch sequence and added Unit 5 to the unit combinations at low loads since it vents well. The June – September "Last On, First Off" operation of Unit 5 as previously observed has been modified by necessity since it may be run at low loads in combination with one or more smaller units to maintain adequate DO and cooler temperatures in the lower Saluda River until the smaller units can be repaired or have new aerating runners installed.

3.2 COMMENTS ON THE CURRENT MONITORING SYSTEM

Prior to 2018 the USGS had a procedure to rate the accuracy of their monitors. This rating was generally based on the amount of correction needed to the data during each inspection period, but other variables are also considered. In 2018 the USGS discontinued this rating process. All provisional temperature and dissolved oxygen data collected with the continuous monitor are analyzed and corrected as needed prior to being approved. The current monitoring system performed well during 2023.

RECOMMENDATIONS FOR 2024

1. With the installation of the new optical DO probe in the tailrace, it is recommended that the USGS continue to check the calibration of the monitor once per month.
2. Replace the nose cone and repair the hub baffles on Unit 3 to attempt to improve DO uptake for this unit. This effort is underway as of mid-April 2024.
3. Continue to coordinate the timing of restrictions on Unit 5 operations at higher loads on a "last on, first off" basis with SCDNR based on fisheries and water quality profile data near the intake towers, i.e., determine when Unit 5 can be operated without restriction to enhance DO in the tailrace.
4. Utilize Unit 5 at low loads (< 10 MW) in combination with Unit 3 or Unit 4 to provide better DO uptake and maintain downstream temperatures < 20 deg. C (68 deg. F)
5. To better represent the current aeration characteristics of Unit 1 as experienced in 2020, use the 2022 version of the Condensed LUTs developed in early 2021 until repairs are completed on Unit 1. (See updated Condensed LUTs in Appendix C).
6. Conduct annual training within DESC so that operators are prepared to minimize DO excursions.
7. Implement the DESC water management procedure so as to allow sufficient aeration to meet the DO objectives in the tailrace when the pool level is being lowered for normal seasonal operations.
8. DESC will notify organizations desiring special releases from the Saluda Project that might adversely affect the level of DO in the tailwater to schedule their activities during periods of the year when low DO is not normally a concern.
9. DESC will continue to coordinate with DNR to provide DO relief throughout an extended low DO excursion and implement options for aiming to keep the DO above 2.0 mg/l during a potential high inflow event.

Note that 10 MW on Unit 5 is approximately 1,800 cfs

4.0 MONITORING OF DISSOLVED OXYGEN IN THE TAILRACE

The current USGS water quality monitor in the tailrace has served its purpose well with respect to providing information on temperature and DO conditions. In 2006, DESC relocated this USGS gage to the center of the river channel as recommended in the 2005 report on operating results to reduce fouling of the gage and improve its representation of DO in the releases from the Saluda Project. USGS use of the new optical DO probe significantly reduced fouling compared to previous probes. Also, USGS is now correcting provisional data following calibration checks, although the corrections may not be made on the web site for about one month following data collection.

APPENDIX A

FINAL GUIDELINES FOR OPERATION OF THE SALUDA PROJECT FOR DISSOLVED OXYGEN MANAGEMENT IN 2024

GUIDELINES FOR OPERATION OF THE SALUDA PROJECT FOR DISSOLVED OXYGEN MANAGEMENT IN 2024

PURPOSE

These Guidelines for Operation of the Saluda Project for Dissolved Oxygen Compliance are prepared pursuant to the *Offer of Settlement On Complaint Regarding Water Quality In Lower Saluda River* (May 19, 2004) (Settlement Agreement). Paragraph 9.3 of the Settlement Agreement provides the following:

> To the extent within SCE&G's reasonable control, each Operating Plan will seek to enhance existing water quality in the lower Saluda River and, more specifically, seek to achieve DO concentrations of 4 mg/1 minimum, 5 mg/l daily average, and 5.5 mg/1 monthly average in the lower Saluda River. In seeking to achieve this goal, each Operating Plan will preserve SCE&G's right or duty to modify operations as necessary to: (A) protect life and property, (B) respond to changed hydrologic or other circumstances not addressed in the Operating Plan, (C) maintain the use of the Project to meet system reserve obligations of 200 MW, and (D) comply with a lawful orders of the [Federal Energy Regulatory] Commission or other authorities. SCE&G will provide notice of such modification to the Conservation Groups, [South Carolina Department of Health and Environmental Control], and Other Agencies in advance of such modification if practicable, and otherwise, as soon as practicable thereafter. The Parties will then use their best efforts to modify the Operating Plan in response thereto.

DESC will implement these Guidelines consistent with paragraph 9.3.

LIMITATIONS

Paragraph 9.3 of the Settlement Agreement includes limitations, and these limitations are more fully explained here. Operation of the Saluda Project affects dissolved oxygen (DO) levels in the Saluda River downstream of the Saluda Project. Factors affecting achievement and maintenance of the DO standard include: (1) the limited capability for aeration of water released through the turbine units, (2) the requirement that DESC (formerly SCE&G) manage water levels in Lake Murray for safety and other reasons, (3) the need to use Saluda Hydro for the special operating needs specified under paragraph 9.3 of the Settlement Agreement, and (4) the need to meet

DESC's reserve obligations as a member of the Virginia-Carolinas Reserve Sharing Group (VACAR RSG).

Generating units occasionally fail, and these generation failures are not generally capable of prediction. These often-sudden failures upset the load-generation balance. Because electricity cannot be stored, any such sudden reduction in generation cannot be made up by an inventory, as would be the case in most other kinds of business. Instead, generation losses must be met by reserve generation that can be dispatched instantly before voltage sags or frequency excursions lead to local or widespread blackouts. VACAR RSG members are bound in a reserve-sharing agreement by which each has agreed to assist any other member in generation emergencies. DESC must employ its reserves to meet its own generation emergencies before calling on assistance from other VACAR RSG members, and it must be constantly ready to provide reserve generation to other VACAR RSG members. Generally, the reserves required to be maintained by DESC are in the range of 190-200 MW, which matches the capacity of the Saluda Project and its ability to respond quickly to any generation outage on its system.

As done in 2004-2023, DESC will provide via email, during 2024, a weekly report to the South Carolina Department of Health and Environmental Control, South Carolina Coastal Conservation League (SCCCL) and other stakeholders documenting the previous week's operation of the Saluda Project.

Unless otherwise specified, these guidelines will be implemented by DESC.

TURBINE VENTING OPERATIONS

Use Lookup Tables (LUTs) as Guides To Aerate the Turbine Releases From the Saluda Project. DESC will use the condensed LUTs included in Appendix C of this document titled "2021 Condensed Lookup Table" (see pages C-5 and C-6) and, in part, based on "Original Lookup Tables Developed in February 2008," (Appendix B). These LUTs reflect the best practice for aeration operations based on field testing and predictive models of how the units at Saluda Hydro can be operated to enhance downstream dissolved oxygen levels and still obtain target MW outputs, given the inflow DO and temperature conditions. To simplify use of the

LUTs a condensed set of LUTs was developed, and these are in Appendix C. Use of the condensed LUTs in Appendix C results in higher than normal DO levels in the tailwater for the conditions when DO in the inflow is greater than 1 mg/L since these LUTs are based on the assumption that DO in the inflow is zero mg/L. As noted in Section 2.2 above, a revision to the condensed Lookup Tables was made in 2021 due to decreased aerating efficiency of Unit 1. The revised 2021 condensed Lookup Tables put Unit 1 last in the dispatch sequence until it is repaired and added Unit 5 to the dispatch combination and are contained in Appendix D.

Estimate Inflow DO and Temperature for Units 1-4 and Unit 5. Turbine DO and temperature from inflows change during the course of the low DO period. To track DO and temperature conditions in the turbine inflows, DESC will obtain DO and temperature profiles in the Saluda Project forebay every other week during low DO season (once per month during other times of the year) and use these profiles to predict conditions in the turbine inflows. During 2024 the United States Geological Survey (USGS) continuous water quality monitor located near the intake of Unit 5 (U5)[2] has been temporarily removed due to construction work on the intake towers and will not be available during 2024.

Use DO Readings in the Tailrace from the USGS Monitor. During 2023, the USGS monitor (USGS Gage No 02168504) will be used to track DO conditions in the tailrace on a daily basis, supplemented by periodic spot measurements by DESC, especially if DO, as measured at the monitor, appears erratic or is lower than expected (*e.g.*, suspected fouling, meter malfunction, *etc*.).

Conduct training of operators in System Control. The System Control Manager will conduct a training session annually with System Operators to ensure proper application of the LUTs. Training of staff includes review of current practices and procedures in the proper application of the LUTs. This training is normally conducted during a six-week period each year. Additional training will be conducted as the need arises.

[2] As with any *in-situ* continuous monitor, anomalous readings occur from time to time, due to equipment fouling or malfunction. If the USGS determines the data are suspect through their Quality Control/Quality Assurance Program, that data may be ignored, appropriately adjusted, or otherwise dealt with according to their final determination. It is acknowledged that the USGS data is reported initially as "provisional."

APPENDIX B

ORIGINAL LOOKUP TABLES DEVELOPED IN FEBRUARY 2008

Note that SCE&G is now Dominion Energy South Carolina, Inc. Appendix B references SCE&G since it is from a document issued in 2008 prior to becoming Dominion Energy South Carolina, Inc.

LOOKUP TABLES FOR OPERATING THE SALUDA PROJECT TO ENHANCE DISSOLVED OXYGEN IN THE TAILRACE TO THE EXTENT PRACTICABLE FOR 2008

FEBRUARY 2008

Lookup Tables (LUTs) will be used as a tool for operating the Saluda Project during the low DO period of each year so that the DO standard in the Lower Saluda River may be met continuously, subject to the limitations contained in paragraph 9.3 of the Settlement Agreement, and to provide optimal aeration when the standard otherwise cannot be met. The LUTs will be used by SCE&G to select the turbine units that will be operated at various total project flow rates and power production levels, under varying inflow DO concentrations and temperatures. Also, the aeration system will be manually operated. It is expected that when a final turbine aeration system is installed at some point in the future, a computer-controlled automated system may be needed to adjust these operations for more optimal aeration.

The overall process used to develop the LUTs involved the following steps:

1. The aeration characteristics of units 1, 2, 3, and 4 were modeled using the discrete bubble model as described in "Saluda DO Standard Project—Lower Saluda River DO Technical Study Report, Appendix C, Prediction of Dissolved Oxygen Concentrations for Turbine Discharges from Saluda Hydro" 2003. The aeration characteristics of unit 5 were estimated based on data collected during turbine aeration testing in 2005 and 2006 (see report "Saluda Hydroelectric Project—2005-2007 Aeration Studies" June 2008.)
2. The predicted DO in the tailrace for each set of inflow DO and temperature conditions was then plotted over the range of hydro operations.
3. The LUTs were then developed using these graphs. One set of LUTs was developed assuming that the units were operated several hours per day and the other set of LUTs was developed assuming the units were operated at a constant level over the course of the entire day.
4. LUTs were developed for a range of DO conditions at the intake, but for only one temperature condition that was similar to that expected during the low DO period. Model predictions were made for other temperature conditions, but the effort was not expended to develop LUTs for all the temperature conditions modeled due to the time required to develop LUTs. The results of aeration studies and the development of aeration models for the Project have shown that temperature has insignificant effect on DO (i.e., less than 0.2 mg/L) within the range of temperature variations in the turbine intakes.

5. The LUTs were developed using mass balance equations that integrated the effects of all the units and predicted DO in the tailrace, assuming full mixing of the releases from all the units.
6. For project operations, SCE&G System Control normally dispatches Saluda Hydro by power production levels rather than water flow rates; therefore, the flow rates initially determined using the turbine aeration model were supplemented by conversion to MW levels using the results of unit tests conducted in 1997 and 1998.

The assumed conditions for the turbine aeration systems are as follows:

1. Units 1-5 have hub baffles, and aeration characteristics for Units 1 and 4 were assumed to be as modeled in 2008 based on data collected on Units 1 and 4 in 2005 and 2006, respectively. Predicted DO levels for Units 2, 3, and 5 were based on data collected during testing in 2005 and 2006.
2. Unit 2 cannot be operated unless 2500 cfs is being released by the other units. Unit 5 would normally be operated on a "last on, first off" basis.

Assumptions used in developing the LUTs:

1. SCE&G plans to operate the Saluda Project at a minimal release of approximately 500 cfs during the summer. Under this condition, DO in the release from the Saluda Project should be well over the State DO standard for Units 1 and 4. Also, inflow water quality (*i.e.*, DO and temperature) will change slowly over the course of the summer and early autumn. The use of Unit 3 for providing minimum flows during the period of low DO will be avoided unless Units 1 and 4 are not available.
2. Two sets of LUTs were prepared: one set for hourly operations where the DO target is 4 mg/L (see discussion below), and the other set for daily operations where the DO target is 5 mg/L, *i.e.*, the daily operations tables will be applied when Saluda is being operated around the clock under steady state conditions, the hourly operations tables will be applied when one or more units are operated over a period of hours. An analysis of historical conditions (see the report supporting the new site-specific standard for DO for the Lower Saluda River) showed that if 4 mg/L was achieved over a period of several hours during a typical day of operations at the Saluda Project, the other requirements of the DO standard (*i.e.,* the daily average of 5 mg/L and the 30-day moving average of 5.5 mg/L) are achieved under almost all conditions. Considering the current aeration systems, the lack of computerized powerhouse controls, and the DO monitoring system, the use of these two sets of LUTs is considered to be what is practicable.
3. It was assumed that the target minimum DO would be 4 mg/L during the period of maximum release each day. This is because an analysis of historical conditions showed that if 4 mg/L was achieved during the maximum release period, the other requirements

of the DO standard (*i.e.*, the daily average of 5 mg/L and the 30-day moving average of 5.5 mg/L) are achieved under almost all conditions.

4. For days when the Saluda Project would be operated throughout the day, it was assumed that the target minimum DO would be 5 mg/L. This approach is consistent with the assumption that SCE&G plans to operate the Saluda Project at around 500 cfs during the low DO period.

Inflow water quality for Unit 5 was assumed to have the same conditions as the inflows for Units 1- 4. This is a conservative assumption in that DO in the inflow to Unit 5 is rarely less than the DO in the inflows to Units 1- 4. This is based upon an extensive review of historical reservoir profile data.

The following LUTs are proposed for the operating guides for achieving aeration objectives during the low DO period. Figures B-1 through B-6 show the predicted DO concentrations in the tailrace versus unit releases for various operating conditions (i.e., inflow water quality conditions) at the Saluda Project. These graphs were used in developing the LUTs.

LOOKUP TABLES FOR HOURLY OPERATIONS

(DO TARGET IS GREATER THAN OR EQUAL TO 4 MG/L)

(Note: DO_{min} values in the following tables are the predicted lowest DO levels that would be expected to occur for the range of stated DO and temperature inflow conditions and the project flows. These values are provided only for those operations that might not attain the 4 mg/L DO objective in the tailrace.)

Turbine Inflow Conditions: DO 3 – 3.9 mg/L; Temperature = 15°C (approximately mid-July to August 1)		
MWs desired	**Approx. flow (cfs)**	**For Hourly operations, the following is recommended:**
≤ 18	≤ 1500	U1; U3; U4; U5 (last on, first off) U2 (restricted for thermal load),
18-28	1500-2250	U1; U4; U3; U5 (last on, first off); U2 (restricted for thermal load)
28-37	2250-3150	U1; U4; U3; U5 (last on, first off); U2 (restricted for thermal load)
37-75	3150-6300	Any two units*** (except U5) **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	Any three units (except U5) **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600, limit for 4 mg/L	Any available small units with U5 as needed to supplement the small units;
≥ 150	≥ 12,600	Any units with preference to U1, U4, U2 and U3, then U5. DO_{min} = 3.7

*** unless unit-specific flows are listed, “any 2 units”, “any 3 units”, and “any 4 units” implies splitting flow approximately evenly between the units.

Turbine Inflow Conditions: DO 2 – 2.9 mg/L; Temperature = 16°C (approximately August 1 to mid-August); DO objective in tailrace is 4 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Hourly</u> operations, the following is recommended:**
≤ 16	≤ 1400	U1; U4; U3;
16-37	1400-3150	U1; U4; U3 DO_{min} = 3.3; U5 (last on, first off) DO_{min} = 3.0
37-75	3150-6300, limit for 4 mg/L	U1+ any unit (except U5); U4+ any unit (except U5) DO_{min} = 3.4; U3+U2 DO_{min} = 3.2; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	U1+U2+U3+U4 DO_{min} = 3.8; U1+U4+(U2 or U3), DO_{min} = 3.6; U4+U2+U3 DO_{min} = 3.2; U2+U3+U5 DO_{min} = 3.0 with U5 (last on, first off) **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	Four original units DO_{min} = 3.3; any available small units with U5 as needed to supplement the small units; DO_{min} = 3.0 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	U1+U4+U2+U3+U5, DO_{min} = 3.0; U1+U2+U3+U5@72MW, DO_{min} = 2.7; U4+U2+U3+U5@72MW, DO_{min} = 2.6 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units, DO_{min} = 2.8 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Turbine Inflow Conditions: DO 1 – 1.9 mg/L; Temperature = 16°C (approximately mid-August to September 1); DO objective in tailrace is 4 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Hourly</u> operations, the following is recommended:**
≤ 14	≤ 1250	U1, U3, U4
14-21	1250-1750	Any original unit;
21-32	1750-2750	U1; U4; U3 DO_{min} = 2.9;
32-37	2750-3150	U1; U3+U4; U4 DO_{min} = 3.5; U3 DO_{min} = 2.4
37-50	3150-4000, limit for 4 mg/L	U1+U4; U1+U3 DO_{min} = 3.6; U4+U3 DO_{min} = 3.4; (U1 or U4)+U5 (last on, first off) DO_{min} = 3.0; U3+U5 (last on, first off) DO_{min} = 2.5
50-75	4000-6300	U1+U4 DO_{min} = 3.5; U1+(U2 or U3) DO_{min} = 3.1; U4+(U2 or U3) DO_{min} = 2.5; U3+(U2 or U5) DO_{min} = 2.2 with U5 (last on, first off) **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	Four original units DO_{min} = 3.0; U1+U4+U2 or U3 DO_{min} = 2.7; U1+U2+U3 DO_{min} = 2.5; U4+U2+U3 DO_{min} = 2.3; any two small units with U5 (last on, first off) DO_{min} = 2.1 to 2.7 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	U1+U4+U3+U2 DO_{min} = 2.4; U1+U4+(U3 or U2)+U5 DO_{min} = 2.3; U2+U3+U4+U5 DO_{min} = 2.1; U3+U2+U5@72MW DO_{min} = 1.6 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	U1+U4+U2+U3+U5, DO_{min} = 2.1; U1 or U4+U2+U3+U5, DO_{min} = 1.7; three small units+U5, DO_{min} = 1.4 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units, DO_{min} = 1.8 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Turbine Inflow Conditions: DO 0 – 0.9 mg/L; Temperature = 16°C (approximately September 1 to mid-September and stays at 0 until lake mixing); DO objective in tailrace is 4 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Hourly</u> operations, the following is recommended:**
≤ 12	≤ 1100	Any unit except U2 or U5
12-19	1100-1600	U1, U3 or U4;
19-29	1600-2400	U1; any two units except U2 or U5; U4 DO_{min} = 3.4; U3 DO_{min} = 2.2;
29-38	2400-3200	U1+U4; U3+U4; U1 DO_{min} = 3.6; U4 DO_{min} = 2.7; U3 DO_{min} = 1.5;
38-57	3200-4800, limit for 4 mg/L	U1+U3+U4; U1+U4 DO_{min} = 3.2; U1+U2 DO_{min} = 2.8; U1+U3 DO_{min} = 2.8; U2+U4 DO_{min} = 2.6; U3+U4 DO_{min} = 2.4; U2+U3 DO_{min} = 2.0;
57-75	4800-6300	U1+U4 DO_{min} = 2.6; U1+U2 or U3 DO_{min} = 2.3; U4+U2 or U3 DO_{min} = 1.8; If only one small unit is operating, consider U5 (last on, first off) as follows: U1+U5 DO_{min} = 2.1; U4+U5 DO_{min} = 1.6; U2 or U3+U5 DO_{min} = 1.2 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	All 4 original units DO_{min} = 2.0; U1+U4+(U2 or U3) DO_{min} = 1.8; U1+U2+U3 DO_{min} = 1.6; U4+U2+U3 DO_{min} = 1.4; any available small units supplemented by U5 as needed DO_{min} = 0.7 ; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	All 4 original units DO_{min} = 1.5; If only three small units are operating, consider U5 (last on, first off) as follows: U1+U2+U3+U5, DO_{min} = 1.3; U4+U2+U3+U5, DO_{min} = 1.1; U2+U3+U5@72MW, DO_{min} = 0.9 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	U1+U4+U2+U3+U5 DO_{min} = 1.1; U1+U4+(U3 or U2)+U5@72MW, DO_{min} = 1.0; U1+U2+U3+U5@72MW, DO_{min} = 1.0; U4+U2+U3+U5@72MW, DO_{min} = 0.9 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units, DO_{min} = 1.0 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Turbine Inflow Conditions: DO 0 – 0.9 mg/L; Temperature = 20°C (approximately September 1 to mid-September and stays at 0 until lake mixing); DO objective in tailrace is 4 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Hourly</u> operations, the following is recommended:**
≤ 10	≤ 1000	Any unit except U2 and U5
10-18	1000-1500	U1, U3 or U4;
18-25	1500-2000	U1; Any two units except U2 and U5; U4 DO_{min} = 3.5; U3 DO_{min} = 2.6;
25-31	2000-2500	Any two small units except U2; U1 DO_{min} = 3.7; U4 DO_{min} = 3.1; U3 DO_{min} = 2.1;
31-36	2500-3000,	Any two small units except U2; U1 DO_{min} = 3.5; U4 DO_{min} = 2.7; U3 DO_{min} = 1.5;
36-44	3000-3600, limit for 4 mg/L	U1+U4; U1+U3 DO_{min} = 3.7; U4+U3 DO_{min} = 3.3; If only one small unit is operating, consider U5 (last on, first off) as follows: U1@ ≤ 33MW + U5@ ≤ 12MW DO_{min} = 3.7; U4@ ≤ 31MW + U5@ ≤ 12MW DO_{min} = 3.4;
44-75	3600-6300	All small units DO_{min} 3.5; U1 full gate + rest split between U3+U4 DO_{min} = 3.3; U1+U4+(U2 or U3) DO_{min} = 2.7; U1+U4 DO_{min} = 2.5; U4+U2+U3 DO_{min} = 2.3; U1+(U2 or U3) DO_{min} = 2.2; If only one small unit is operating, consider U5 (last on, first off) as follows: U1+U5 DO_{min} = 2.0; U4+U5 DO_{min} = 1.5; U2+U3 DO_{min} = 1.4; (U2 or U3)+U5 DO_{min} = 1.1; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	All four original units DO_{min} = 2.0; U1+U4+(U2 or U3) DO_{min} = 1.7; U1+U2+U3 DO_{min} = 1.5; U4+U2+U3 DO_{min} = 1.3; any one-two small units supplemented by U5 as needed DO_{min} = 0.7; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	All 4 original units DO_{min} = 1.4; U1+U4+U5+(U2 or U3) DO_{min} = 1.3; U1+U2+U3+U5, DO_{min} = 1.2; U4+U2+U3+U5, DO_{min} = 1.1; U2+U3+U5@72MW, DO_{min} = 0.9 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	U1+U4+U2+U3+U5 DO_{min} = 1.1; U1+U4+(U3 or U2)+U5@72MW, DO_{min} = 1.0; U1+U2+U3+U5@72MW, DO_{min} = 1.0; U4+U2+U3+U5@72MW, DO_{min} = 0.9 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units, DO_{min} = 1.0 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Lookup Tables for Daily Operations

(DO Target Is Greater Than or Equal to 5 mg/L)

(Note: DO_{min} values in the following tables are the predicted lowest DO levels that would be expected to occur for the range of stated DO and temperature inflow conditions and the project flows. These values are provided only for those operations that might not attain the 5 mg/L DO objective in the tailrace.)

Turbine Inflow Conditions: DO 4 – 4.9 mg/L; Temperature = 14°C (approximately July 1 to mid-July); DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For Daily operating conditions (i.e., operating ~ 24 hours per day), the following is recommended:**
≤ 25	≤ 2000	Any unit except U2 and U5
25-37	2000-3150	Any original unit(s) except U2;
37-75	3150-6300	Any 2 or more original units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	Any 3 or 4 small units; if only one original unit is available and U5 is operated up to 72MW, DO_{min} = 4.4 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600, limit for 5 mg/L	Any 4 or more units; if U1 and U4 are out and U5 is operated up to 72MW DO_{min} = 4.6 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	All 5 units DO_{min} = 4.9; if U1 or U4 is out DO_{min} 4.5; U1+U4+U5@72MW+U2 or U3 DOmin = 4.7 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units DO_{min} = 4.8 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

*See discussion in Appendix A on Page 1 Paragraph 1, and Items 2 and 4 on Pages 8 and 9.

Turbine Inflow Conditions: DO 3 – 3.9 mg/L; Temperature = 15°C (approximately mid-July to August 1); DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Daily</u> operating conditions (i.e., operating ~ 24 hours per day), the following is recommended:**
≤ 15	≤ 1350	Any unit except U2 and U5
15-25	1350-2000	Any original unit;
25-37	2000-3150	U1; U4; Flow split between any 2 units; U3 DO_{min} = 4.3;
37-75	3150-6300, limit for 5 mg/L	U1+U4; any 3 original units; U2+U3 DO_{min} = 4.3; U2+U5 DO_{min} = 4.0 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	All small units DO_{min} = 4.6; U1+U4+(U2 or U3) DO_{min} = 4.5; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	U1+U4+U2+U3 DOmin = 4.2 ; any available small units with U5 as needed to supplement the small units DO_{min} = 3.7 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 150	≥ 12,600	Any units with preference to U1, U4, U2 and U3, then U5. DO_{min} = 3.7 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Turbine Inflow Conditions: DO 2 – 2.9 mg/L; Temperature = 16°C (approximately August 1 to mid-August); DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Daily</u> operating conditions (i.e., operating ~ 24 hours per day), the following is recommended:**
≤ 13	≤ 1200	Any unit except U2 and U5
13-21	1200-1750	Any original unit except U2 and U5;
21-28	1750-2250	U1; U4; Any 2 units except U2 and U5; U3 DO_{min} = 4.0;
28-37	2250-3150	U1; Any 2 original units; U4 DO_{min} = 4.3; U3 DO_{min} = 3.3;
37-75	3150-6300, limit for 5 mg/L	U1+U2+U3+U4; U1+U4+(U2 or U3) DO_{min} = 4.5; U1+U4 DO_{min} = 4.2; U1+(U2 or U3) DO_{min} = 3.8; U4+(U2 or U3) DO_{min} = 3.4; U2+U3 DO_{min} = 3.3; (U2 or U3)+U5 DO_{min} = 3.1 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	U1+U2+U3+U4 DO_{min} = 3.8; U1+U4+(U2 or U3), DO_{min} = 3.6; U4+U2+U3 DO_{min} = 3.2; U2+U3+U5 DO_{min} = 3.0 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	Four original units DO_{min} = 3.3; any available small units with U5 as needed to supplement the small units DO_{min} = 3.0 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	U1+U4+U2+U3+U5, DO_{min} = 3.0; U1+U2+U3+U5 at full gate, DO_{min} = 2.7; U4+U2+U3+U5 at full gate, DO_{min} = 2.6 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units, DO_{min} = 2.8 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Turbine Inflow Conditions: DO 1 – 1.9 mg/L; Temperature = 16°C (approximately mid-August to September 1); DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Daily</u> operating conditions (i.e., operating ~ 24 hours per day), the following is recommended:**
≤ 10	≤ 1000	Any unit except U2 and U5
10-16	1000-1400	U1; U3; U4;
16-25	1400-2000	U1; Any 2 units except U2 and U5; U4 DO_{min} = 4.5; U3 DO_{min} = 3.5;
25-37	2000-3100, limit for 5 mg/L	Any 2 original units except U2 and U5; U1 DO_{min} = 4.4; U4 DO_{min} = 3.6; U3 DO_{min} = 2.5;
37-75	3100-6300	U1+U4 DO_{min} = 3.4; U1+(U2 or U3) DO_{min} = 3.1; U4+(U2 or U3) DO_{min} = 2.6; U3+(U2 or U5) DO_{min} = 2.2 with U5 (last on, first off) **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	Four original units DO_{min} = 3.0; U1+U4+U2 or U3 DO_{min} = 2.7; U1+U2+U3 DO_{min} = 2.5; U4+U2+U3 DO_{min} = 2.3; any two small units with U5 (last on, first off) DO_{min} = 2.1 to 2.7 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	U1+U4+U3+U2 DO_{min} = 2.4; U1+U4+(U3 or U2)+U5 DO_{min} = 2.3; U2+U3+U4+U5 DO_{min} = 2.1; U3+U2+U5@72MW DO_{min} = 1.6 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	U1+U4+U2+U3+U5, DO_{min} = 2.1; U1 or U4+U2+U3+U5, DO_{min} = 1.7; three small units+U5, DO_{min} = 1.4 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units, DO_{min} = 1.8 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Turbine Inflow Conditions: DO 0 – 0.9 mg/L; Temperature = 16°C (approximately September 1 to mid-September and stays at 0 until lake mixing); DO objective in tailrace is 5 mg/L

MWs desired	Approximate flow (cfs)	For Daily operating conditions (i.e., operating ~ 24 hours per day), the following is recommended:
≤ 8	≤ 900	Any unit except U2 and U5
8-21	900-1700	U1; U3+U4; U4 DO_{min} = 4.2; U3 DO_{min} = 3.7;
21-31	1700-2500	U1+(U3 or U4); U1 DO_{min} = 4.0; U4 DO_{min} = 3.3; U3 DO_{min} = 2.0;
31-37	2500-3150, limit for 5 mg/L	U1+U3+U4; U1+ (U3 or U4) DO_{min} = 4.8; U1 DO_{min} = 3.6; U4 DO_{min} = 2.9; U3 DO_{min} = 1.6;
37-75	3150-6300	All 4 small units DO_{min} = 3.7; U1+(U3 or U2)+U4 DO_{min} = 2.9; U1+U4 DO_{min} = 2.6; U1+(U2 or U3) DO_{min} = 2.2; U4+(U2 or U3) DO_{min} = 1.6; U2+U5 DO_{min} = 1.2 with U5 (last on, first off) **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	All 4 original units DO_{min} = 2.0; U1+U4+(U2 or U3) DO_{min} = 1.8; U1+U2+U3 DO_{min} = 1.6; U4+U2+U3 DO_{min} = 1.4; any one-two small units supplemented by U5 as needed DO_{min} = 0.7 ; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	All 4 original units DO_{min} = 1.5; If two-three small units are operating, consider U5 (last on, first off) as follows: U1+U4+(U3 or U2)+U5, DO_{min} = 1.3; U1+U2+U3+U5, DO_{min} = 1.1; U2+U3+U5@72MW, DO_{min} = 0.9 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	U1+U4+U2+U3+U5 DO_{min} = 1.1; U1+U4+(U3 or U2)+U5@72MW, DO_{min} = 1.0; U1+U2+U3+U5@72MW, DO_{min} = 1.0; U4+U2+U3+U5@72MW, DO_{min} = 0.9 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units, DO_{min} = 1.0 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Turbine Inflow Conditions: DO 0 – 0.9 mg/L; Temperature = 20°C (approximately September 1 to mid-September and stays at 0 until lake mixing); DO objective in tailrace is 5 mg/L

MWs desired	Approximate flow (cfs)	For Daily operating conditions (i.e., operating ~ 24 hours per day), the following is recommended:
≤ 8	≤ 900	Any unit except U2 and U5
8-18	900-1500	U1; U3+U4; U3 or U4, DO_{min} = 4.0;
18-25	1500-2000	U1+U3 or U4; U1 DO_{min} = 4.0; U4 DO_{min} = 3.5; U3 DO_{min} = 2.6;
25-37	2000-3150, limit for 5 mg/L	U1+U3+U4; U1+(U3 or U4) DO_{min} = 4.5; U3+U4 DO_{min} = 3.9; U1 DO_{min} = 3.4; U4 DO_{min} = 2.6; U3 DO_{min} = 1.5;
37-75	3150-6300	All small units DO_{min} 3.5; U1 full gate + rest split between U3+U4 DO_{min} = 3.3; U1+U4+(U2 or U3) DO_{min} = 2.7; U1+U4 DO_{min} = 2.5; U4+U2+U3 DO_{min} = 2.3; U1+(U2 or U3) DO_{min} = 2.2; If only one small unit is operating, consider U5 (last on, first off) as follows: U1+U5 DO_{min} = 2.0; U4+U5 DO_{min} = 1.5; U2+U3 DO_{min} = 1.4; (U2 or U3)+U5 DO_{min} = 1.1; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	All four original units DO_{min} = 2.0; U1+U4+(U2 or U3) DO_{min} = 1.7; U1+U2+U3 DO_{min} = 1.5; U4+U2+U3 DO_{min} = 1.3; any one-two small units supplemented by U5 as needed DO_{min} = 0.7; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	All 4 original units DO_{min} = 1.4; If two-three small units are operating, consider U5 (last on, first off) as follows: U1+U4+(U3 or U2)+U5, DO_{min} = 1.3; U1+U2+U3+U5, DO_{min} = 1.1; U2+U3+U5@72MW, DO_{min} = 0.9 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	U1+U4+U2+U3+U5 DO_{min} = 1.1; U1+U4+(U3 or U2)+U5@72MW, DO_{min} = 1.0; U1+U2+U3+U5@72MW, DO_{min} = 1.0; U4+U2+U3+U5@72MW, DO_{min} = 0.9 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units, DO_{min} = 1.0 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

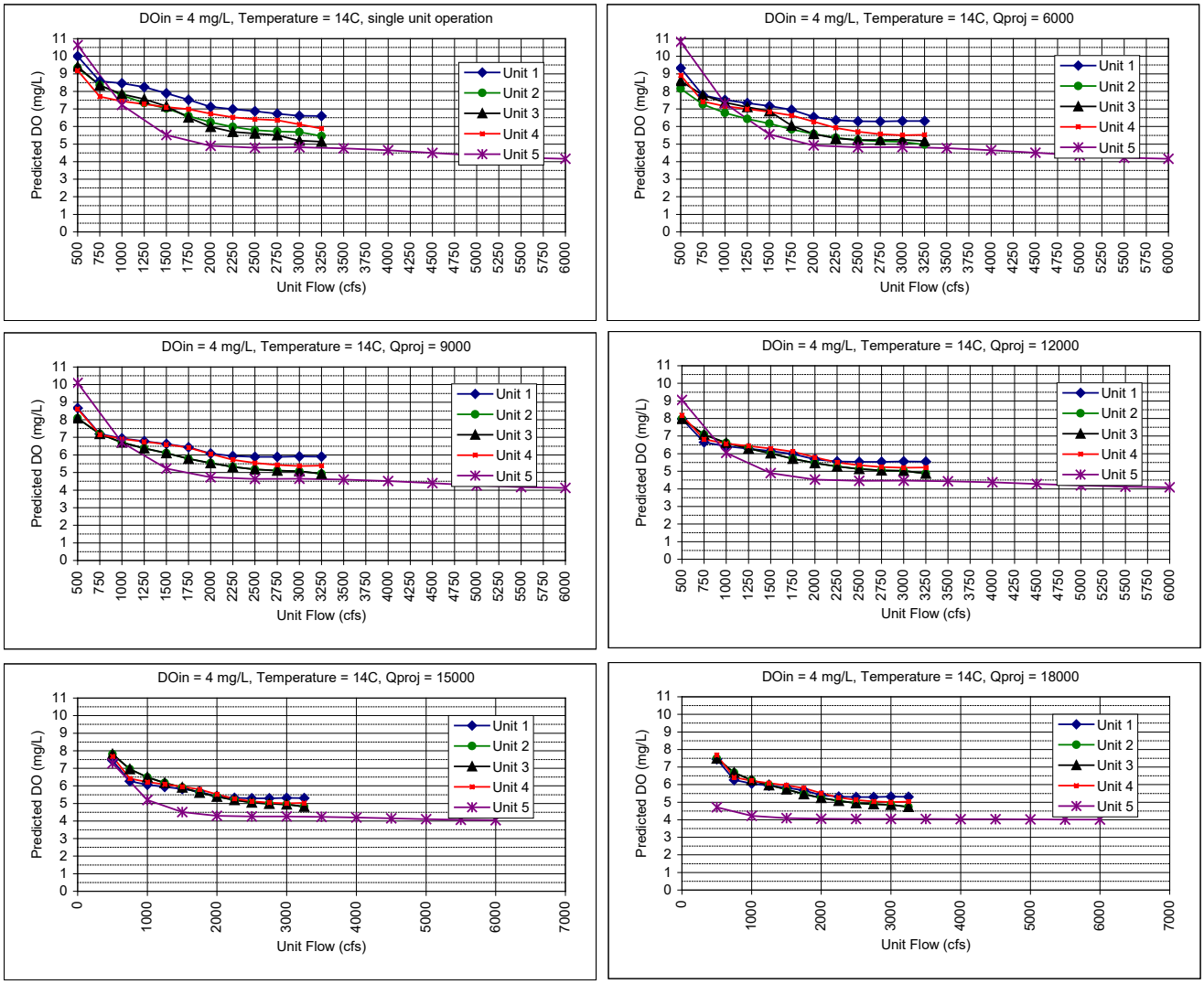


FIGURE B-1 PREDICTED DO FOR EACH UNIT VERSUS UNIT FLOWS FOR THE RANGE OF TOTAL PROJECT RELEASES FOR THE FOLLOWING WATER QUALITY CONDITIONS: DO IN = 4 MG/L AND TEMPERATURE = 14°C. THIS PLOT WAS USED TO DEVELOP THE LUTS

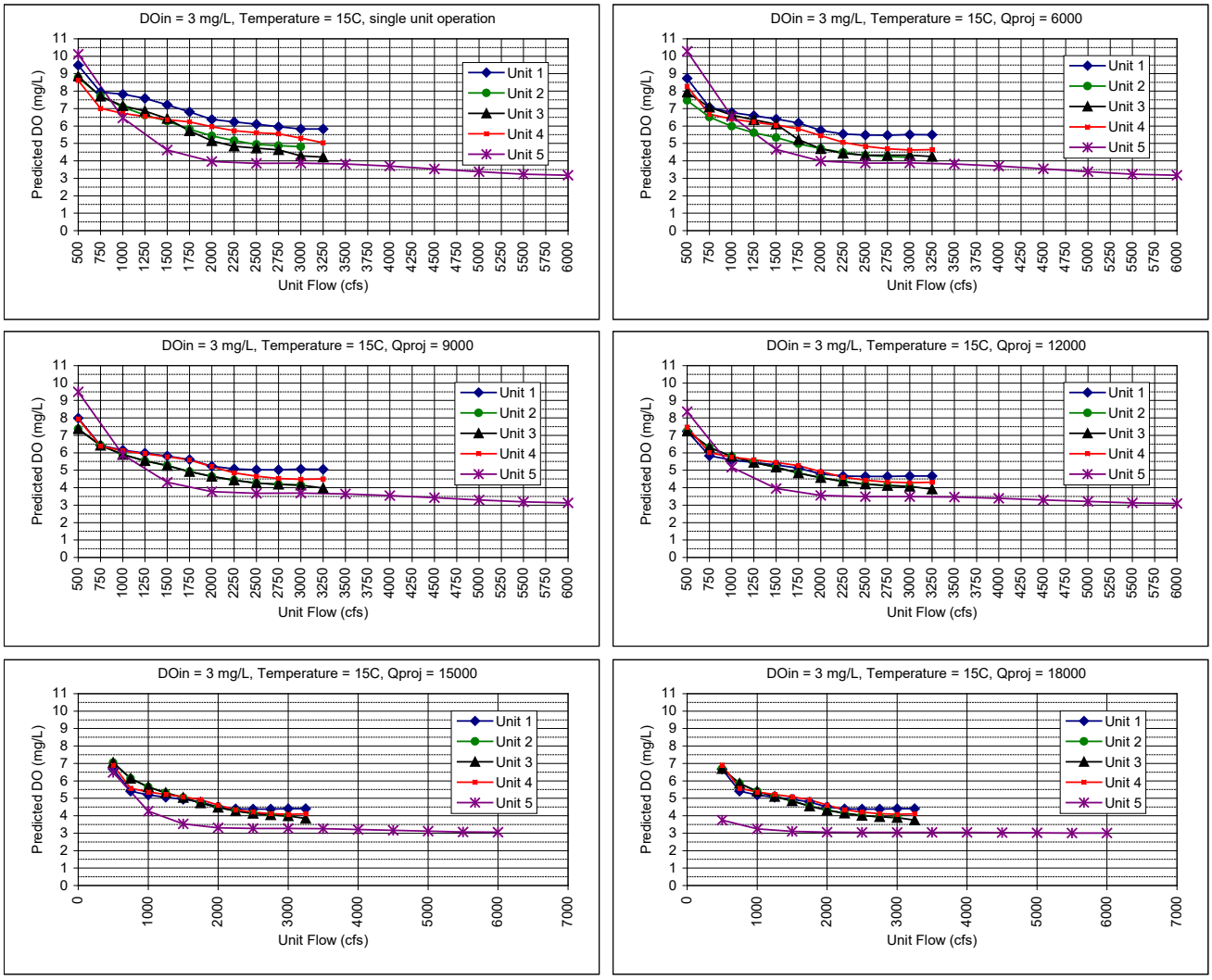


FIGURE B-2 PREDICTED DO FOR EACH UNIT VERSUS UNIT FLOWS FOR THE RANGE OF TOTAL PROJECT RELEASES FOR THE FOLLOWING WATER QUALITY CONDITIONS: DO IN = 3 MG/L AND TEMPERATURE = 15°C. THIS PLOT WAS USED TO DEVELOP THE LUTS

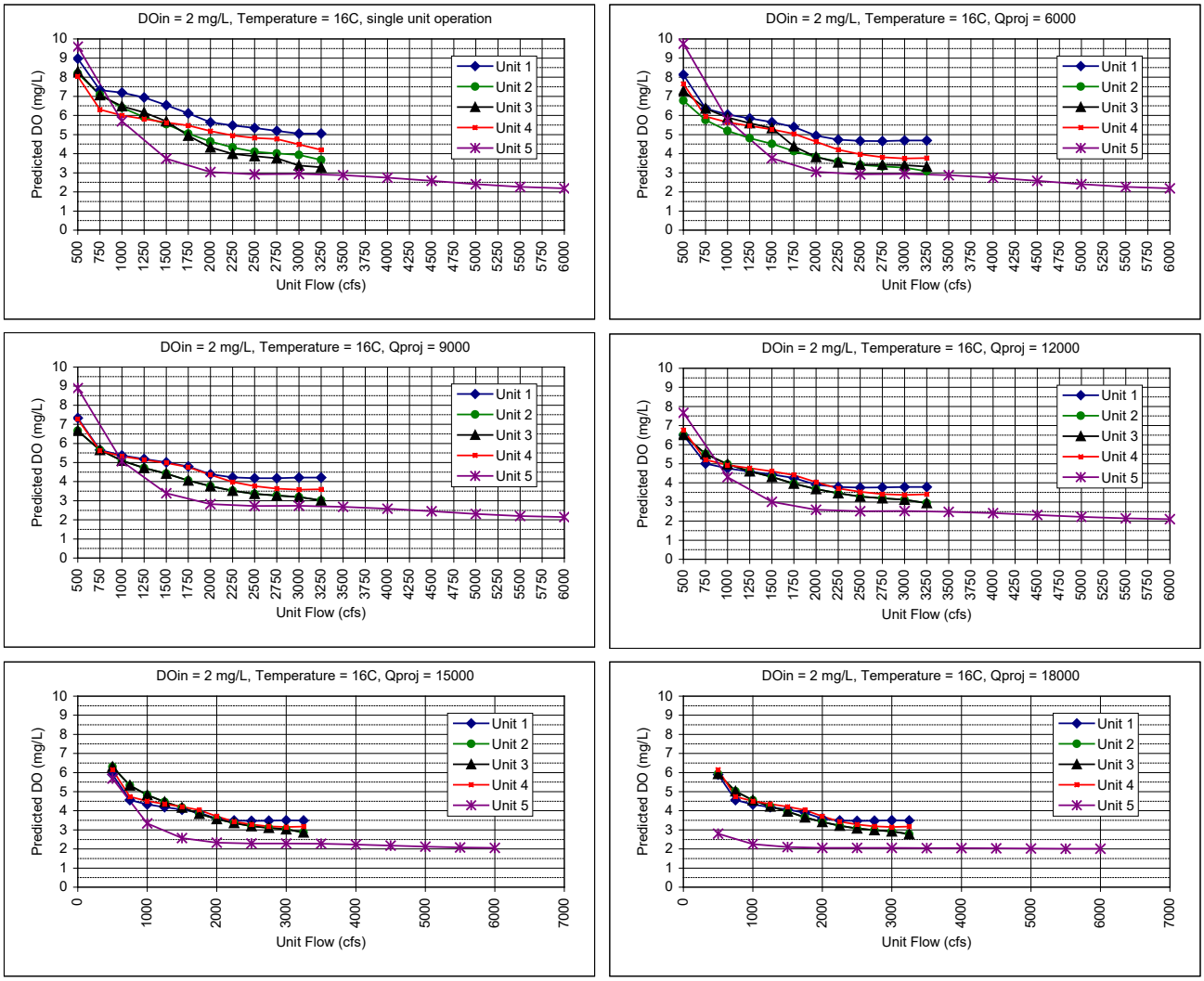


FIGURE B-3 PREDICTED DO FOR EACH UNIT VERSUS UNIT FLOWS FOR THE RANGE OF TOTAL PROJECT RELEASES FOR THE FOLLOWING WATER QUALITY CONDITIONS: DO IN = 2 MG/L AND TEMPERATURE = 16°C. THIS PLOT WAS USED TO DEVELOP THE LUTS

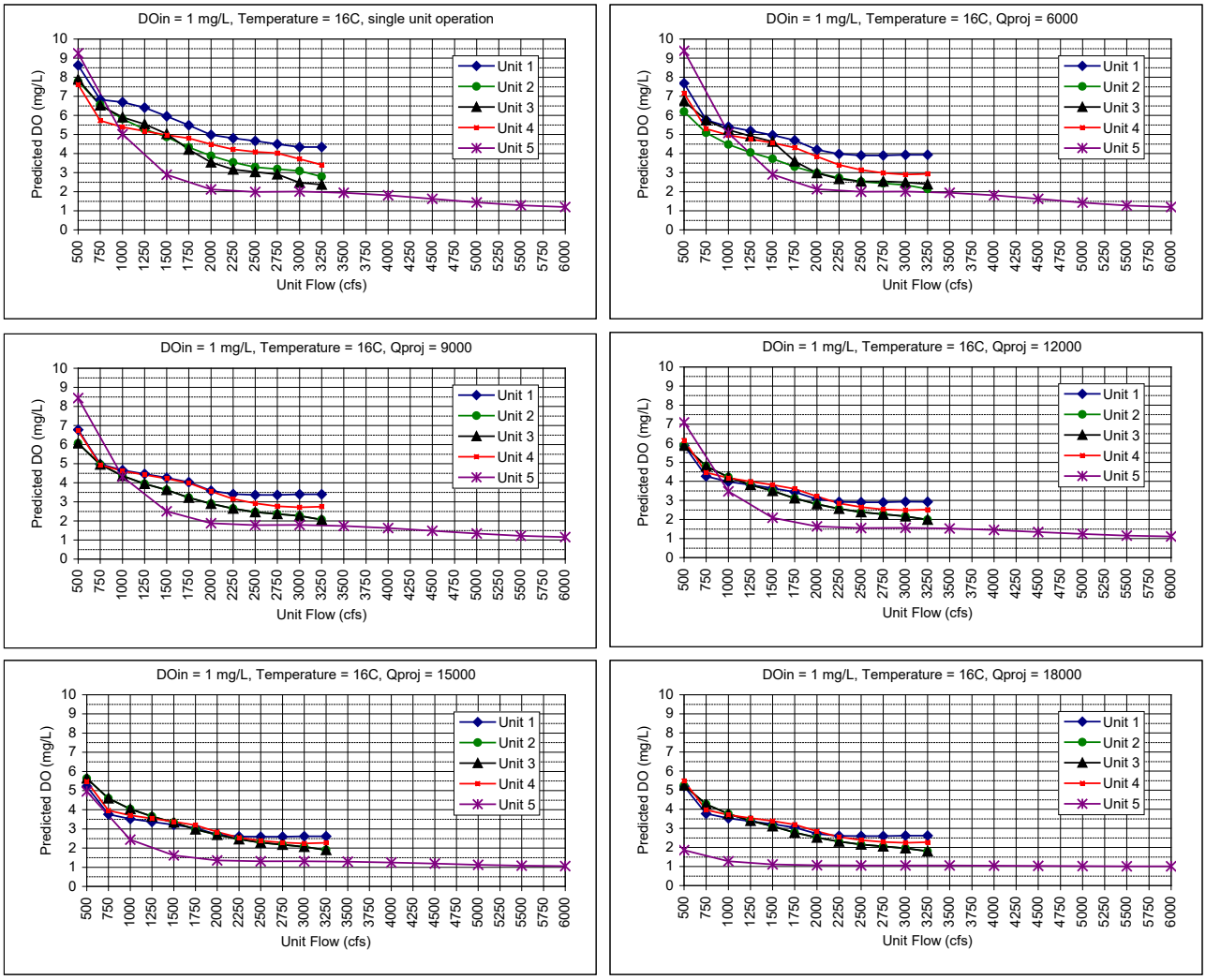


FIGURE B-4 PREDICTED DO FOR EACH UNIT VERSUS UNIT FLOWS FOR THE RANGE OF TOTAL PROJECT RELEASES FOR THE FOLLOWING WATER QUALITY CONDITIONS: DO IN = 1 MG/L AND TEMPERATURE = 16°C. THIS PLOT WAS USED TO DEVELOP THE LUTS

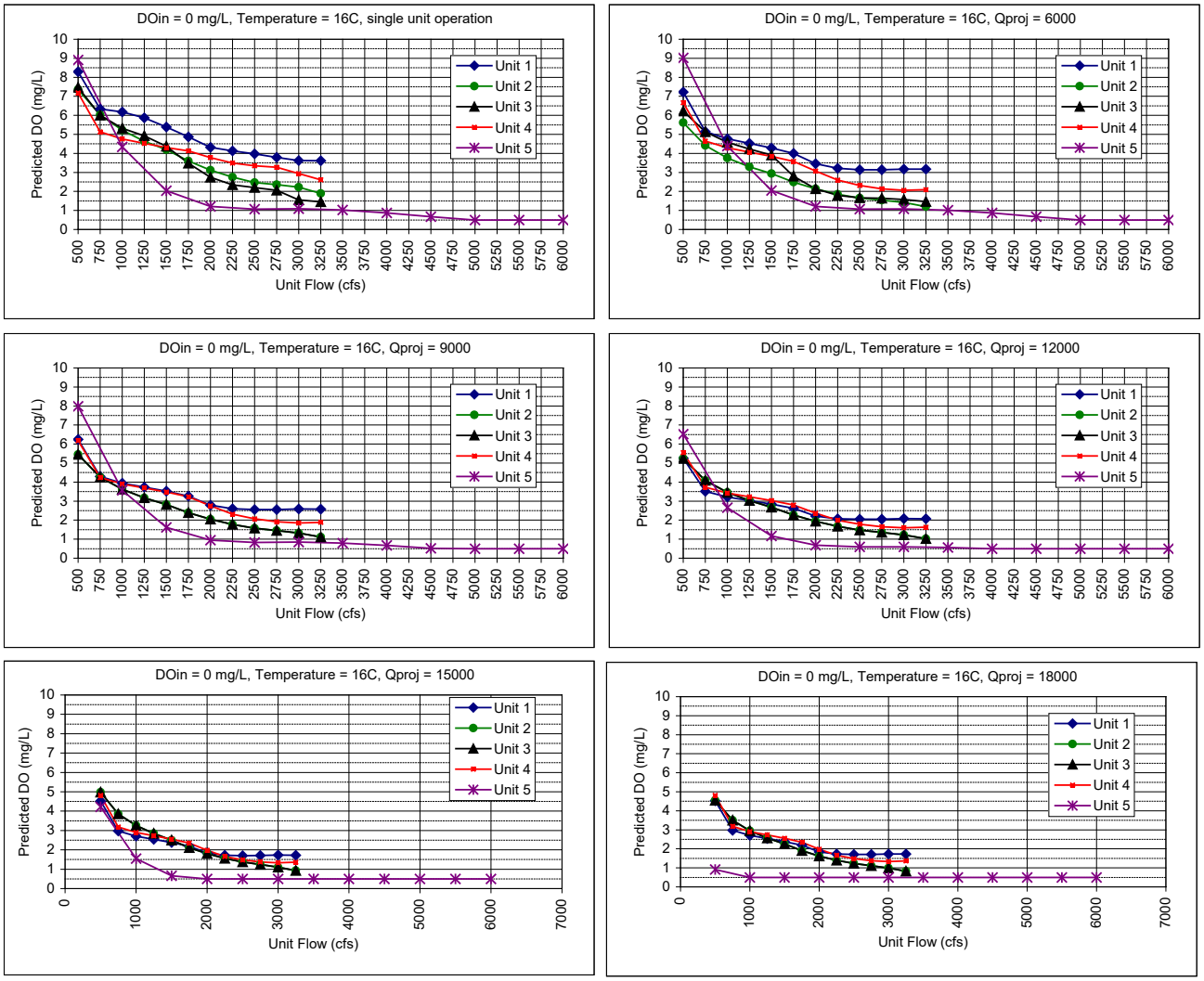


FIGURE B-5 PREDICTED DO FOR EACH UNIT VERSUS UNIT FLOWS FOR THE RANGE OF TOTAL PROJECT RELEASES FOR THE FOLLOWING WATER QUALITY CONDITIONS: DO IN = 0 MG/L AND TEMPERATURE = 16°C. THIS PLOT WAS USED TO DEVELOP THE LUTS

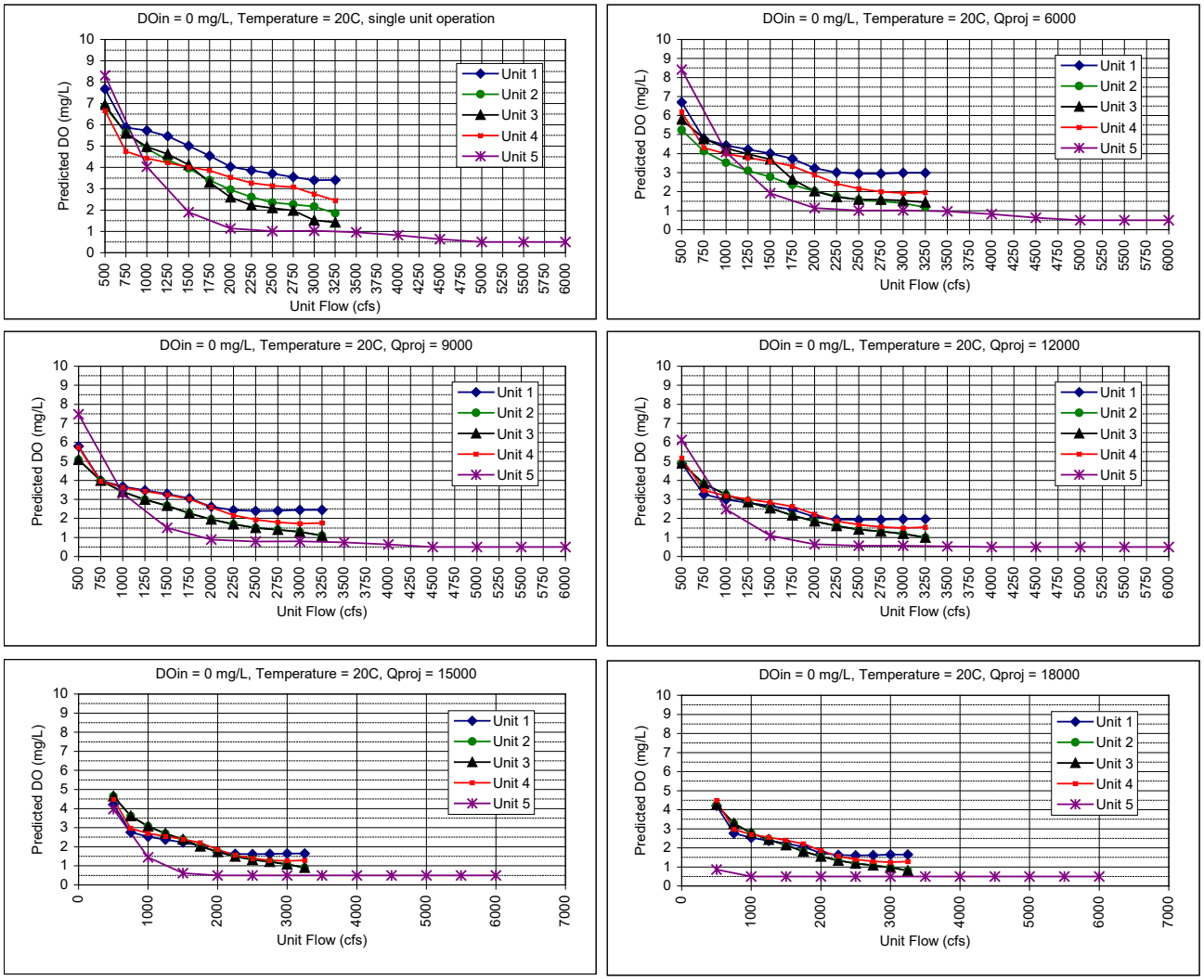


FIGURE B-6 PREDICTED DO FOR EACH UNIT VERSUS UNIT FLOWS FOR THE RANGE OF TOTAL PROJECT RELEASES FOR THE FOLLOWING WATER QUALITY CONDITIONS: DO IN = 0 MG/L AND TEMPERATURE = 20°C. THIS PLOT WAS USED TO DEVELOP THE LUTS

APPENDIX C

CONDENSED LOOKUP TABLES
(UPDATED JANUARY 2015, 2021, AND 2024)

Original Condensed Look-Up Table for Hourly Operations

Turbine Inflow Conditions: DO = 0 – 3.9 mg/L; DO objective in tailrace is 4 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Hourly</u> operations, the following unit operations are recommended in the order of preference (the bold, blue values should attain 4 mg/L DO):**
≤ 10	≤ 1000	**1. U1, U3, or U4**
10-18	1000-1500	**1. U1, U3 or U4; 2. Even split any 2 units (except 2 & 5);**
22-25	1500-2000	**1. U1; 2. Even split any 2 units (except 2 & 5);** **3.** U4; **4.** U3;
25-31	2000-2500	**1. Even split any 2 small units (except 2);** **2.** U1; **3.** U4; **4.** U3;
31-36	2500-3000	**1. Even split any 2 small units (except 2);** **2.** U1; **3.** U4; **4.** U3;
36-44	3000-3600, limit for 4 mg/L	**1. U1+U4;** **2.** U1+U3; **3**. U4+U3; **4**. for project flow up to 3150 cfs, use in order of preference: U1, U4, U3
44-75	3600-6300	**1.** U1+U2+U3+U4; **2.** U1 full gate + rest split between U3+U4; **3**. U1+U4+(U2 or U3); **4**. U1+U4; **5**. U4+U2+U3; **6**. U1+(U2 or U3); **7**. U2+U3; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	**1.** U1+U2+U3+U4; **2.** U1+U4+(U2 or U3); **3.** U1+U2+U3; **4.** U4+U3+U2; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	**1.** U1+U4+U3+U2 **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	**1.** U1+U4+U2+U3+U5; **2.** U1+U4+(U2 or U3)+U5@72MW; **3.** U4+U2+U3+U5@72MW **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note that minimum flows during periods of low DO should be maintained at 450-500 cfs so that venting will draw air into the units

Original Condensed Look-Up Table for Daily Operations

Turbine Inflow Conditions: DO = 0 – 4.9 mg/L; DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For <u>Daily</u> operating conditions (i.e., operating ~ 24 hours per day), the following unit operations are recommended in the order of preference (the bold, blue values should attain 5 mg/L DO):**
≤ 8	≤ 900	**1. Any unit (except 2 & 5)**
8-18	900-1500	**1. U1; 2. Even split any 2 small units (except 2); 3.** U4; **4.** U3;
18-25	1500-2000	**1. U1+U4; 2. U1+U3; 3.** U1; **4.** U4; **5.** U3;
25-37	2000-3150, limit for 5 mg/L	**1. U1+U3+U4; 2.** U1+(U3 or U4); **3**. U3+U4; **4.** U1; **5**. U4; **6**. U3;
37-75	3150-6300	**1**. U1+U2+U3+U4; **2**. U1+U4+(U3 or U2); **3.** U1+U4; **4**. U1+(U2 or U3); **5**. U4+(U2 or U3); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	**1.** U1+U2+U3+U4; **2.** U1+U4+(U2 or U3); **3.** U1+U2+U3; **4.** U4+U3+U2 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	**1.** U1+U4+U3+U2 **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	**1.** U1+U4+U2+U3+U5; **2.** U1+U4+(U2 or U3)+U5@72MW; **3.** U4+U2+U3+U5@72MW **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note that minimum flows during periods of low DO should be maintained at 450-500 cfs so that venting will draw air into the units

2012 Rev 1, 2013 and 2014 Condensed Look-up Table for Hourly Operations (4 hours or less per day)

Turbine Inflow Conditions: DO = 0 – 3.9 mg/L; DO objective in tailrace is 4 mg/L		
MWs desired	**Approximate flow (cfs)**	**For Hourly operations (operating 4 hours or less per day), the following unit operations are recommended in the order of preference (the bold, blue values should attain 4 mg/L DO):**
≤ 10	≤ 1000	**1. U3 or U4; 2. U1**
10-18	1000-1500	**1. U3+U4; 2. U1+U3+U4; 3. U1+(U3 or U4); 4. U4 5. U3 6.** U1
22-25	1500-2000	**1. U1+U3+U4; 2. U3+U4; 3.** U1+(U3 or U4); **4.** U4 **5.** U3 **6.** U1 **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
25-31	2000-2500	**1. U1+U3+U4; 2. U3+U4; 3.** U1+(U3 or U4); **4.** U4; **5.** U3; **6.** U1; **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
31-36	2500-3000	**1. U1+U3+U4; 2. U3+U4; 3.** U1+(U3 or U4); **4.** U4; **5.** U3; **6.** U1; **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
36-44	3000-3600, limit for 4 mg/L	**1. U1+U3+U4; 2.** U3+U4; **3.** U1 + (U3 or U4); **4.** For project flow up to 3150 cfs, use in order of preference: U4, U3, U1;
44-75	3600-6300	**1.** U1+U2+U3+U4; **2.** U4 full gate + rest split between U1+U3; **3.** U3+U4+(U2 or U1); **4.** U3+U4; **5.** U4+U2+U3; **6.** U1+U3; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	**1.** U1+U2+U3+U4; **2.** U3+U4+(U1 or U2); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	**1.** U1+U2+U3+U4 **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	**1.** U1+U2+U3+U4+U5; **2.** U3+U4+(U1 or U2)+U5@72MW; **3.** U4+U3+U2+U5@72MW **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note 1: Minimum flows during periods of low DO should be maintained at 450-500 cfs so that venting will draw air into the units. Note 2: When running multiple units spread load evenly among them whenever possible.

2012 Rev 1, 2013 and 2014 Condensed Look-up Table for Daily Operations (greater than 4 hours per day)

Turbine Inflow Conditions: DO = 0 – 4.9 mg/L; DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For Daily operating conditions (operating more than 4 hours per day), the following unit operations are recommended in the order of preference (the bold, blue values should attain 5 mg/L DO):**
≤ 8	≤ 900	**1. U3 or U4; 2. U1**
8-18	900-1500	**1. U3+U4; 2. U1+U3+U4; 3. U1+(U3 or U4); 4.** U4; **5.** U3; **6.** U1
18-25	1500-2000	**1. U1+U3+U4; 2. U3+U4; 3.** U1+(U3 or U4); **4.** U4; **5.** U3; **6.** U1 **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
25-37	2000-3150, limit for 5 mg/L	**1.** U1+U3+U4; **2.** U3+U4; **3.** U4+(U1 or U3); **4.** U4; **5.** U3; **6.** U1 **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
37-75	3150-6300	**1.** U1+U2+U3+U4; **2.** U3+U4+(U1 or U2); **3.** U1+U4; **4.** U4+(U1 or U3); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	**1.** U1+U2+U3+U4; **2.** U3+U4+(U1 or U2); **3.** U1+U3+U4; **4.** U4+U3+U2 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	**1.** U1+U4+U3+U2 **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	**1.** U1+U4+U2+U3+U5; **2.** U3+U4+(U1 or U2)+U5@72MW; **3.** U4+U2+U3+U5@72MW **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note 1: Minimum flows during periods of low DO should be maintained at 450-500 cfs so that venting will draw air into the units.
Note 2: When running multiple units spread load evenly among them whenever possible.

Condensed Lookup Tables (Updated January 2015) for Hourly Operations (4 hours or less per day)

Turbine Inflow Conditions: DO = 0 – 3.9 mg/L; DO objective in tailrace is 4 mg/L		
MWs desire	**Approximate flow (cfs)**	**For Hourly operations (operating 4 hours or less per day), the following unit operations are recommended in the order of preference (the bold, blue values should**
≤ 10	≤ 1000	**1. U4; 2. U1, 3. U3**
10-18	1000-1500	**1. U1+U4; 2. U1+U3+U4; 3. U3+(U4 or U1); 4. U4 5.** U1 6. U3
22-25	1500-2000	**1. U1+U3+U4; 2. U1+U4; 3. U3+(U1 or U4); 4.** U4 **5.** U1 **6.** U3 **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
25-31	2000-2500	**1. U1+U3+U4; 2. U1+U4; 3.** U3+(U1 or U4); **4.** U4; **5.** U1; **6.** U3; **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
31-36	2500-3000	**1. U1+U3+U4; 2. U1+U4; 3.** U3+(U1 or U4); **4.** U4; **5.** U1; **6.** U3; **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
36-44	3000-3600, limit for 4 mg/L	**1. U1+U3+U4; 2.** U1+U4**; 3.** U3 + (U1 or U4); **4.** For project flow up to 3150 cfs, use in order of preference: U4, U1, U3;
44-75	3600-6300	**1.** U1+U2+U3+U4; **2.** U4 full gate + rest split between U1+U3; **3.** U1+U4+(U2 or U3); **4.** U1+U4; **5.** U4+U1+U2; **6.** U3+(U1 or U4); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	**1.** U1+U2+U3+U4; **2.** U1+U4+(U3 or U2); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	**1.** U1+U2+U3+U4 **2.** any available small units with U5 as needed to supplement the small units;
150-178	12,600-15,000	**1.** U1+U2+U3+U4+U5; **2.** U1+U4+(U3 or U2)+U5@72MW; **3.** U4+U1+U2+U5@72MW **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note 1: Minimum flows during periods of low DO should be maintained at 450-500 cfs so that venting will draw air into the units. Note 2: When running multiple units spread load evenly among them whenever possible.

Condensed Lookup Tables (Updated January 2015) for Daily Operations (greater than 4 hours per day)

Turbine Inflow Conditions: DO = 0 – 4.9 mg/L; DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For Daily operating conditions (operating more than 4 hours per day), the following unit operations are recommended in the order of preference (the bold, blue values should attain 5 mg/L DO):**
≤ 8	≤ 900	**1. U4; 2. U1, 3. U3**
8-18	900-1500	**1. U1+U4; 2. U1+U3+U4; 3. U3+(U1 or U4); 4. U4; 5.** U1; **6.** U3
18-25	1500-2000	**1. U1+U3+U4; 2. U1+U4; 3.** U3+(U1 or U4); **4.** U4; **5.** U1; **6.** U3 **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
25-37	2000-3150, limit for 5 mg/L	**1.** U1+U3+U4; **2.** U1+U4; **3.** U3+(U1 or U4); **4.** U4; **5.** U1; **6.** U3 **Option with Technical Services concurrence: U1+U2+U3+U4; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
37-75	3150-6300	**1.** U1+U2+U3+U4; **2.** U1+U4+(U3 or U2); **3.** U1+U4; **4.** U4+(U1 or U3); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	**1.** U1+U2+U3+U4; **2.** U1+U4+(U3 or U2); **3.** U1+U3+U4; **4.** U4+U1+U2 **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	**1.** U1+U2+U3+U4; **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	**1.** U1+U2+U3+U4+U5; **2.** U1+U4+(U3 or U2)+U5@72MW; **3.** U4+U2+U1+U5@72MW **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note1: Minimum flows during periods of low DO should be maintained at 450-500 cfs so that venting will draw air into the units. Note 2: When running multiple units spread load evenly among them whenever possible.

2021 Condensed Look-up Table for Hourly Operations (4 hours or less per day)

Turbine Inflow Conditions: DO = 0 – 3.9 mg/L; DO objective in tailrace is 4 mg/L		
MWs desired	**Approximate flow (cfs)**	**For Hourly operations (operating 4 hours or less per day), the following unit operations are recommended in the order of preference (the bold, blue values should attain 4 mg/L DO):**
≤ 10	≤ 1000	**1. U4; 2. U3; 3. U3+U4; 4.** U1
10-18	1000-1500	**1. U3+U4; 2. U3+U4+U5; 3. U4+(U3 or U5); 4.** U4; **5.** U3; **6.** U1
22-25	1500-2000	**1. U3+U4+U5; 2. U4+(U3 or U5); 3.** U4; **4.** U3; **5.** U1 **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
25-31	2000-2500	**1. U3+U4+U5; 2.** U4+(U3 or U5); **3.** U3+(U4 or U5); **4.** U4; **5.** U3; **6.** U5; **7.** U1; **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
31-36	2500-3000	**1. U3+U4+U5; 2.** U4+(U3 or U5); **3.** U3+(U4 or U5); **4.** U4; **5.** U3; **6.** U5; **7.** U1; **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
36-44	3000-3600, limit for 4 mg/L	**1. U2+U3+U4+U5; 2.** U3+U4; **3.** U3 + (U4 or U5); **4.** U5; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
44-75	3600-6300	**1.** U2+U3+U4+U5; **2.** U4 full gate + rest split between U2+U3; **3.** U5+U4+(U2 or U3); **4.** U3+U4; **5.** U4+U2+U5; **6.** U3+(U4 or U5); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	**1.** U2+U3+U4+U5; **2.** U5+U4+(U3 or U2); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	**1.** U2+U3+U4+U5; **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	**1.** U2+U3+U4+U5; **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note1: Minimum flows during periods of low DO should be maintained at 600-700 cfs so that venting will draw air into the units.
Note 2: When running multiple units spread load evenly among them whenever possible.

2021 Condensed Look-up Table for Daily Operations (greater than 4 hours per day)

Turbine Inflow Conditions: DO = 0 – 4.9 mg/L; DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For Daily operating conditions (operating more than 4 hours per day), the following unit operations are recommended in the order of preference (the bold, blue values should attain 5 mg/L DO):**
≤ 8	≤ 900	**1. U3+U4; 2. U4; 3. U5;** **4.** U3; **5.** U1
8-18	900-1500	**1. U3+U4; 2. U3+U4+U5; 3. U4+(U3 or U5);** **4.** U4; **5.** U3; **6.** U5; **7.** U1
18-25	1500-2000	**1. U3+U4+U5; 2. U4+(U3 or U5); 3.** U4; **4.** U3; **5.** U5; **6.** U1 **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
25-37	2000-3150, limit for 5 mg/L	**1.** U3+U4+U5; **2.** U3+U4; **3.** U3+(U4 or U5); **4.** U4; **5.** U3; **6.** U5; **7.** U1 **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
37-75	3150-6300	**1.** U2+U3+U4+U5; **2.** U4+U5+(U3 or U2); **3.** U3+U4; **4.** U5+(U4 or U3); **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
75-113	6300-9500	**1.** U2+U3+U4+U5; **2.** U4+U5+(U3 or U2); **3.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	**1.** U2+U3+U4+U5; **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	**1.** U2+U3+U4+U5; **2.** any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All available units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note1: Minimum flows during periods of low DO should be maintained at 600-700 cfs so that venting will draw air into the units.
Note 2: When running multiple units spread load evenly among them whenever possible.

2024 Condensed Look-up Table for Hourly Operations (4 hours or less per day)

Turbine Inflow Conditions: DO = 0 – 3.9 mg/L; DO objective in tailrace is 4 mg/L		
MWs desired	**Approximate flow (cfs)**	**For Hourly operations (operating 4 hours or less per day), the following unit operations are recommended in the order of preference (the bold, blue values should attain 4 mg/L DO):**
≤ 10	≤ 1000	**1. U3; 2. (U3 or U4)+U5;** 3. U4; 4. U1
10-18	1000-1500	**1. (U3 or U4)+U5;** 2. U3+U4; 3. U3; 4. U4; 5. U1
22-25	1500-2000	**1. U3+U4+U5; 2. (U3 or U4)+U5;** 3. U4+U3; 4. U3; 5. U4; 6. U1 **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
25-31	2000-2500	**1. U3+U4+U5; 2. (U3 or U4)+U5;** 3. U3+(U4 or U1); 4. U3; 5. U4; 6. U1; 7. U5; **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
31-36	2500-3000	**1. U3+U4+U5;** 2. U5+(U3 or U4); 3. U3+(U4 or U1); 4. U3; 5. U4; 6. U1; 7. U5; **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
36-44	3000-3600, limit for 4 mg/L	**1. U2+U3+U4+U5;** 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
44-75	3600-6300	1. U2+U3+U4+U5; 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
75-113	6300-9500	1. U2+U3+U4+U5; 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
113-150	9500-12,600	1. U2+U3+U4+U5; 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
150-178	12,600-15,000	**1.** U2+U3+U4+U5; 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
≥ 178	≥ 15,000	All units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note 1: Minimum flows during periods of low DO should be maintained at 600-700 cfs so that venting will draw air into the units.
Note 2: Due to decreased venting of the smaller units, Unit 5 may be run along with a small unit to meet DO and temp. requirements.
Note 3: When running multiple units spread load evenly among them whenever possible unless directed otherwise by Technical Services.

2024 Condensed Look-up Table for Daily Operations (greater than 4 hours per day)

Turbine Inflow Conditions: DO = 0 – 4.9 mg/L; DO objective in tailrace is 5 mg/L		
MWs desired	**Approximate flow (cfs)**	**For Daily operating conditions (operating more than 4 hours per day), the following unit operations are recommended in the order of preference (the bold, blue values should attain 5 mg/L DO):**
≤ 8	≤ 900	**1. U3; 2. (U3 or U4)+U5;** 3. U4; 4. U1
8-18	900-1500	**1. (U3 or U4)+U5; 2. U3+U4;** 3. U3; 4. U4; 5. U1
18-25	1500-2000	**1. U3+U4+U5; 2.** U5+(U3 or U4); **3.** U3+U4; **4.** U3; **5.** U4; **6.** U1 **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
25-37	2000-3150, limit for 5 mg/L	**1.** U3+U4+U5; **2.** U3+U4; **3.** U3+(U4 or U5); **4.** U3; **5.** U4; **6.** U1; **7.** U5 **Option with Technical Services concurrence: U2+U3+U4+U5; Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**
37-75	3150-6300	1. U2+U3+U4+U5; 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
75-113	6300-9500	1. U2+U3+U4+U5; 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
113-150	9500-12,600	1. U2+U3+U4+U5; 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
150-178	12,600-15,000	1. U2+U3+U4+U5; 2. any available small units with U5 as needed to supplement the small units; **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run.**
≥ 178	≥ 15,000	All available units **Flows from Saluda need to be ≥ 2500 cfs before Unit 2 can be run**

Note 1: Minimum flows during periods of low DO should be maintained at 600-700 cfs so that venting will draw air into the units.
Note 2: Due to decreased venting of the smaller units, Unit 5 may be run along with a small unit to meet DO and temp. requirements.
Note 3: When running multiple units spread load evenly among them whenever possible unless directed otherwise by Technical Services.

APPENDIX D

DESC AERATION TESTING ON UNIT 1 IN COMPARISON TO UNITS 3 AND 4 FOR LOW GATE SETTINGS (SEPTEMBER 2014)

Note that SCE&G is now Dominion Energy South Carolina, Inc. Appendix D references SCE&G since it is from a document issued in 2014 prior to becoming Dominion Energy South Carolina, Inc.

SALUDA HYDRO UNIT 1 AERATION STUDY, SEPTEMBER 2014

On September 23 & 24, 2014 testing was conducted in the tailrace of Saluda Hydroelectric Plant to determine the current aeration capabilities of Unit 1 as compared to Units 3 and 4. The test was conducted by running the single unit (1, 3 or 4) at spinning, then 2 MW, 4 MW, 6 MW, 8MW and 10 MW. For each sampling, time was allowed for the tailrace area to stabilize and collect the water quality data (approximately 30 – 45 minutes). Once 10 MW was attained on a Unit and water quality data were collected, then that Unit was shut down and the same test was run on the next Unit (with all other units shutdown). If at any time the dissolved oxygen (DO) in the tailrace was close to 4 mg/l during the test for that particular unit, generation was either increased by 1 MW above the current MW or the test was stopped for that unit at that time. Water quality data was collected approximately 155 feet downstream of the powerhouse.

The results indicated that Unit 4 aerated the best followed by Unit 1 and then Unit 3 with the lowest DO increase. The data also showed that higher DO occurred at the lower gate settings with DO decreasing as the gate openings increased.

The temperatures measured in the tailrace, ~ 14.5± °C, were very similar over the gate settings ranging from 19.3 to 23.3 for Unit 1 and 17.8 to 23.2 for Unit 4, indicating that inflow water quality was likely pulled from the same layer in the lake. This indicates that the difference in tailrace DO levels between Unit 1 at 4.09-4.89 mg/L and Unit 4 at 5.57-6.34 mg/L is probably attributed to Unit 4 drawing more air into its draft tube.

The DO measured for Unit 1 at 25.2 % gate dropped to 3.75 mg/L. This could be caused by less air being drawn into the unit and/or less time for water traveling through the draft tube, but it could also be attributed to lower DO in the intake since the temperature dropped from about 14.66 to 14.51 °C.

It should be noted that Unit 3 aeration was very similar to Unit 1 aeration for the higher gate settings tested for Unit 3 at 18.1 and 26 %.

Table D-1 Results of Aeration Testing

9/23/14 Time (EDT)	Unit 1 (MW)	DO (mg/l)	BP (mmHg)	TDG	Water Temp (°C)	Headwater (ft)	Tailwater (ft)	Turbine Gate setting (%)	USGS 02168504 Discharge (cfs)
9:15	0.1	7.89	762	813	15.18	356.87	174.47	3.5	686
10:00	2.0	7.06	762	801	14.90	356.87	174.49	10.1	706
10:45	4.0	6.04	762	791	14.72	356.86	174.65	15.0	832
11:35	6.1	4.89	762	747	14.64	356.86	174.84	19.3	993
12:16	7.0	4.42	762	754	14.64	356.87	174.97	21.4	1,100
12:36	8.1	4.09	762	741	14.66	356.86	175.00	23.3	1,140
12:56	9.0	3.75	763	746	14.51	356.86	175.11	25.2	1,200

9/23/14 Time (EDT)	Unit 3 (MW)	DO (mg/l)	BP (mmHg)	TDG (%)	Water Temp (°C)	Headwater (ft)	Tailwater (ft)	Turbine Gate setting (%)	USGS 02168504 Discharge (cfs)
13:40	0.5	7.04	763	817	15.03	356.87	174.67	7.5	776
14:18	2.5	6.25	762	800	14.99	356.87	174.62	11.3	781
14:45	4.2	5.47	762	782	14.61	356.88	174.73	11.7	827
9/24/14									
8:40	6.2	4.42	763	750	14.71	356.86	175.08	18.1	954
15:14	8.2	3.84	762	748	14.50	356.88	175.02	26.0	1,020

9/24/14 Time (EDT)	Unit 4 (MW)	DO (mg/l)	BP (mmHg)	TDG (%)	Water Temp (°C)	Headwater (ft)	Tailwater (ft)	Turbine Gate setting (%)	USGS 02168504 Discharge (cfs)
9:15	0.3	7.36	763	788	15.25	356.85	174.64	7.6	781
10:24	2.2	7.30	764	800	14.89	356.86	174.57	12.0	804
11:19	4.0	6.95	763	801	14.84	356.85	174.70	15.4	880
12:03	6.0	6.34	763	760	14.65	356.85	174.91	17.8	1,040
13:00	8.1	5.84	763	756	14.60	356.84	175.16	22.2	1,200
13:54	9.0	5.57	763	754	14.64	356.86	175.27	23.2	1,260
14:40	10.1	5.37	763	766	14.64	356.84	175.38	24.8	1,320

Figure D-1 Results of Aeration Testing—Results of DO Measurements over Ranges of Megawatts and % Gate Settings for Units 1, 3, and 4 at Low Gate Settings

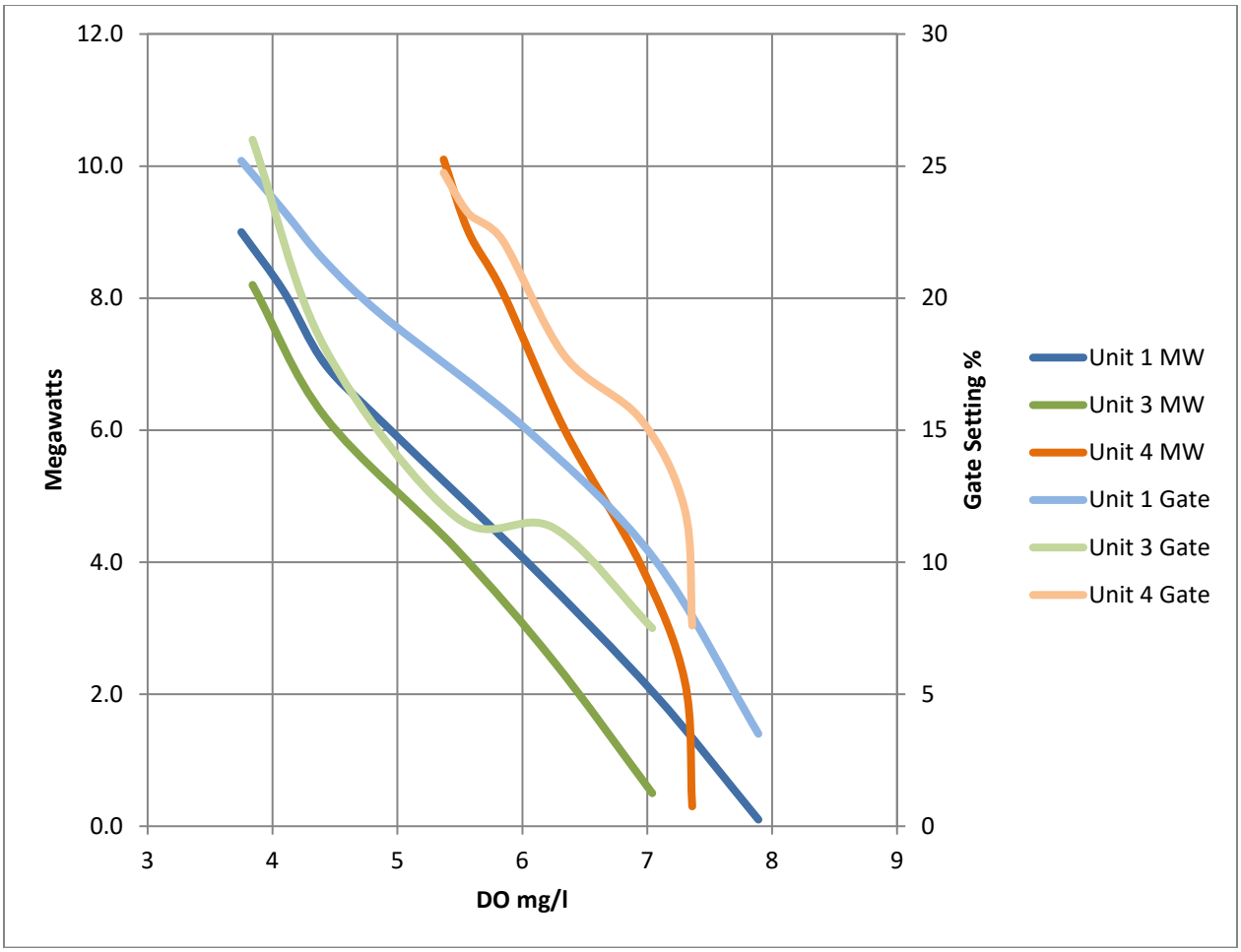
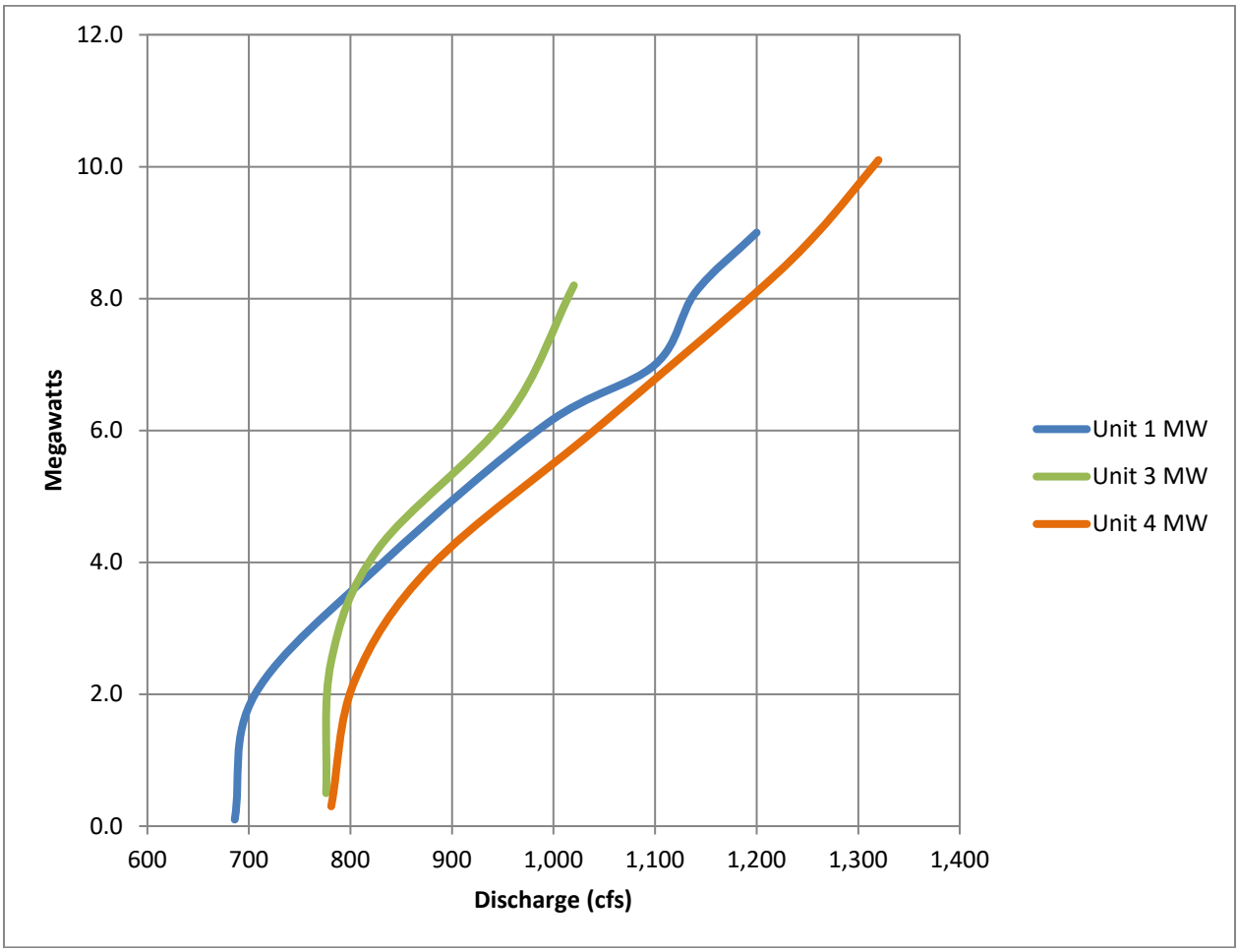


Figure D-2 Results of Aeration Testing—Results of Data Collection on Megawatts versus Discharge for Units 1, 3, and 4 at Low Gate Settings



APPENDIX E

DESC AND AGENCY CORRESPONDENCE DURING 2023

From: Elizabeth Miller <MillerE@dnr.sc.gov>
Sent: Thursday, June 1, 2023 10:55 AM
To: Raymond Ammarell (DESC Generation - 8) <raymond.ammarell@dominionenergy.com>
Subject: [EXTERNAL] Saluda Hydro Unit 5 operations

Hi Ray,
It is that time of year again. I just wanted to send you a friendly reminder. The SCDNR recommends that Saluda Hydro's Unit 5 be the last unit turned on and the first unit turned off during the low DO season, which typically begins in June and lasts through the beginning of October. Secondly, would you mind notifying Jason Bettinger and me when the Saluda Hydro Project needs to utilize Unit 5 so that we can keep an eye on striped bass habitat in the reservoir?
How have all of the unit repairs been testing so far? We greatly appreciate all of the efforts made to improve the DO uptake of the runners.
Thanks,
Elizabeth C. Miller
FERC Coordinator
Office of Environmental Programs
South Carolina Department of Natural Resources
217 Fort Johnson Road, Charleston, SC 29412
P.O. Box 12559, Charleston, SC 29422-2559
Office: 843-953-3881
Cell: 843-729-4636
www.dnr.sc.gov/environmental

From: Raymond Ammarell (DESC Generation - 8)
Sent: Friday, June 2, 2023 9:32 AM
To: 'Elizabeth Miller' <MillerE@dnr.sc.gov>
Cc: Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>
Subject: RE: Saluda Hydro Unit 5 operations

Hi Elizabeth,
I am copying Amy Bresnahan on this reply so she will be in the loop. Thanks for the reminder on Unit 5. Our latest forebay profile indicates we are right on the edge of low DO season and we have been running Units 3 and 4 at very low load with the vents open. We also had Unit 5 on at 1 MW Tuesday and Wednesday this week to lower the lake a bit, and took it off yesterday morning to give Jason some lower flows for fish sampling and it will be last on first off going forward, and I will let you know when we operate it.
The dive inspection last week revealed missing nose cones on two of the small units. The nose cones were last repaired/replaced in the mid-2000s. These are located on the bottom of the runner and we believe they help with drawing air through the vents. The plant is working on a plan to replace the cones. Unit 1 is currently in an outage and is dewatered to attempt to seal the head cover again, since the repairs last year were not effective on that unit. Hopefully we will be able to make an effective seal this year.
Thanks,
Raymond R. Ammarell, P.E.
DESC Power Generation

Hydro Dam Safety Compliance

400 Otarre Parkway, Cayce, SC 29033
Mailing Address: 220 Operation Way, MC B223, Cayce, SC 29033
O: 803-217-7322 M: 803-206-3710

From: Amy Bresnahan (DESC Generation - 8)
Sent: Thursday, June 8, 2023 4:43 PM
To:
Subject: Lake Murray forebay water quality 6/6/2023

Matt, Troy, Dan and James,

As of June 6, 2023 forebay DO readings at the Saluda Hydro Unit 5 intake level are around 4.9 mg/l. Saluda Hydro Units 1 – 4 intake level DO readings are around 3.1 mg/l and the turbine vents are open on all available units.

Based on these readings, the low DO season has begun for 2023. Please use the attached 2023 Condensed Lookup Tables when dispatching Saluda Hydro. Please note that the unit run preferences given in the lookup tables also apply when the units are spinning or at minimum load.

Saluda Hydro personnel, please follow the 2023 Lookup Tables when conducting any unit testing or local operation during the low DO season. If the situation is not addressed in the tables, please call System Control, Ray Ammarell or me for assistance.
Please note that the attached Lookup Tables may be revised during this season as we evaluate the performance of the units as they come back online from repairs.

We will continue to monitor the DO in the lake and river, and will send updates as new data is available. If you have any questions regarding the tables, please call me or Ray.

Amy Bresnahan, P.E.
Power Generation, Civil Engineering
Dominion Energy South Carolina, Inc.

From: Raymond Ammarell (DESC Generation - 8)
Sent: Wednesday, June 14, 2023 3:33 PM
To: Elizabeth Miller - SCDNR <millere@dnr.sc.gov>
Cc: Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>
Subject: Saluda Unit 5 operation Thursday 6/15

Elizabeth,

Lake Murray is currently at about 358.3 and we are currently running Units 3 and 4 at 1 MW each. The DO from those units is running between 5 and 5.5 mg/l, and increasing generation on them will drop the DO lower. We are considering running Unit 5 at 5 MW for about 24 hours Thursday AM – Friday AM. This will let us get the lake down closer to 358 as there is more rain in the forecast over the next few days. The recent repairs to Unit 1 do not appear to have improved its DO performance, and Unit 2 can't be operated until we have 2,500 CFS being released from the plant. We'll take Unit 5 off Friday morning for the plant to perform scheduled maintenance.

Raymond R. Ammarell, P.E.
DESC Power Generation
Hydro Dam Safety Compliance
400 Otarre Parkway, Cayce, SC 29033
Mailing Address: 220 Operation Way, MC B223, Cayce, SC 29033

O: 803-217-7322 M: 803-206-3710

From: Elizabeth Miller <MillerE@dnr.sc.gov>
Sent: Wednesday, June 14, 2023 3:51 PM
To: Raymond Ammarell (DESC Generation - 8) <raymond.ammarell@dominionenergy.com>
Cc: Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>; Jason Bettinger <BettingerJ@dnr.sc.gov>
Subject: [EXTERNAL] RE: Saluda Unit 5 operation Thursday 6/15

Hi Ray,
Thanks for the notification.
I see where the combination of Units 3 & 4 is just around 1,200 cfs. With the addition of Unit 5, what do you expect the outflow to be? Is there a possibility that Unit 2 could be run at 2,500 cfs, instead of running three turbines just below the 2,500 cfs threshold in order to bring the lake level down? I am not certain of what would need to be involved in the process, but I wanted to check to see if there was possibility of avoiding using Unit 5 if possible.

Thanks,
Elizabeth C. Miller
SCDNR
Office: 843-953-3881
Cell: 843-729-4636

From: Raymond Ammarell (DESC Generation - 8)
Sent: Wednesday, June 14, 2023 4:18 PM
To: 'Elizabeth Miller' <MillerE@dnr.sc.gov>
Cc: Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>; Jason Bettinger <BettingerJ@dnr.sc.gov>
Subject: RE: Saluda Unit 5 operation Thursday 6/15

Elizabeth,
The way we have to operate Unit 2 by permit is we need to have 2,500 CFS being released from other units at Saluda prior to starting Unit 2. If we increase generation on just Units 3 and 4 to provide 2,500 CFS the DO would be very low. If we run Unit 5 at 5 MW with Units 3 and 4 as they are I think we will be close to 2,500 CFS but I don't think we will be able to run just Units 2, 3, and 4 with good DO and 2,500+ CFS.

Raymond R. Ammarell, P.E.
DESC Power Generation
Hydro Dam Safety Compliance

From: Elizabeth Miller <MillerE@dnr.sc.gov>
Sent: Wednesday, June 14, 2023 4:21 PM
To: Raymond Ammarell (DESC Generation - 8) <raymond.ammarell@dominionenergy.com>
Cc: Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>; Jason Bettinger <BettingerJ@dnr.sc.gov>
Subject: [EXTERNAL] RE: Saluda Unit 5 operation Thursday 6/15

Ok, thank you for clarifying. What time to you anticipate starting Unit 5 tomorrow morning?
Elizabeth C. Miller
SCDNR

Office: 843-953-3881
Cell: 843-729-4636

From: Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>
Sent: Thursday, June 15, 2023 8:27 AM
To: 'Elizabeth Miller' <MillerE@dnr.sc.gov>
Cc: Jason Bettinger <BettingerJ@dnr.sc.gov>; Raymond Ammarell (DESC Generation - 8) <RAYMOND.AMMARELL@dominionenergy.com>
Subject: RE: Saluda Unit 5 operation Thursday 6/15

Elizabeth,
We started up Unit 5 around 7:30am today.
Amy

From: Raymond Ammarell (DESC Generation - 8)
Sent: Friday, June 16, 2023 4:24 PM
To: 'Elizabeth Miller' <MillerE@dnr.sc.gov>
Cc: Jason Bettinger <BettingerJ@dnr.sc.gov>; Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>
Subject: RE: Saluda Unit 5 operation Thursday 6/15

Elizabeth,
With Units 3, 4, and 5 running at Saluda Hydro we are just exceeding current inflow by about 200 CFS. Considering the rain in the forecast most of next week, we plan to continue running the three units through the weekend to maintain or lower the lake level and we will reevaluate Monday.
Thanks,
Ray

From: Elizabeth Miller <MillerE@dnr.sc.gov>
Sent: Friday, June 16, 2023 4:35 PM
To: Raymond Ammarell (DESC Generation - 8) <raymond.ammarell@dominionenergy.com>
Cc: Jason Bettinger <BettingerJ@dnr.sc.gov>; Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>
Subject: [EXTERNAL] RE: Saluda Unit 5 operation Thursday 6/15

Hi Ray,
Thank you for the update. Is the plan to continue running Unit 5 at 5 MW? Would you mind reminding me what that equates to in cfs?
SCDNR understands that DESC is concerned about the DO output of Units 3 and 4 at higher rates. If possible, is there a way the Units can be tested for a short term to see if the DO continues to decline at a higher output? SCDNR has concerns about relying on Unit 5 this early in the low DO season.
How are the Unit 1 repairs going? Do you think it would be operational soon?
Thanks,
Elizabeth C. Miller
SCDNR
Office: 843-953-3881
Cell: 843-729-4636

From: Raymond Ammarell (DESC Generation - 8)
Sent: Monday, June 19, 2023 10:19 AM
To: 'Elizabeth Miller' <MillerE@dnr.sc.gov>
Cc: Jason Bettinger <BettingerJ@dnr.sc.gov>; Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>
Subject: RE: Saluda Unit 5 operation Thursday 6/15

Elizabeth,
With the heavy rains forecast across the state this week, we will likely be running Saluda Hydro at higher outputs depending on how much inflow increases through the week. Based on the NWS current forecast, this has a good chance to be a pretty significant event in both the Broad and Saluda basins. If Lake Greenwood has to open their spillway we will be forced to operate at much higher outputs and all the Saluda units will need to be used for that. We are also considering increasing output from Saluda Hydro now while not compromising DO to reduce the lake level in advance of the rainfall. Amy or I will keep you updated on the plans this week.
Regarding your questions about testing Units 3 and 4 individually, we can do that at some point when inflows are low to see how they perform. However it is well documented that the units pull less air as the load on them is increased. Having to rely on Unit 5 early in low DO season is not where we would like to be either, but I think that may be the reality of the situation.
Regarding Unit 5 CFS vs. MW data, we don't run Unit 5 alone that often, so I will need to look at the data we have for those instances and send you that information. Rough estimate right now is 5 MW would be about 1,100 CFS for Unit 5.

Raymond R. Ammarell, P.E.
DESC Power Generation
Hydro Dam Safety Compliance

From: Raymond Ammarell (DESC Generation - 8)
Sent: Thursday, June 29, 2023 2:34 PM
To: Elizabeth Miller - SCDNR <millere@dnr.sc.gov>; Jason Bettinger <bettingerj@dnr.sc.gov>
Subject: Running Unit 5 at 1 MW

Elizabeth and Jason,
As you requested, I am letting you know we are running Unit 5 at 1 MW (about 1,000 CFS) along with Units 3 and 4 in order to keep DO up while we get a bit ahead of inflow. We were running Units 3 and 4 alone but the DO was falling below 5 mg/l and we didn't want to increase those two units and have it fall further. We will shut down Unit 5 at our earliest opportunity.

Raymond R. Ammarell, P.E.
DESC Power Generation
Hydro Dam Safety Compliance

From: Jason Bettinger <BettingerJ@dnr.sc.gov>
Sent: Wednesday, October 4, 2023 2:54 PM
To: Raymond Ammarell (DESC Generation - 8) <raymond.ammarell@dominionenergy.com>
Cc: Elizabeth Miller <MillerE@dnr.sc.gov>
Subject: [EXTERNAL] Saluda Units

Hello Ray, Did you all have some recent success with repairing one or more of the lower units? I was surprised to see the lower discharge with suitable oxygen and cooler temperatures.
On another note, I got a questions the other day about some new buoy lines or restricted access below Stevens Creek Dam. Do you all have some ongoing work there?
Thanks, Jason

From: Raymond Ammarell (DESC Generation - 8) <raymond.ammarell@dominionenergy.com>
Sent: Thursday, October 5, 2023 6:42 AM

To: 'Jason Bettinger' <BettingerJ@dnr.sc.gov>
Cc: Elizabeth Miller <MillerE@dnr.sc.gov>
Subject: RE: Saluda Units

Jason,

Last week McMeekin Station went into a scheduled outage, and we were able to run Unit 2 by itself and it is aerating the way it should. We had tested it briefly this spring and saw good DO numbers but couldn't use it while McMeekin ran this summer due to the NPDES requirement to release 2,500 CFS when Unit 2 operates with McMeekin in operation (McMeekin returns cooing water to Unit 2 penstock). With McMeekin off that restriction does not apply.

Below Stevens Creek Dam, our Public Safety Plan includes 3 buoys below the powerhouse to keep boats away from the discharge area. We had to replace the anchor on one of them recently because the buoy had broken its cable and drifted down near the plant's boat ramp. I thought the plant had removed the buoy from the river until the cable is replaced. Maybe the out of place buoy is what you were asked about.

Raymond R. Ammarell, P.E.
DESC Power Generation
Dam Safety & Hydro Compliance

From: Jason Bettinger <BettingerJ@dnr.sc.gov>
Sent: Friday, October 6, 2023 11:38 AM
To: Raymond Ammarell (DESC Generation - 8) <raymond.ammarell@dominionenergy.com>
Cc: Elizabeth Miller <MillerE@dnr.sc.gov>
Subject: [EXTERNAL] RE: Saluda Units

Thanks Ray. How long will McMeekin be off line allowing you to use unit 2? Jason

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From: Raymond Ammarell (DESC Generation - 8) <raymond.ammarell@dominionenergy.com>
Sent: Friday, October 6, 2023 4:23 PM
To: 'Jason Bettinger' <BettingerJ@dnr.sc.gov>
Cc: Elizabeth Miller <MillerE@dnr.sc.gov>
Subject: RE: Saluda Units

Jason,

The two McMeekin units have back to back outages this fall. The first McMeekin unit should be available in early November after its outage is over. We generally like to run units after an outage to work out any issues, and by then the lake temps should be cool enough to run Unit 5 by itself without causing temperature issues downstream. We are going to work on the Saluda units more this winter to try to get them to aerate better.

Raymond R. Ammarell, P.E.
DESC Power Generation
Dam Safety & Hydro Compliance

From: Raymond Ammarell (DESC Generation - 8)
Sent: Thursday, November 16, 2023 9:56 AM
To: Elizabeth Miller - SCDNR <millere@dnr.sc.gov>; Bill Marshall (marshallb@dnr.sc.gov) <marshallb@dnr.sc.gov>; Jason Bettinger <bettingerj@dnr.sc.gov>; Rusty Wenerick (weneriwr@dhec.sc.gov) <WENERIWR@dhec.sc.gov>; Chuck Hightower - DHEC <hightocw@dhec.sc.gov>; Bill Stangler (CRK@congareeriverkeeper.org)

<CRK@congareeriverkeeper.org>; Gerrit Jobsis - AR <gjobsis@americanrivers.org>; Peter Raabe - AR <praabe@americanrivers.org>
Cc: James Miller (DESC Generation - 8) <james.miller@dominionenergy.com>; Henry Delk (DESC Generation - 8) <HENRY.DELK@dominionenergy.com>; David Tucker (DESC Generation - 8) <DAVID.TUCKER@dominionenergy.com>; Amy Bresnahan (DESC Generation - 8) <amy.bresnahan@dominionenergy.com>; Matt Hammond (DESC Trans Distribution - 7T) <matt.hammond@dominionenergy.com>
Subject: Saluda DO Yesterday Evening

Saluda DO Stakeholders,

I wanted to let you know about the DO excursion below 4 mg/l that occurred for several hours yesterday evening. We had to take one of our larger coal fired units offline for several hours to perform a repair, and the water level in Monticello Reservoir is still too low to allow Fairfield Pumped Storage to cover the required reserves for our system as it normally would. Our system operators needed to have the Saluda units 1, 3, and 4 spinning in addition to Unit 5 for rapid start until the coal unit came back on line. This was a reserve operation to maintain system reliability. Unit 5 has been providing DO levels of about 8.5 mg/l, but adding the small units in at minimum load reduced the DO to between 2 and 3 mg/l at the tailrace gage. DO at the Columbia (Zoo) gage has just now dropped to 6 mg/l and it looks like that may be the low reading at that gage that will result from this operation.

This will be documented in the annual Article 31 report and discussed at the review meeting next year. In the meantime, please let me know if you have any questions.

Raymond R. Ammarell, P.E.
DESC Power Generation
Dam Safety & Hydro Compliance

From: Amy Bresnahan (DESC Generation - 8)
Sent: Monday, November 27, 2023 8:59 AM
To: Gerrit Jobsis <gjobsis@americanrivers.org>; praabe@americanrivers.org; Congaree Riverkeeper <crk@congareeriverkeeper.org>; Jason Bettinger <BettingerJ@dnr.sc.gov>; Eddy Moore (eddym@scccl.org) <eddym@scccl.org>
Subject: Lake Murray forebay water quality 11/21/2023

Good morning,

Attached is the latest WQ profile of Lake Murray at the Saluda Hydro intake towers. The data indicates that the reservoir is fully mixed and the low DO season is over for 2023. Dominion Energy South Carolina, Inc. will resume sending this information next year when the low DO season begins.

Amy Bresnahan, P.E.
Power Generation, Civil Engineering
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