DOMINION VIRGINIA POWER / NORTH CAROLINA POWER
PROJECT OPERATION AND FLOW MONITORING PLAN
LICENSE ARTICLE 412
Roanoke Rapids and Gaston
FERC Project Number 2009

June 2005

ROANOKE RAPIDS AND GASTON
FERC HYDROPOWER PROJECT 2009
NEW LICENSE, ISSUED 3-31-2004
ARTICLE 412 PROJECT OPERATION AND FLOW MONITORING PLAN

1.0 Goals

The purpose of this plan is to ensure compliance with license Articles 405, 406, 407, 408, 409, 410 and 424 as revised and issued by the Commission on March 4, 2005. The plan is to provide a means to independently verify compliance with the license articles listed above and to ensure consistent operation of the project. Specifically, the plan ensures compliance with:

Flow requirements in the lower Roanoke River;
Lake level requirements;
Flow requirements and ramping rates in the Roanoke Rapids bypassed reach;
The US Army Corps of Engineers (USACE) John H. Kerr Reservoir Flood control plan; and,
Whitewater boating seasonal flow requirements.

2.0 General

2.1 Dominion has developed and implemented an internal tracking system through use of an existing database licensed to the company. The system is referred to as the Environmental Tracking System (ETS) and is in use to ensure compliance with environmental regulatory requirements. The system has been customized to send automated reminders to responsible individuals at appropriate intervals to ensure compliance with license requirements, particularly plan compliance and reporting due dates.

3.0 Description of Monitoring Equipment and Compliance Plan

3.1 Downstream Flow (Article 409)

3.1.1 Flow from the Roanoke Rapids Dam is measured at the U.S. Geological Survey (USGS) Roanoke Rapids gage #02080500 and can be found at the USGS web site address: http://waterdata.usgs.gov/nc/nwis/uv?02080500. The gage is approximately one mile downstream of Roanoke Rapids Dam. The USGS uses a pressure sensor and calibrates and maintains the gage. Dominion provides annual funding to the USGS for the operation and maintenance of the gage.

3.1.2 Data from the USGS Roanoke Rapids Gage is electronically obtained by Dominion on an hourly basis and fed into a Programmable Logic Control (PLC). The PLC loads the data into Dominion's Environmental Monitoring System (EMS). The EMS displays data as required by the Roanoke Rapids Dam Operator (Operator) and is accumulated into a database within the EMS. The EMS updates the Operator's operating log hourly to indicate accumulated and daily average flow. The EMS data is available for display to the Roanoke Rapids Dam Operator.

3.1.3 To improve the monitoring response of Roanoke River flows to operational changes, Dominion plans to evaluate the benefits of installing an electronic flow-sensing device in the tailrace approximately 500 feet downstream of the dam. If such installation will improve Dominion's ability to better meet downstream flow requirements, it will install the flow-sensing device after Commission notification and approval of this Project Operation and Flow Monitoring Plan. At such time the device is installed, calibrated and tested, Dominion after consultation with the NC Department of Environment and Natural Resources (NCDENR) and the NC Wildlife Resources Commission (NCWRC) will update the Project Operation and Flow Monitoring Report that details the equipment and method utilized to measure downstream flow from the dam. This evaluation will be completed by December 31, 2009.

3.1.4 Station operators will utilize station procedure number RR-0-L-2 *Minimum and Target Flows* to assist in maintaining license compliance.

3.2 Lake Level Fluctuation (Article 406)

3.2.1 Roanoke Rapids is equipped on both the headwater and tailwater sides of the dam with a submerged pressure sensor equipped with a transducer that sends the water level signal to the EMS. The headwater gage is used to comply with Roanoke Rapids Lake water level requirements.

a. The headwater pressure sensor is located at elevation 113 feet just north of the Unit 1 intake bay. The pressure sensor is in a 4" pipe that penetrates the headworks into the lake. The tailwater pressure transducer is located in the unwatering gallery at elevation 29 feet, near Unit 1 in a 4-inch pipe.3.2.2 Gaston is equipped on both the headwater and tailwater sides of the dam with a float and cable level monitoring device located in a stilling well. The wells are 20 inch diameter pipes with a 2-inch diameter pipe equipped with a needle valve to dampen rapid changes in water level. The devices are equipped with a transducer that sends the water level to the EMS. The headwater gage is used to comply with Lake Gaston water level requirements. Location of the headwater well is south of Unit 4 intake bay. Location of the tailwater stilling well is on the north side of the switchyard retaining wall, 11 ft. downstream of the Unit 4 draft tube gate piers.

3.2.3 The lake water levels are continuously displayed on the Operators control boards, available both in numerical and graphic forms. The levels are alarmed to warn the Operator when levels are approaching license-required minimums or maximums as specified in Article 406.

3.2.4 Data is recorded and maintained on the EMS on an hourly basis, and anticipated maximum and minimum lake levels made available and updated daily on Dominion's website.

3.2.5 Both Roanoke Rapids and Gaston Dams have staff gages on the reservoir side of the dam, and Gaston has a staff gage on the tailrace side of the dam.

a. Roanoke Rapids headwater staff gage is located on the face of the dam between the Unit 1 intake bay and the skimmer gate.

b. Gaston's headwater staff gage is also close to the location of the stilling well, on the south side of the dam near Unit 4's intake bay

3.2.6 The Roanoke Rapids and Gaston transducer readings are cross checked with visual staff gage readings monthly. Malfunction of the transducers may cause a failure to provide an indication of actual water levels. However, such a failure does not affect the provision of minimum flows downstream of Roanoke Rapids dam. Based on experience, Dominion estimates that malfunctions of the transducers are repaired and the units restored to full operation within two hours. Operators record such events in the operating log.

3.2.7 Station operators will utilize station procedure number RR-0-L-5 *Lake Water Levels* to assist in maintaining license compliance.

3.3 Bypass Flows (Articles 407 and 411)

3.3.1 Temporary bypass flows are maintained by cracking open two floodgates (e.g., gates 1 and 17). The temporary arrangement will be maintained until the permanent bypassed reach flow plan, approved by the Commission, is implemented.

3.3.2 Temporary bypass flows are maintained by manually observing the gate openings of a gate at the north end of the dam and one at the south end of the dam.

3.3.3 Flows through the gate at a median Roanoke Rapids Lake level of 129.5 feet msl with a one foot opening are approximate 1000 cfs.

3.3.4 Each of two gates is opened approximately two inches in order to maintain 325 cfs continuously.

3.3.5 When freshet flows are required (total of 500 cfs), one of the electric motor operated gates is opened an additional two inches.

3.3.6 Monitoring equipment for bypassed flows shall be automated upon Bypassed Flow Plan (Article 411) approval by the Commission (due to the Commission on September 30, 2005).

3.3.7 Station operators will utilize station procedure number RR-0-L-1 *Flows In Bypassed Reach* to assist in maintaining license compliance.

3.4 Bypassed Reach Ramping Rates (Article 408)

3.4.1 Ramping rate flows are determined by the same formula described in 3.3.3 above, Roanoke Rapids floodgates flows per one foot opening = 1000 cfs.

3.4.2 At a flow of 5,000 cfs, total floodgate opening at Roanoke Rapids would equate to five feet.

3.4.3 The gates would be closed to maintain the ramp rate as described in Article 408 following the below listed table

Desired Flow (cfs)	Total Gate Opening	Hour
5000	5 feet	0
4000	4 feet	4
3000	3 feet	8
2000	2 feet	12

1500	1.5 feet	16
1000	1 foot	20
700	8.4 inches	24
500	6 inches	28
325	4 inches	32

3.4.4 Gates movements are logged manually in the Roanoke Rapids Control room in the gate-opening log.

3.4.5 Station operators will utilize station procedure number RR-0-L-1 *Flows in Bypassed Reach* to assist in maintaining license compliance.

3.5 Flood Control Operation (Article 410)

3.5.1 Floodgates are opened to provide downstream flows as prescribed by the USACE.

3.5.2 Floodgate opening requirement is determined by the formula in 3.4.3 above. Flood flows released from the Roanoke Rapids Dam are measured at the USGS Roanoke Rapids gage. Minor adjustments are made to gate openings to obtain the flows prescribed by the USACE.

3.5.3 Dam operators determine gate opening and closing sequence per station procedure RR-0-L-13 *Spillway Gate Operating Sequence.*

3.5.4 Dominion will notify the Commission within 10 days if flood flows are stepped down more quickly than the rate specified in Article 410.

3.5.5 Hot Weather Flow Reduction

Dominion shall work in conjunction with the USACE to reduce flows in the mainstem river gradually during the months of May through September to minimize the effect of hypoxic water inflow. Upon agreement with the USACE or until the USACE 216 study indicates that a different step-down schedule should be followed, Dominion will work with the USACE to implement the following step-down schedule from a 20,000-cfs flow:

Table FL5-1

Hour	Flow (cfs)
0	17,000
8	14,000
16	12,000
20	11,000
24	10,500
28	10,000
32	9,500
36	9,000

3.5.6 Table FL 5.1 represents a maximum flow reduction schedule. A slower step-down schedule (one that gets to the 9000 cfs flow over a longer period of time) may be mutually agreed to by the North Carolina Division of Water Quality (NCDWQ), the USACE and Dominion on a case by case basis.

3.5.7 During the time frame needed to execute the flow reduction schedule, Dominion would not engage in load-following operations.

3.5.8 Station operators will utilize station procedure number RR-0-L-3 *Flood Control Operation* to assist in maintaining license compliance.

3.6 Flow Augmentation (Article 405)

3.6.1 Downstream flow augmentation is expected to be an unusual condition. Its intention is to provide flow from project storage to improve or sustain downstream water quality in the lower Roanoke River during severe drought conditions. The source of the additional downstream flow will be the approximately three feet of storage in Lake Gaston between 197.0′ msl and 200.0′ msl, a volume of approximately 60,000 acre-feet. Dominion will commence flow augmentation per direction of the NCDWQ in consultation with the USACE and the NCWRC.

3.6.2 Dominion will begin flow augmentation per direction of the NCDWQ only after the following conditions are met:

- The USACE is operating the Kerr Reservoir under its drought management strategy;
- Roanoke Rapids Dam is not in a hydropower peaking mode and is only releasing drought minimum flows as directed by the USACE in accordance with Article 409;
- A weekly declaration from the USACE (as defined in Settlement Agreement GP2) is issued that is less than the total drought minimum flow required at the Roanoke Rapids Dam; and,
- Lake Gaston surface water elevation is above 197.0 msl.

3.6.3 Prior to commencing flow augmentation, Dominion will provide 24-hour notification to the Lake Gaston Association. Dominion will notify the Commission within 10 days of modifying the flows and lake levels.

3.6.4 Dam operators shall insure that during low flow augmentation required flows remain in the bypassed reach (station procedure RR-0-L-01 *Flow in Bypass Reach*). Dominion will commence augmenting flow using storage out of Gaston. Drought minimum flows shall be maintained at the USGS Roanoke Rapids Gage per license article 409. Once Lake Gaston reaches 197 msl, if conditions require Dominion to reduce flows below the drought minimums in order to maintain 197 msl, consultation with the USACE, NCDWQ and NCWRC will be required to determine the best course of action. Dominion will be required to obtain a license variance if any license conditions will be exceeded. Once the event (drought) that caused the flow augmentation requirement is over, Dominion will maintain drought flows downstream until the Gaston lake level is above 199 msl.

3.6.5 Dominion will document in the control room electronic logs the date and

time the flow augmentation commences. The data documenting these events is part of the normal operation logs and will be contained in the annual report to the Commission documenting project operations and compliance.

3.6.6 This plan is in place and is currently the mode of operation for the project. Reporting will commence with the March 2006 annual operations report required by the Commission.

3.7 Whitewater Boating (Article 424)

3.7.1 Dominion will provide the advanced and short-term planned releases in accordance with the Commission approved Whitewater Boating Plan.

3.7.2 Dominion will record the flows and dates of whitewater boating releases and submit them with the annual report due to the Commission by February 15th of each year.

4.0 Reporting

4.1 Downstream Flow (Article 409)

4.1.1 Dominion currently records flow data automatically to the EMS. The data is collected in an electronic file. The file summarizes daily flow data for maximum, minimum and average flows.

4.1.2. By March 31 of each year, Dominion will deliver an electronic report to the Commission, NCWRC, North Carolina Division of Water Resources (NCDWR), and NCDWQ documenting daily minimum, maximum and average flows and identifying any controlling flows conditions (i.e. normal, flood control, spawning season, drought flow).

4.2 Lake Level Fluctuation (Article 406)

4.2.1 Licensee currently records lake levels automatically to the EMS. The data is collected in an electronic file.

4.2.2 By March 31 of each year, Dominion will deliver an electronic report to the Commission, NCWRC and the Lake Gaston Association.

4.3 Bypass Flows (Articles 407 and 411)

4.3.1 Currently bypass flows are recorded manually.

4.3.2 An annual summary report of bypass flows shall be developed and summarized in electronic format and reported to the Commission, NCWRC, U.S. Fish and Wildlife Service (USFWS), NOAA Fisheries, and NCDENR by March 31.

4.3.3. Upon completion of the Bypassed Reach Flow Plan, Dominion will include flow data that is recorded electronically to the EMS.

4.4 Bypassed Reach Ramping Rates (Article 408)

4.4.1 An annual summary report of dates and times bypassed reach ramping occurs will be put into electronic format and reported to the Commission, NCWRC, USFWS, NOAA Fisheries and NCDENR by March 31.

4.4.2 The report will include dates, times, flows, number of gates open and amount each gate was open for each required flow per 3.4.3 above.

4.5 Flood Control Operation (Article 410)

4.5.1 Dominion will cooperate as required by the license with the USACE in

administering flood control per direction by the USACE.

4.5.2. Dominion will coordinate flood ramp down rates and will advise the USACE as to license requirements for ramp downs during hot weather months.

4.5.3 Dominion will report by exception if and when it is not able to meet the ramp down requirements of Article 410.

4.6 Flow Augmentation (Article 405)

4.6.1 Since this is likely to be a rare event, Dominion will notify the Commission within 10 days of implementing this conservation strategy.

4.6.2 If this conservation strategy is utilized, Dominion will summarize the event in the annual March 31 report to the Commission.

4.7 Incident Reporting

4.7.1 Any time downstream flows (per conditions in Article 409) or Bypassed reach flows (Article 407) fall below license minimums, the NCWRC and NCDWQ shall be notified within 48 hours of the incident.

4.7.2 Dominion, within 30 days, shall file a report to the Commission with copies to the NCWRC, NCDWQ, NCDWR, USFWS and NOAA Fisheries that will:

- Identify cause, severity and duration of the incident
- Describe any observed environmental impacts resultant of the incident
- Include data indicating compliance / non-compliance of the license conditions
- Describe corrective measures implemented to bring conditions back into compliance
- Describe measures implemented or proposed to ensure similar incidents will not reoccur
- Provide comments or correspondence, if any, received from the agencies notified at the time of the incident.

4.7.3 Accuracy of reservoir level gages, determination of compliance

- The lake level measurement is accurate to approximately 0.1 foot.
- The stilling wells dampen out most lake level fluctuations, however the levels are influenced by wind and turbine flow when hydropower units are started up or shut down
- The low level compliance requirements compensates for these changes by allowing for up to 360 hours per year below the reservoir low level condition of 199.0 feet msl.
- For the purpose of notifying the Commission of an out of compliance event for Lake Gaston for the upper level of 200.0 feet msl, the incident will be recorded and reported in the annual report but not be considered out of compliance unless the level exceeds 200.2 feet msl during the period June 16 – February 29 or 201.2 feet msl during the period March 1- June 15 (except whenever under flood control operation).
- For the purpose of notifying the Commission of an out of compliance event for Roanoke Rapids Lake for the upper level of 132.0 feet msl, the incident will be recorded and reported in the annual report but not be considered out of compliance unless the level exceeds 132.2 feet msl, except whenever under flood

control operation.

4.7 Summary Report

A summary of Narrative will be developed for the Annual March 31 report to the Commission. Any unusual conditions and exceptions to license conditions will be noted. Copies of the report will be sent to:

The Commission's Atlanta Regional Office
US Fish and Wildlife Service
US Army Corps of Engineers, Wilmington District Commander
NOAA Fisheries
North Carolina Department of Environment and Natural Resources
Division of Water Resources
Division of Water Quality
Division of Marine Fisheries
North Carolina Wildlife Resources Commission
Virginia Secretary of Natural Resources
The Nature Conservancy
Roanoke River Basin Association
Lake Gaston Association
Regional Partnership of Local Governments

5.0 Implementation Schedule

5.1 Downstream Flow (Article 409)

Dominion is currently complying with the requirements of the new license. Reporting will occur according to section 4 above the first March 31 following the Commission's approval of this plan.

5.2 Lake Level Fluctuation (Article 406)

Dominion is currently complying with the requirements of the new license. Reporting will occur according to section 4 above the first March 31 following the Commission's approval of this plan.

5.3 Bypass Flows (Articles 407 and 411)

Dominion is currently complying with the temporary measures required in the license as revised by the Commission on March 4, 2005. The implementation plan will be included in the Bypassed Reach Flow plan due to the Commission on September 30, 2005.

5.4 Bypassed Reach Ramping Rates (Article 408)

Dominion has been voluntarily cooperating with the USACE, NCWRC and NCDWQ and implementing this requirement since 1995. Reporting will occur according to section 4 above the first March 31 following the Commission's approval of this plan.

5.5 Flood Control Operation (Article 410)

Dominion is currently complying with the requirements of the new license. Reporting will occur according to section 4 above the first March 31 following the Commission's approval of this plan.

5.6 Flow Augmentation (Article 405)

This requirement will be implemented only upon consultation with the USACE, NCDWQ and NCWRC. Implementation will begin when required according to the conditions set forth in 3.6.2 above.

5.7 Whitewater Boating (Article 424)

Dominion will implement the Whitewater Boating plan within 30 days after receiving approval from the Commission of the plan.