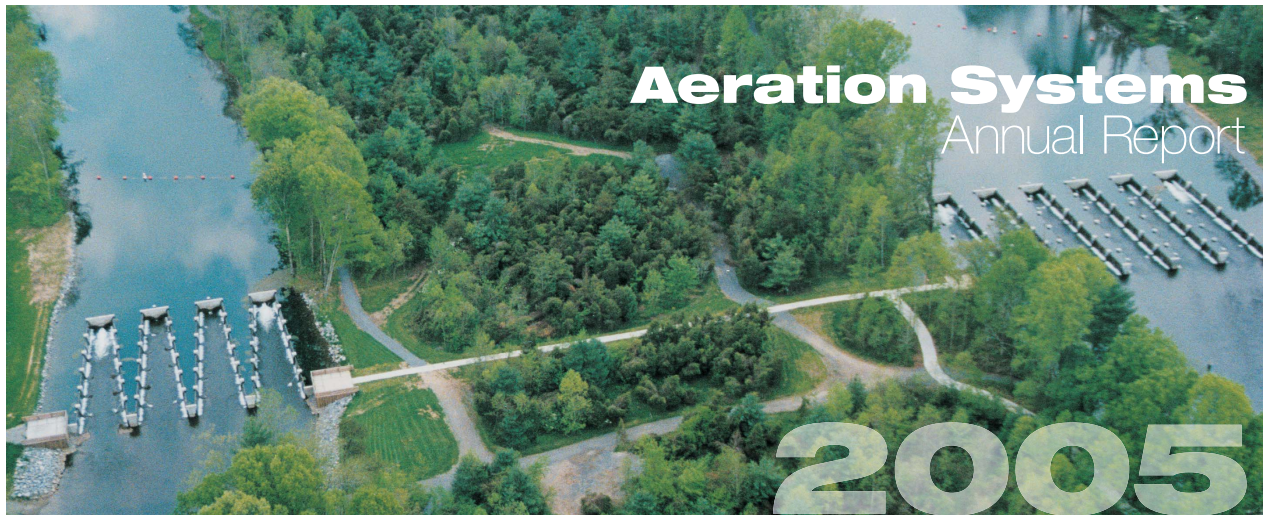


Reservoir Releases Improvements



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Program Goals and Objectives

Since the early 1990s, TVA has spent over \$50 million to address low concentrations of dissolved oxygen in the water released through its dams during hydro generation and dry riverbeds that result when generation is shut off. In the first stage of the improvement effort, TVA installed equipment at 15 dams to add life-sustaining oxygen to the water released into the tailwater (the area just below the dam) at 16 projects. At the same time, TVA made operational changes and installed additional equipment to sustain minimum flows below its dams.

TVA currently is completing a second round of improvements. Oxygen systems have been installed or enhanced at nine projects, and improvements at three more projects are under study. The additional oxygenation capacity will help offset increased oxygen demands associated with delaying the seasonal drawdown of TVA reservoirs until Labor Day under the new operating policy approved by the TVA Board in June 2004. Dissolved oxygen (DO) concentration improvement is achieved by the use of various aeration systems to meet the established DO targets listed in Attachment I.

System Descriptions

Aeration systems have been installed at Apalachia, Blue Ridge, Boone, Chatuge, Cherokee, Douglas, Fontana, Fort Loudoun, Hiwassee, Norris, Nottely, South Holston, Tims Ford, Watauga, and Watts Bar Dams. The DO levels at Fort Patrick Henry, are improved through the operation of the aeration system at Boone Dam.

Aeration systems consist of oxygen injection, surface-water pumps, aeration weirs, air compressors and blowers, and turbine venting. Some projects require the use of multiple systems to attain desired results. The following table shows the various systems that have been implemented at each dam.

System	Location
Oxygen Injection	Blue Ridge, Cherokee, Douglas, Fort Loudoun, Hiwassee, Norris, Nottely, Tims Ford, Watts Bar
Surface Water Pumps	Cherokee, Douglas
Aeration Weirs	Chatuge, South Holston, Norris*
Air Compressors and Blowers	Nottely, Tims Ford
Turbine Venting	Apalachia, Boone, Cherokee, Douglas, Fontana, Hiwassee, Norris, South Holston, Watauga

* The intended use of Norris weir is for minimum flow; however, incidental aeration also is achieved.

System Operations

The duration of aeration system operations varies from site to site. Typically, operations begin in mid-spring to early summer and end in late summer to early winter. Climatic and hydrologic conditions influence aeration system operations and can vary greatly from year to year. A summary of aeration operations for each project from 2000–2005 is provided in Attachments II–VII.

Unit operational preference is used at Fort Loudoun, Hiwassee, and Watts Bar to enhance aeration efforts.

DO monitoring was conducted on a normal schedule during FY 2005, as described in Attachment VIII.

Hardware, Software, and Communications Improvements

Improvements to RRI network systems, as well as enhancements resulting from the Reservoir Operations Study, implemented during FY 2005 are listed below.

Blue Ridge

Maintenance activities:

- Evaluated and tested communication system for the new Hach/Hydrolab DataSonde 5X Optical (DO) sensing system.
- Designed, installed and tested a new tailrace DO data acquisition system to monitor and control two simultaneously operating Hydrolab DataSonde water quality sensing systems. These systems can communicate with all of the standard membrane type probes and the new optical oxygen sensors.

Capital improvement activities:

- Designed, fabricated, and installed instrumentation and controls for the Forebay Oxygen Diffuser System (FODS). The primary component systems were :
 - A network operated diffuser line control valve system remotely operable by River Scheduling in the Forecast Center.
 - The Electrical Equipment Enclosure (EEE) structure to house the monitoring and controls for the oxygen distribution system.
 - A complete cabling system for all sensors needed for remote data display and control.
 - A remotely controllable uninterruptible AC power supply system for all monitoring, control and communication equipment.
 - Total mass flow and individual diffuser line flow oxygen measurement systems.
 - Tank pressure and level sensing for the oxygen tank.
 - Modified the fiber optic based network communication between the local plant and the instrumentation on the oxygen pad.

- Modifications of the voice phone communication provided in the EEE and near the new liquid oxygen tank.
- Telephone data communication wiring for liquid oxygen vendors to check the fill level status of the tank.
- Evaluated and installed vaporizer bank switching, pressure build vaporizer bank switching, and tank emergency shutoff controls.
- Prepared and released electrical design drawings for the oxygen supply system enhancements.

Cherokee

Maintenance activities:

- Evaluated and tested communication system for the new Hach/Hydrolab DataSonde 5X Optical DO sensing system.
- Designed and fabricated a new tailrace DO data acquisition system to monitor and control two simultaneously operating Hydrolab DataSonde water quality sensing systems. These systems can communicate with all of the standard membrane type probes and the new optical oxygen sensors.
- Performed design work to run fiber optic cable between downstream DO monitoring site and the powerhouse communication room.

Capital improvement activities:

- Designed, fabricated, and installed instrumentation and controls for the Forebay Oxygen Diffuser System (FODS). The primary component systems were :
 - A network operated diffuser line control valve system remotely operable by River Scheduling in the Forecast Center.
 - The EEE structure to house the monitoring and controls for the oxygen distribution system.
 - A complete conduit and cabling system for all sensors needed for remote data display and control.
 - An expanded AC power system for the oxygen pad.
 - A remotely controllable uninterruptible AC power supply system for all monitoring, control and communication equipment.
 - Total mass flow and individual diffuser line oxygen flow measurement systems.
 - Tank pressure and level sensing for each of the two oxygen tanks.
 - Modified the fiber optic based network communication between the local plant and the instrumentation on the oxygen pad.
 - Voice phone communication was provided in the EEE and near the new tanks.

- Telephone data communication wiring for liquid oxygen vendors to check the fill level status of the tanks.
- Evaluated, tested, and installed vaporizer bank switching, pressure build vaporizer bank switching, and tank switching controls.
- Prepared and released electrical design drawings for the oxygen supply system enhancements.

Douglas

Maintenance activities:

- Evaluated and tested the communication system for the new Hach/Hydrolab DataSonde 5X Optical DO sensing system.
- Designed, fabricated, and installed a new tailrace DO data acquisition system to monitor and control two simultaneously operating Hydrolab DataSonde water quality sensing systems. These systems can communicate with all of the standard membrane type probes and the new optical oxygen sensors.
- Designed and installed a new security enhanced network radio communication system to the downstream DO monitoring site.
- Liquid oxygen vendor installed telemetry to monitor oxygen tank levels.

Capital improvement activities:

- Designed, fabricated, and installed instrumentation and controls for the Forebay Oxygen Diffuser System.

The primary component systems were :

- A partial conduit and cabling system for sensors needed for remote data display and control.
- An expanded AC power system for the oxygen pad.
- Tank pressure and level sensing for each of the two oxygen tanks.
- Modifications to the network communication between the local plant and the instrumentation on the oxygen pad.
- Upgrade to voice communication from the oxygen pad to the new tank and oxygen pad entrance.
- Telephone data communication wiring for liquid oxygen vendors to check the fill level status of the tanks.
- Evaluated, tested, and installed vaporizer bank switching, pressure build vaporizer bank switching, and tank switching controls.
- Prepared and released electrical design drawings for the oxygen supply system enhancements.

Fort Loudoun

Maintenance activities:

- Liquid oxygen vendor installed telemetry to monitor oxygen tank levels.

Capital improvement activities:

- Designed, fabricated, and installed instrumentation and controls for the Forebay Oxygen Diffuser System. The primary component systems were :
 - A network operated diffuser line control valve system remotely operable by River Scheduling in the River Forecast Center.
 - Instrumentation box enclosures and support structure to house the monitoring and controls for the oxygen distribution system.
 - A complete conduit and cabling system for all sensors needed for remote data display and control.
 - An expanded AC power system for the oxygen pad.
 - A remotely controllable uninterruptible AC power supply system for all monitoring, control and communication equipment.
 - Total mass flow and individual diffuser line flow oxygen measurement systems.
 - Tank pressure and level sensing for each of the two oxygen tanks.
 - Network communication upgrades on the oxygen pad.
 - Voice phone communication upgrade.
 - Telephone data communication wiring for liquid oxygen vendors to check the fill level status of the tanks.
- Evaluated, tested, and installed vaporizer bank switching, pressure build vaporizer bank switching, and tank switching controls.
- Prepared and released electrical design drawings for the oxygen supply system enhancements.

Hiwassee

Maintenance activities:

- Evaluated and tested communication system for the new Hach/Hydrolab DataSonde 5X Optical DO sensing system.
- Designed, fabricated, and installed a new tailrace DO data acquisition system to monitor and control two simultaneously operating Hydrolab DataSonde water quality sensing systems. These systems can communicate with all of the standard membrane type probes and the new optical oxygen sensors.

- Designed and installed a new security enhanced network radio communication system to the downstream DO monitoring site.

Norris

Maintenance activities:

- Evaluated and tested communication system for the new Hach/Hydrolab DataSonde 5X Optical DO sensing system.
- Designed, fabricated, and installed a new tailrace DO data acquisition system to monitor and control two simultaneously operating Hydrolab DataSonde water quality sensing systems. These systems can communicate with all of the standard membrane type probes and the new optical oxygen sensors.

Capital improvement activities:

- Designed, fabricated, and installed instrumentation and controls for the Forebay Oxygen Diffuser System. The primary component systems were :
 - A network operated diffuser line control valve system remotely operable by River Scheduling in the Forecast Center.
 - The Electrical Equipment Enclosure structure to house the monitoring and controls for the oxygen distribution system.
 - A complete conduit and cabling system for all sensors needed for remote data display and control.
 - A new AC power system to oxygen pad.
 - A remotely controllable uninterruptible AC power supply system for all monitoring, control and communication equipment.
 - Total mass flow and individual diffuser line flow oxygen measurement systems.
 - Tank pressure and level sensing for the oxygen tank.
 - Fiber optic based network communication between the local plant and the instrumentation on the oxygen pad.
 - Modifications to provide voice phone communication in the Electrical Equipment Enclosure and next to the new tank.
 - Telephone data communication wiring for liquid oxygen vendors to check the fill level status of the tanks.
- Evaluated, tested, and installed vaporizer bank switching, pressure build vaporizer bank switching, and tank switching controls.
- Prepared and released electrical design drawings for the oxygen supply system enhancements.

Nottely

Capital improvement activities:

- Designed, fabricated, and installed instrumentation and controls for the Forebay Oxygen Diffuser System. The primary component systems were :
 - A network operated diffuser line control valve system remotely operable by River Scheduling in the Forecast Center.
 - The Electrical Equipment Enclosure structure to house the monitoring and controls for the oxygen distribution system.
 - A complete conduit and cabling system for all sensors needed for remote data display and control.
 - A new AC power system to oxygen pad.
 - A remotely controllable uninterruptible AC power supply system for all monitoring, control and communication equipment.
 - Total mass flow and individual diffuser line flow oxygen measurement systems.
 - Tank pressure and level sensing for the oxygen tank.
 - Fiber optic based network communication between the local plant and the instrumentation on the oxygen pad.
 - Modifications to provide voice phone communication in the Electrical Equipment Enclosure and next to the new tank.
 - Telephone data communication wiring for liquid oxygen vendors to check the fill level status of the tank.
- Evaluated, tested, and installed vaporizer bank switching, pressure build vaporizer bank switching, and tank emergency shutoff controls.
- Prepared and released electrical design drawings for the oxygen supply system enhancements.

Tims Ford

Maintenance activities:

- Evaluated and tested communication system for the new Hach/Hydrolab DataSonde 5X Optical DO sensing system.
- Designed, fabricated and installed a new tailrace DO data acquisition system to monitor and control two simultaneously operating Hydrolab DataSonde water quality sensing systems. These systems can communicate with all of the standard membrane type probes and the new optical oxygen sensors.

Capital improvement activities:

- Designed, fabricated and installed instrumentation and controls for the Forebay Oxygen Diffuser System. The primary component systems were :

- A network operated diffuser line control valve system remotely operable by River Scheduling in the Forecast Center.
 - The Electrical Equipment Enclosure structure to house the monitoring and controls for the oxygen distribution system.
 - A complete conduit and cabling system for all sensors needed for remote data display and control.
 - A new AC power system to oxygen pad.
 - A remotely controllable uninterruptible AC power supply system for all monitoring, control and communication equipment.
 - Total mass flow and individual diffuser line flow oxygen measurement systems.
 - Tank pressure and level sensing for the new oxygen tank.
 - The initial stage of installing a fiber optic based network communication between the local plant and the instrumentation on the oxygen pad.
 - Modifications to provide voice phone communication in the Electrical Equipment Enclosure and next to the new tank.
 - Telephone data communication wiring for liquid oxygen vendors to check the fill level status of the tank.
- Evaluated, tested, and installed vaporizer bank switching, pressure build vaporizer bank switching, and tank emergency shutoff controls.
 - Prepared and released electrical design drawings for the oxygen supply system enhancements.

Watts Bar

Maintenance activities:

- Liquid oxygen vendor installed telemetry to monitor oxygen tank levels.

Capital improvement activities:

- Designed, fabricated and installed instrumentation and controls for the Forebay Oxygen Diffuser System. The primary component systems were :
 - A network operated diffuser line control valve system remotely operable by River Scheduling in the Forecast Center.
 - The Electrical Equipment Enclosure structure to house the monitoring and controls for the oxygen distribution system.
 - A complete cabling system for all sensors needed for remote data display and control.
 - An expanded AC power system for the oxygen pad.
 - A remotely controllable uninterruptible AC power supply system for all monitoring, control and communication equipment.
 - Total mass flow and individual diffuser line flow oxygen measurement systems.

- Tank pressure and level sensing for each of the two oxygen tanks.
 - Modifications to the network communication between the local plant and the instrumentation on the oxygen pad.
 - Upgrades to voice phone communication to the oxygen pad.
 - Telephone data communication wiring for liquid oxygen vendors to check the fill level status of the tanks.
- Evaluated, tested, and installed vaporizer bank switching, pressure build vaporizer bank switching, and tank switching controls.

Physical Modifications and Improvements

Improvements to the physical operations of RRI systems and RRI enhancements resulting from the ROS implemented during FY 2005 are listed below.

Blue Ridge

Maintenance activities:

- Rebuilt the pressure regulators.
- Installed an additional taildeck monitoring stilling well.

Capital improvement activities:

- Issued Scope of Work Document for the oxygenation system.
- Prepared, reviewed, and issued Categorical Exclusion Checklist (CEC).
- Prepared Process and Instrumentation Diagram (P&ID) drawings for the oxygen supply system.
- Prepared and released civil and mechanical design drawings for the oxygen supply system enhancements.
- Performed civil site construction for the oxygen supply system enhancements. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway and installation of new security fencing.
- Designed and fabricated a new oxygen distribution header.
- Installed new 21,000 gallon liquid oxygen tank.
- Installed new 150 scfm pressure build vaporizer system for the new 21,000 gallon liquid oxygen tank.
- Installed piping, valve and control panel for liquid oxygen tank emergency shutoff.
- Installed new main pressure regulator station and related piping.

Boone

Capital improvement activities:

- Added central aeration system through the turbine hub on unit 1 Autoventing turbine (AVT) to help ensure downstream DO target was met.

Chatuge

Maintenance activities:

- Cleaned and inspected the weir pipes during the fall and spring to help maintain minimum flow.

Cherokee

Maintenance activities:

- Inspected the surface water pumps and made suggestions for future maintenance activities.
- Performed additional monitoring in support of ROS Biological Opinion Requirements, Task 1.
- Replaced one 3,000 foot diffuser line with a 6,000 foot diffuser line.
- Installed an additional downstream monitoring stilling well.

Capital improvement activities:

- Issued Scope of Work Document for the oxygenation system.
- Prepared P&ID drawings for the oxygen supply system.
- Prepared and released civil and mechanical design drawings for the oxygen supply system enhancements.
- Performed civil site construction for the oxygen supply system enhancements. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway, and installation of new security fencing.
- Installed new 21,000 gallon liquid oxygen tank.
- Installed new 300 scfm pressure build vaporizer system for the new 21,000 gallon liquid oxygen tank.
- Designed and procured equipment to enhance the pressure build vaporizer system on the 19,800 gallon liquid oxygen tank.
- Designed, procured and installed piping, valves and control panel for liquid oxygen tank switching.
- Designed and procured new process vaporizer bank switching system.
- Designed and procured new main pressure regulator station.
- Installed new oxygen distribution header.
- Fabricated and installed 15,000 feet of new diffuser line.

Douglas

Maintenance activities:

- Fabricated and installed 4,000 feet of new diffuser line.
- Inspected the surface water pumps and made suggestions for future maintenance activities.

Capital improvement activities:

- Issued Scope of Work Document for the oxygenation system.
- Prepared P&ID drawings for the oxygen supply system.
- Prepared and released civil and mechanical design drawings for the oxygen supply system enhancements.
- Performed civil site construction for the oxygen supply system enhancements. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway and installation of new security fencing.
- Installed new 21,000 gallon liquid oxygen tank.
- Installed new 300 scfm pressure build vaporizer system for the new 21,000 gallon liquid oxygen tank.
- Designed and procured equipment to enhance the pressure build vaporizer system on the 19,800 gallon liquid oxygen tank.
- Designed, procured and installed piping, valves and control panel for liquid oxygen tank switching.
- Designed and procured new process vaporizer bank switching system.
- Designed and procured new main pressure regulator station.

Fort Loudoun

Capital improvement activities:

- Issued Scope of Work Document for the oxygenation system.
- Prepared P&ID drawings for the oxygen supply system.
- Prepared and released civil and mechanical design drawings for the oxygen supply system enhancements.
- Performed civil site construction for the oxygen supply system enhancements. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway and installation of new security fencing.
- Installed new 21,000 gallon liquid oxygen tank.
- Installed new 150 scfm pressure build vaporizer system for the new 21,000 gallon liquid oxygen tank.
- Installed new 150 scfm pressure build vaporizer system for the 11,000 gallon liquid oxygen tank.
- Installed piping, valves and control panel for liquid oxygen tank switching.

Hiwassee

Maintenance activities:

- Installed an additional downstream monitoring stilling well.

Capital improvement activities:

- Replaced 3,500 feet of oxygen diffuser line.

Normandy

Maintenance activities:

- Operated the aeration diffuser system from 4/4/05–12/2/05.

Norris

Maintenance activities:

- Cleaned and inspected the weir pipes during the spring and fall to help maintain minimum flows.

Capital improvement activities:

- Issued Scope of Work Document for the oxygenation system.
- Prepared P&ID drawings for the oxygen supply system.
- Prepared, reviewed and issued CEC.
- Prepared and released civil and mechanical design drawings for the new oxygen supply system.
- Performed civil site construction for the new oxygen supply system. This included site preparation, demolition of existing features as required, relocation of potable water pipe, installation of embedded conduit, pouring concrete pad, tank piers, roadway and installation of new security fencing.
- Installed new 21,000 gallon liquid oxygen tank.
- Installed new 150 scfm pressure build vaporizer system for the new 21,000 gallon liquid oxygen tank.
- Installed piping, valve and control panel for liquid oxygen tank emergency shutoff.
- Installed four new 560 scfm process vaporizers (two banks of two vaporizers) and related piping, valves and bank switching equipment.
- Installed new main pressure regulator station and related piping.
- Fabricated and installed new oxygen distribution header.
- Installed five oxygen supply and five buoyancy pipes (total length of 17,500 feet) from oxygen distribution header to reservoir.
- Fabricated and installed 12,000 feet of new diffuser line.

Nottely

Maintenance activities:

- Installed an additional downstream monitoring stilling well.
- Upgraded the blowers to operate at higher pressures.
- Installed mass flowmeter for blower.

Capital improvement activities:

- Issued Scope of Work Document for the oxygenation system.
- Prepared P&ID drawings for the oxygen supply system.
- Prepared, reviewed and issued CEC.
- Prepared and released civil and mechanical design drawings for the new oxygen supply system.
- Performed civil site construction for the new oxygen supply system. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway and installation of new security fencing.
- Installed new 21,000 gallon liquid oxygen tank.
- Installed new 150 scfm pressure build vaporizer system for the new 21,000 gallon liquid oxygen tank.
- Installed piping, valve and control panel for liquid oxygen tank emergency shutoff.
- Installed four new 560 scfm process vaporizers (two banks of two vaporizers) and related piping, valves and bank switching equipment.
- Installed new main pressure regulator station and related piping.
- Fabricated and installed new oxygen distribution header.
- Installed five oxygen supply and five buoyancy pipes from oxygen distribution header to reservoir.
- Fabricated and installed 8,000 feet of new diffuser line.

South Holston

Maintenance activities:

- Collected additional scrollcase grab samples to monitor potentially low DO from September to November.
- Cleaned and inspected the weir pipes during the spring and fall to help maintain minimum flow.

Capital improvement activities:

- Began making modifications to the weir to seasonally change the minimum flow from 90 cfs to 150 cfs.

Tims Ford

Maintenance activities:

- Rebuilt the pressure regulators for the penstock system.
- Performed the annual penstock inspection and made minor repairs to the oxygen lines.

Capital improvement activities:

- Issued Scope of Work Document for the oxygenation system.
- Prepared, reviewed and issued CEC.
- Prepared and released civil and mechanical design drawings for the new oxygen supply system.
- Performed civil site construction for the new oxygen supply system. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway and installation of new security fencing.
- Installed new 21,000 gallon liquid oxygen tank.
- Installed new 150 standard cubic feet per minute (scfm) pressure build vaporizer system for the new 21,000 gallon liquid oxygen tank.
- Installed piping, valve and control panel for liquid oxygen tank emergency shutoff.
- Installed four new 560 scfm process vaporizers (two banks of two vaporizers) and related piping, valves and bank switching equipment.
- Installed new main pressure regulator station and related piping.
- Fabricated and installed new oxygen distribution header.
- Installed seven oxygen supply and seven buoyancy pipes (total length of 6,000 feet) from oxygen distribution header to reservoir.
- Fabricated and installed 12,000 feet of new diffuser line.

Watts Bar

Capital improvement activities:

- Performed civil site construction for the oxygen supply system enhancements. This included installation of embedded conduit, pouring concrete pads, tank piers, roadway and installation of new security fencing.
- Installed new 21,000 gallon liquid oxygen tank.
- Installed new 450 scfm pressure build vaporizer system for the new 21,000 gallon liquid oxygen tank.
- Installed new 450 scfm pressure build vaporizer system for the 14,600 gallon liquid oxygen tank.
- Installed piping, valves and control panel for liquid oxygen tank switching.

- Installed twelve new 560 scfm process vaporizers (two banks of six vaporizers) and related piping, valves and bank switching equipment.
- Installed new main pressure regulator station and related piping.
- Installed new oxygen distribution header.

Other Capital Improvement Activities

- Awarded a contract for vaporizer subsystems and related components.
- Flowed oxygen from eight new 21,000 gallon liquid oxygen tanks into the respective reservoirs for tailwater oxygenation.

System Performance

Oxygen Usage

Almost 11,685 tons of liquid oxygen were used during FY 2005 at a cost of approximately \$1,234,000. The price of liquid oxygen ranged from \$73 to \$126 per ton. Plant-by-plant LO_x usages and costs are depicted in Attachments IX and X, and month-by-month usage for each plant is summarized in Attachment XI.

FY 2005 Performance Measures

The DO deficit due to forced outage (the amount of time dissolved oxygen levels in dam releases were below target due to a forced outage) decreased from 2.0 mg/L deficit days in FY 2004 to 0.84 mg/L deficit days in FY2005.

FY 2005 performance is summarized in Attachment XII (FY 2005 Performance Measure Chart), Attachment XIII (FY 2005 Aeration Systems Availability), and Attachment XIV (FY 2005 Aeration Systems Outage Reports). The FY 2004 Performance Measure Chart is included as Attachment XV.

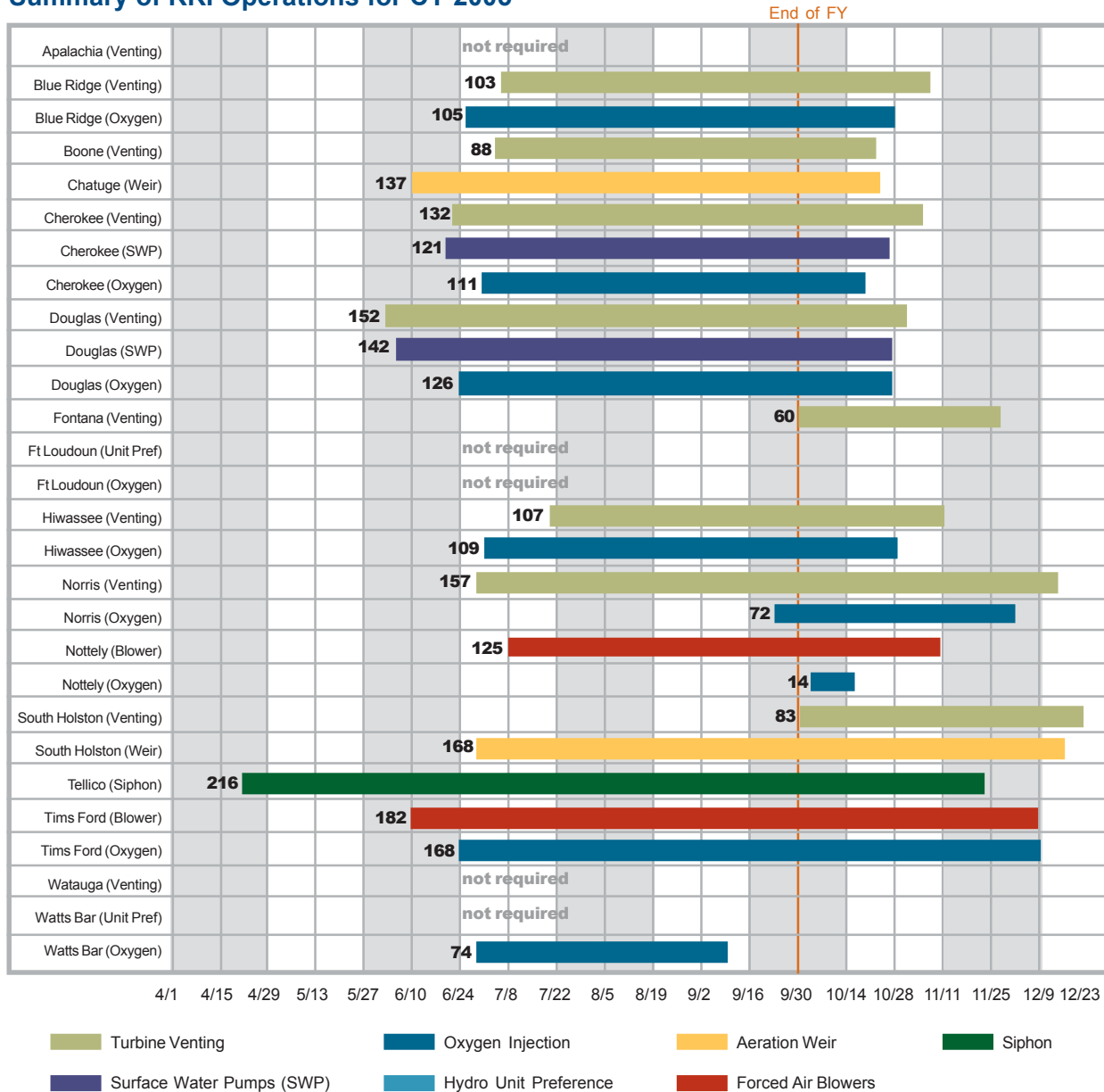
Attachment I

Dissolved Oxygen Targets by Project

Project	Dissolved Oxygen Target (mg/L)	Aeration System Component
Apalachia	6	Turbine venting
Blue Ridge	6	Forebay oxygen injection
Boone	4	Turbine venting
Chatuge	4	Aeration weir
Cherokee	4	Turbine venting, surface water pumps, forebay oxygen injection
Douglas	4	Turbine venting, surface water pumps, forebay oxygen injection
Fontana	6	Turbine venting
Fort Loudoun	4	Forebay oxygen injection
Fort Patrick Henry	4	Upstream improvements
Hiwassee	6	Forebay oxygen injection
Norris	6	Turbine venting, forebay oxygen injection
Nottely	4	Turbine air injection, forebay oxygen injection
South Holston	6	Turbine venting and aeration weir
Tims Ford	6	Turbine air injection, penstock oxygen injection, forebay oxygen injection
Watauga	6	Turbine venting
Watts Bar	4	Forebay oxygen injection

Attachment II—A

Summary of RRI Operations for CY 2005



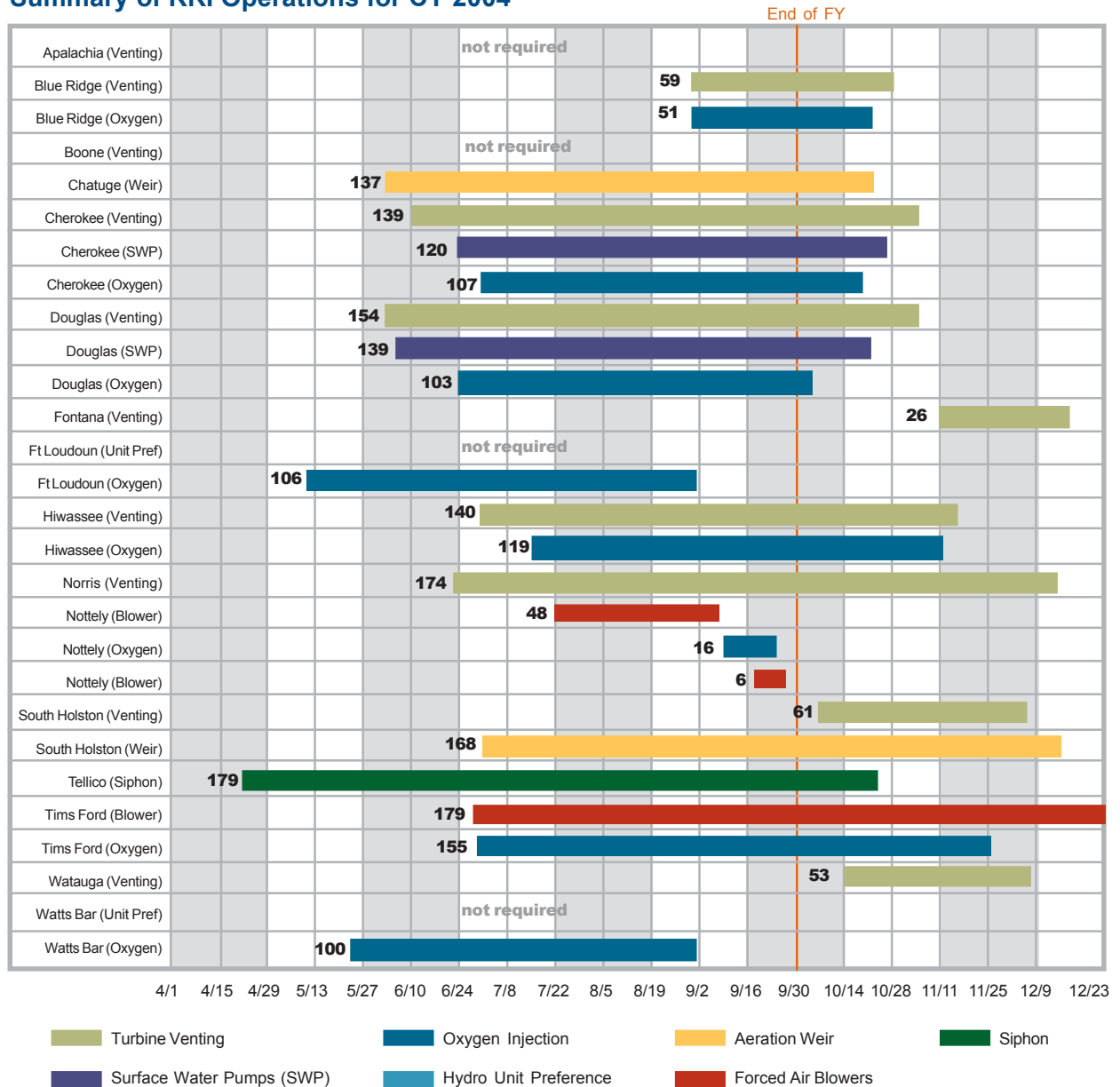
Attachment II—B

Summary of RRI Operations for CY 2005

Project	Starting Date	Duration	Ending Date
Apalachia (Venting)		0	Not Required
Blue Ridge (Venting)	20-Jul	103	31-Oct
Blue Ridge (Oxygen)	11-Jul	105	24-Oct
Boone (Venting)	21-Jul	88	17-Oct
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	23-Jun	132	2-Nov
Cherokee (SWP)	27-Jun	121	26-Oct
Cherokee (Oxygen)	30-Jun	111	19-Oct
Douglas (Venting)	3-Jun	152	2-Nov
Douglas (SWP)	7-Jun	142	27-Oct
Douglas (Oxygen)	23-Jun	126	27-Oct
Fontana (Venting)	29-Sep	60	28-Nov
Ft. Loudoun (Unit Pref)		0	Not Required
Ft. Loudoun (Oxygen)		0	Not Required
Hiwassee (Venting)	20-Jul	107	4-Nov
Hiwassee (Oxygen)	11-Jul	109	28-Oct
Norris (Venting)	10-Jul	157	14-Dec
Norris (Oxygen)	20-Sep	72	1-Dec
Nottely (Blower)	8-Jul	125	10-Nov
Nottely (Oxygen)	4-Oct	14	18-Oct
South Holston (Venting)	29-Sep	83	21-Dec
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	21-Apr	216	23-Nov
Tims Ford (Blower)	9-Jun	182	8-Dec
Tims Ford (Oxygen)	23-Jun	168	8-Dec
Watauga (Venting)		0	Not Required
Watts Bar (Unit Pref)		0	Not Required
Watts Bar (Oxygen)	27-Jun	74	9-Sep

Attachment III—A

Summary of RRI Operations for CY 2004



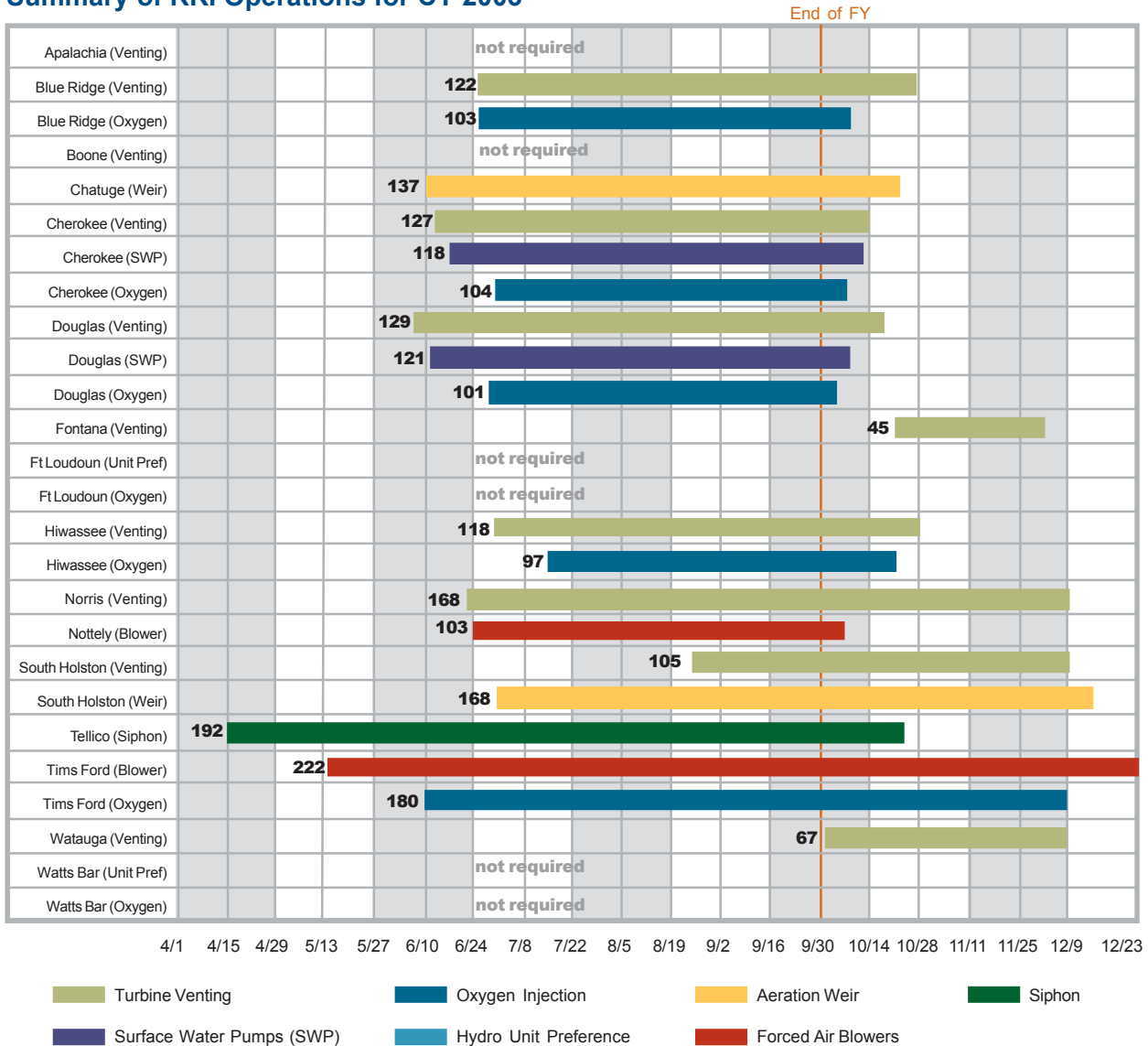
Attachment III—B

Summary of RRI Operations for CY 2004

Project	Starting Date	Duration	Ending Date
Apalachia (Venting)		0	Not Required
Blue Ridge (Venting)	29-Aug	59	27-Oct
Blue Ridge (Oxygen)	29-Aug	51	19-Oct
Boone (Venting)		0	Not Required
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	17-Jun	139	3-Nov
Cherokee (SWP)	28-Jun	120	26-Oct
Cherokee (Oxygen)	6-Jul	107	21-Oct
Douglas (Venting)	2-Jun	154	3-Nov
Douglas (SWP)	8-Jun	139	25-Oct
Douglas (Oxygen)	24-Jun	103	5-Oct
Fontana (Venting)	11-Nov	26	7-Dec
Ft. Loudoun (Unit Pref)		0	Not Required
Ft. Loudoun (Oxygen)	18-May	106	1-Sep
Hiwassee (Venting)	28-Jun	140	15-Nov
Hiwassee (Oxygen)	16-Jul	119	12-Nov
Norris (Venting)	22-Jun	174	13-Dec
Nottely (Blower)	21-Jul	48	7-Sep
Nottely (Oxygen)	8-Sep	16	24-Sep
Nottely (Blower)	24-Sep	6	30-Sep
South Holston (Venting)	7-Oct	61	7-Dec
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	26-Apr	179	22-Oct
Tims Ford (Blower)	1-Jul	179	27-Dec
Tims Ford (Oxygen)	1-Jul	155	3-Dec
Watauga (Venting)	15-Oct	53	7-Dec
Watts Bar (Unit Pref)		0	Not Required
Watts Bar (Oxygen)	24-May	100	1-Sep

Attachment IV—A

Summary of RRI Operations for CY 2003



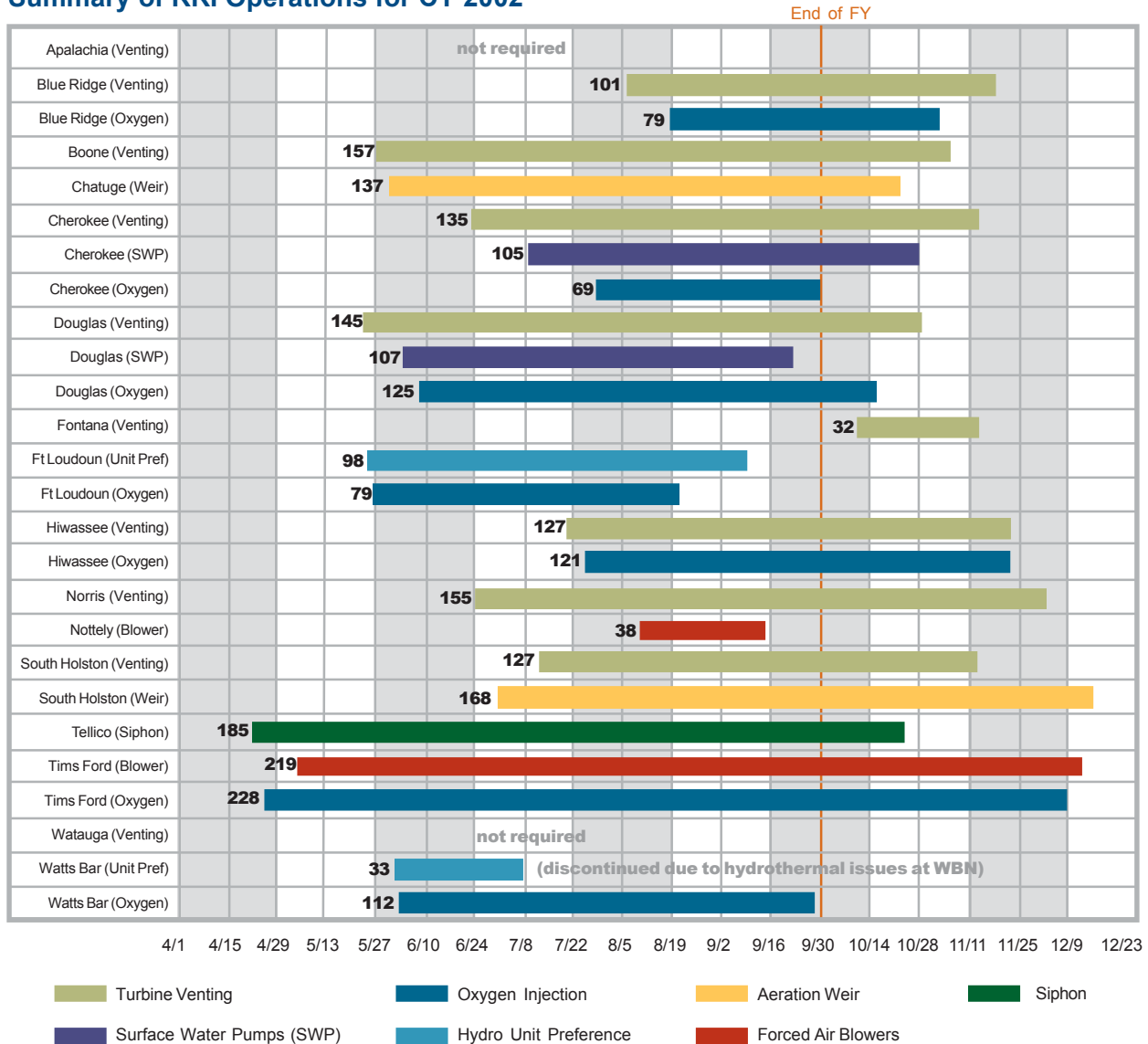
Attachment IV—B

Summary of RRI Operations for CY 2003

Project	Starting Date	Duration	Ending Date
Apalachia (Venting)		0	Not Required
Blue Ridge (Venting)	27-Jun	122	27-Oct
Blue Ridge (Oxygen)	27-Jun	103	8-Oct
Boone (Venting)		0	Not Required
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	11-Jun	127	16-Oct
Cherokee (SWP)	18-Jun	118	14-Oct
Cherokee (Oxygen)	27-Jun	104	9-Oct
Douglas (Venting)	9-Jun	129	16-Oct
Douglas (SWP)	11-Jun	121	10-Oct
Douglas (Oxygen)	30-Jun	101	9-Oct
Fontana (Venting)	20-Oct	45	4-Dec
Ft. Loudoun (Unit Pref)		0	Not Required
Ft. Loudoun (Oxygen)		0	Not Required
Hiwassee (Venting)	2-Jul	118	28-Oct
Hiwassee (Oxygen)	16-Jul	97	21-Oct
Norris (Venting)	23-Jun	168	8-Dec
Nottely (Blower)	27-Jun	103	8-Oct
South Holston (Venting)	25-Aug	105	8-Dec
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	15-Apr	192	24-Oct
Tims Ford (Blower)	15-May	222	23-Dec
Tims Ford (Oxygen)	11-Jun	180	8-Dec
Watauga (Venting)	2-Oct	67	8-Dec
Watts Bar (Unit Pref)		0	Not Required
Watts Bar (Oxygen)		0	Not Required

Attachment V—A

Summary of RRI Operations for CY 2002



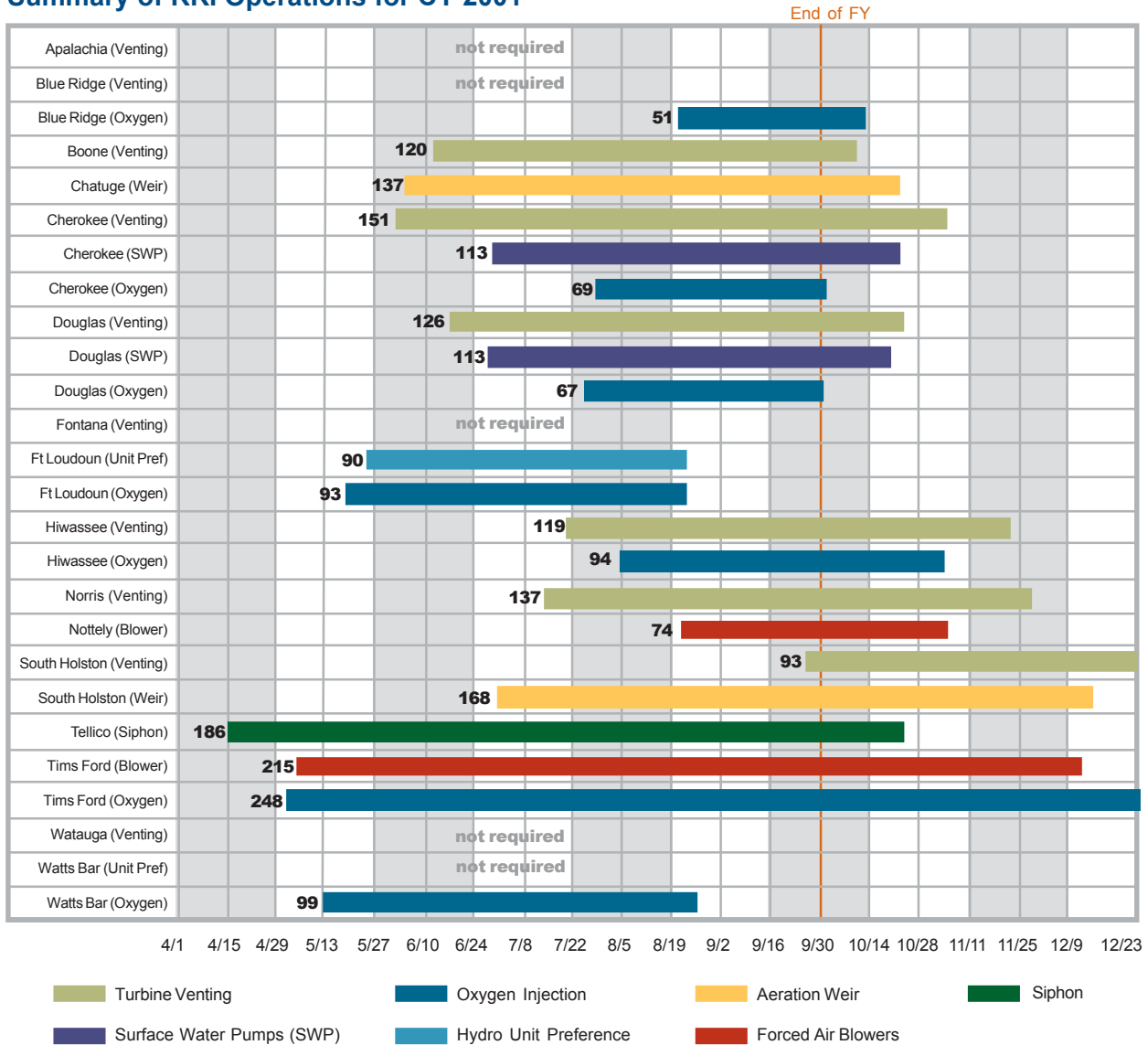
Attachment V—B

Summary of RRI Operations for CY 2004Summary of RRI Operations for CY 2002

Project	Starting Date	Duration	Ending Date
Apalachia (Venting)		0	Not Required
Blue Ridge (Venting)	6-Aug	101	15-Nov
Blue Ridge (Oxygen)	19-Aug	79	6-Nov
Boone (Venting)	4-Jun	157	8-Nov
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	1-Jul	135	13-Nov
Cherokee (SWP)	16-Jul	105	29-Oct
Cherokee (Oxygen)	25-Jul	69	2-Oct
Douglas (Venting)	30-May	145	22-Oct
Douglas (SWP)	5-Jun	107	20-Sep
Douglas (Oxygen)	14-Jun	125	17-Oct
Fontana (Venting)	11-Oct	32	12-Nov
Ft. Loudoun (Unit Pref)	3-Jun	98	9-Sep
Ft. Loudoun (Oxygen)	4-Jun	79	22-Aug
Hiwassee (Venting)	17-Jul	127	21-Nov
Hiwassee (Oxygen)	23-Jul	121	21-Nov
Norris (Venting)	1-Jul	155	3-Dec
Nottely (Blower)	7-Aug	38	14-Sep
South Holston (Venting)	17-Jul	127	21-Nov
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	22-Apr	185	24-Oct
Tims Ford (Blower)	7-May	219	12-Dec
Tims Ford (Oxygen)	25-Apr	228	9-Dec
Watauga (Venting)		0	Not Required
Watts Bar (Unit Pref)	4-Jun	33	7-Jul
Watts Bar (Oxygen)	6-Jun	112	26-Sep

Attachment VI—A

Summary of RRI Operations for CY 2001



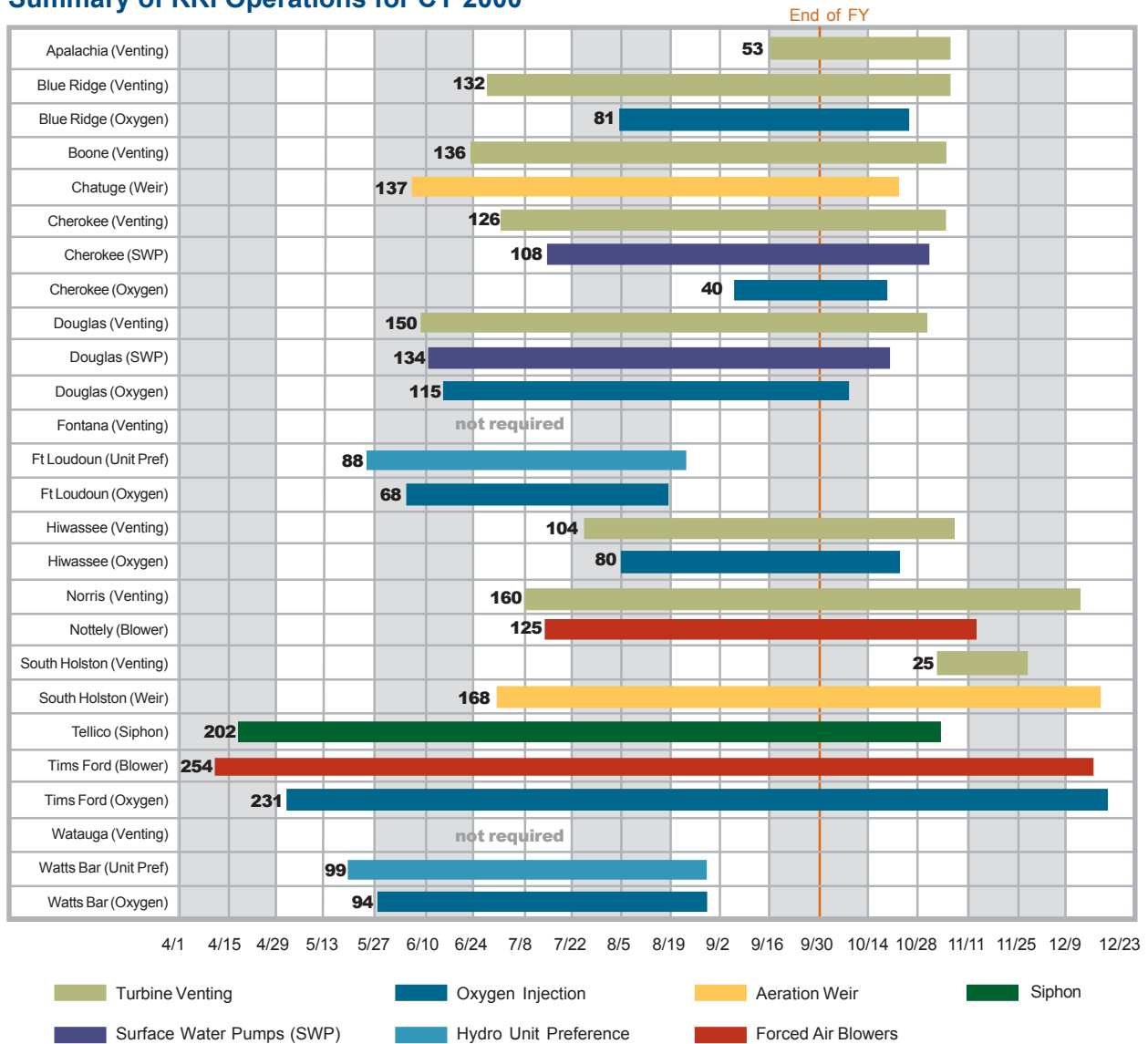
Attachment VI—B

Summary of RRI Operations for CY 2004 Summary of RRI Operations for CY 2001

Project	Starting Date	Duration	Ending Date
Apalachia (Venting)		0	Not Required
Blue Ridge (Venting)		0	Not Operated
Blue Ridge (Oxygen)	21-Aug	51	11-Oct
Boone (Venting)	14-Jun	120	12-Oct
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	7-Jun	151	5-Nov
Cherokee (SWP)	28-Jun	113	19-Oct
Cherokee (Oxygen)	26-Jul	69	3-Oct
Douglas (Venting)	20-Jun	126	24-Oct
Douglas (SWP)	28-Jun	113	19-Oct
Douglas (Oxygen)	26-Jul	67	1-Oct
Fontana (Venting)		0	Not Required
Ft. Loudoun (Unit Pref)	23-May	90	21-Aug
Ft. Loudoun (Oxygen)	20-May	93	21-Aug
Hiwassee (Venting)	20-Jul	119	16-Nov
Hiwassee (Oxygen)	3-Aug	94	5-Nov
Norris (Venting)	13-Jul	137	27-Nov
Nottely (Blower)	23-Aug	74	5-Nov
South Holston (Venting)	25-Sep	93	27-Dec
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	15-Apr	186	18-Oct
Tims Ford (Blower)	11-May	215	12-Dec
Tims Ford (Oxygen)	4-May	248	7-Jan
Watauga (Venting)		0	Not Required
Watts Bar (Unit Pref)		0	Not Required
Watts Bar (Oxygen)	21-May	99	28-Aug

Attachment VII—A

Summary of RRI Operations for CY 2000



Attachment VII—B

Summary of RRI Operations for CY 2004Summary of RRI Operations for CY 2000

Project	Starting Date	Duration	Ending Date
Apalachia (Venting)	15-Sep	53	7-Nov
Blue Ridge (Venting)	28-Jun	132	7-Nov
Blue Ridge (Oxygen)	4-Aug	81	24-Oct
Boone (Venting)	23-Jun	136	6-Nov
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	3-Jul	126	6-Nov
Cherokee (SWP)	14-Jul	108	30-Oct
Cherokee (Oxygen)	9-Sep	40	19-Oct
Douglas (Venting)	9-Jun	150	6-Nov
Douglas (SWP)	11-Jun	134	23-Oct
Douglas (Oxygen)	17-Jun	115	10-Oct
Fontana (Venting)		0	Not Required
Ft. Loudoun (Unit Pref)	25-May	88	21-Aug
Ft. Loudoun (Oxygen)	6-Jun	68	13-Aug
Hiwassee (Venting)	27-Jul	104	8-Nov
Hiwassee (Oxygen)	4-Aug	80	23-Oct
Norris (Venting)	7-Jul	160	14-Dec
Nottely (Blower)	12-Jul	125	14-Nov
South Holston (Venting)	2-Nov	25	27-Nov
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	18-Apr	202	6-Nov
Tims Ford (Blower)	5-Apr	254	15-Dec
Tims Ford (Oxygen)	1-May	231	18-Dec
Watauga (Venting)		0	Not Required
Watts Bar (Unit Pref)	23-May	99	30-Aug
Watts Bar (Oxygen)	28-May	94	30-Aug

Attachment VIII

FY 2005 Monitoring Schedule

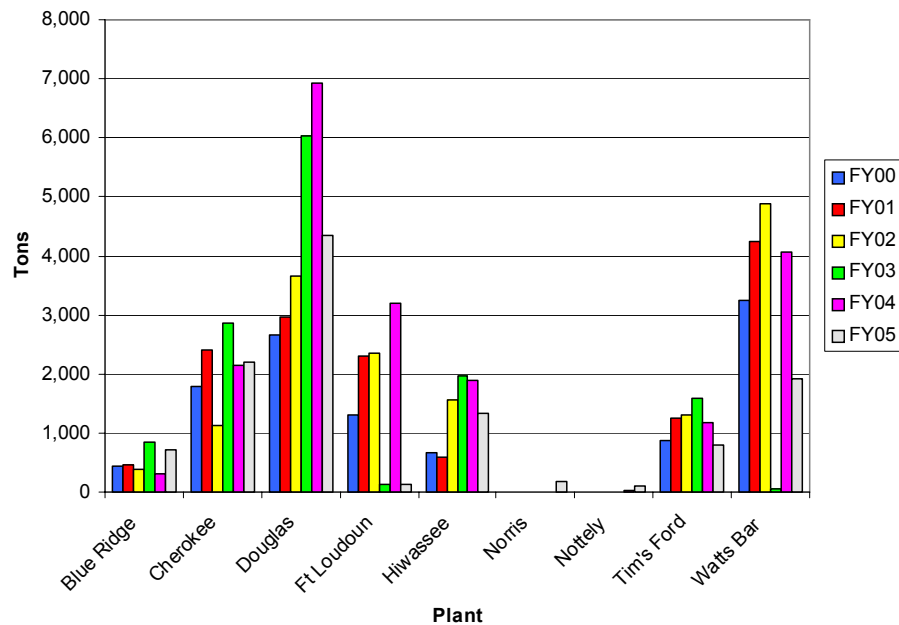
Project/Location	Number of Units	Target DO (mg/L)	Monitoring Start Date	Estimated Monitoring End Date	Type Monitoring	Frequency	Parameters	Special Parameters
Apalachia Penstock/unit Taildeck/unit	2	6.0	6/30/05	11/1/05	Grab Grab	Biweekly Biweekly	DO, T DO, T	TDG (grab only)
Blue Ridge Scrollcase/unit Taildeck/unit	1	6.0	6/15/05	11/1/05	Grab Cont (Hydrolab)	Weekly 15 min.	DO, T DO, T	
Boone Scrollcase/unit Taildeck/unit	3	4.0	5/15/05	11/15/05	Grab Grab	Biweekly Biweekly	DO, T DO, T	TDG (grab only)
Chatuge Scrollcase Weir (above/below, during gen.)	1	4.0	6/15/05	10/15/05	Grab Grab	Biweekly Biweekly	DO, T DO, T	TDG (grab only)
Cherokee Reservoir (1 station - RM 56) Scrollcase (unit 1 and 4) Downstream (2000 ft.)	4	4.0	5/15/05	10/20/05	Profile Grab Cont (Hydrolab)	Weekly (6/15 - 9/15) Weekly 15 min.	Hydrolab DO, T DO, T	TDG (grab only)
Douglas Reservoir (1 station - RM 35.5) Scrollcase (unit 1 and 4) Downstream (2500 ft.)	4	4.0	5/15/05	10/23/05	Profile Grab Cont (Hydrolab)	Weekly (6/15 - 9/15) Weekly 15 min.	Hydrolab DO, T DO, T	TDG (grab only)
Fontana Scrollcase/unit Taildeck/unit	3	6.0	8/21/05	12/15/05	Grab Grab	Biweekly Biweekly	DO, T DO, T	TDG (grab only)
Fort Loudoun Reservoir (1 station - RM 605) Taildeck/unit Taildeck (unit 1 and 4)	4	4.0	5/1/05	9/15/05	Profile Grab Cont (Hydrolab)	Weekly (6/1 - 9/15) Weekly 15 min.	DO, T DO, T	TDG (grab only)
Fort Patrick Henry Taildeck/unit	2	4.0	5/15/05	11/15/05	Grab	Biweekly	DO, T	TDG (grab only)
Hiwassee Scrollcase/unit Downstream (1200 ft., left bank)	2	6.0	6/30/05	11/15/05	Grab Cont (Hydrolab)	Weekly 15 min.	DO, T DO, T	
Normandy Downstream bridge			8/1/05	10/31/05	Grab	Biweekly	DO, T	
Norris Taildeck/unit Tailrace (left wing wall) Canoe portage below weir Hwy 61 bridge	2	6.0	6/1/05	12/15/05	Grab Cont (Hydrolab) Grab Grab	Weekly 15 min Weekly Weekly	DO, T DO, T DO, T DO, T	TDG continuous
Nottely Penstock/unit Downstream (1000 ft., right bank)	2	4.0	6/15/05	11/15/05	Grab Cont (Hydrolab)	Weekly 15 min.	DO, T DO, T	TDG (grab only)
South Holston Scrollcase Taildeck Downstream (bridge below weir) Scrollcase	1	6.0	7/15/05	12/23/05	Grab Grab Grab Grab	Biweekly Biweekly Biweekly on request (Sept-Nov)	DO, T DO, T DO, T DO, T	If DO nears 3, collect weekly; if DO nears 2, collect twice/week
Tims Ford Taildeck/unit Scrollcase/unit Taildeck	2	6.0	4/15/05	12/31/05	Grab Grab Cont (Hydrolab)	Weekly Weekly 15 min.	DO, T DO, T DO, T	TDG continuous
Watauga Penstock/unit Taildeck/unit Wilbur (taildeck and below weir)	2	6.0	7/15/05	12/15/05	Grab Grab Grab	Weekly Weekly Weekly	DO, T DO, T DO, T	
Watts Bar Reservoir (1 station - RM 534) Taildeck/unit Taildeck (units 1, 2, and 5)	5	4.0	5/1/05	9/1/05	Profile Grab Cont (Hydrolab)	Weekly (6/1 - 9/15) Weekly 15 min.	DO, T DO, T	
Watts Bar enhance (Chickamauga) Reservoir (1 station - Forebay) Taildeck/unit Downstream bridge trestle	4	4.0	4/1/05	10/31/05	Profile Grab Cont (Hydrolab)	Weekly (April - Oct) Weekly 15 min.	Hydrolab DO, T DO, T	pH, conductivity

Attachment IX

Annual Oxygen Usage by Plant in Tons

Plant	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Average
Blue Ridge	424	455	390	839	306	720	522
Cherokee	1,782	2,410	1,135	2,857	2,149	2,193	2,088
Douglas	2,668	2,955	3,659	6,042	6,919	4,335	4,430
Fort Loudoun	1,313	2,304	2,340	128	3,184	136	1,567
Hiwassee	653	594	1,555	1,960	1,882	1,331	1,329
Norris	0	0	0	0	0	184	184
Nottely	0	0	0	0	31	95	63
Tims Ford	868	1,265	1,294	1,595	1,165	785	1,162
Watts Bar	3,243	4,251	4,881	63	4,074	1,905	3,069
TOTAL	10,951	14,234	15,254	13,484	19,710	11,684	14,415

RRI-Oxygen Usage by Plant



Attachment X

Oxygen Costs by Plant, FY 2000–FY 2005

Business Sensitive

For cost information, contact Chuck Bach, (865) 632-4203

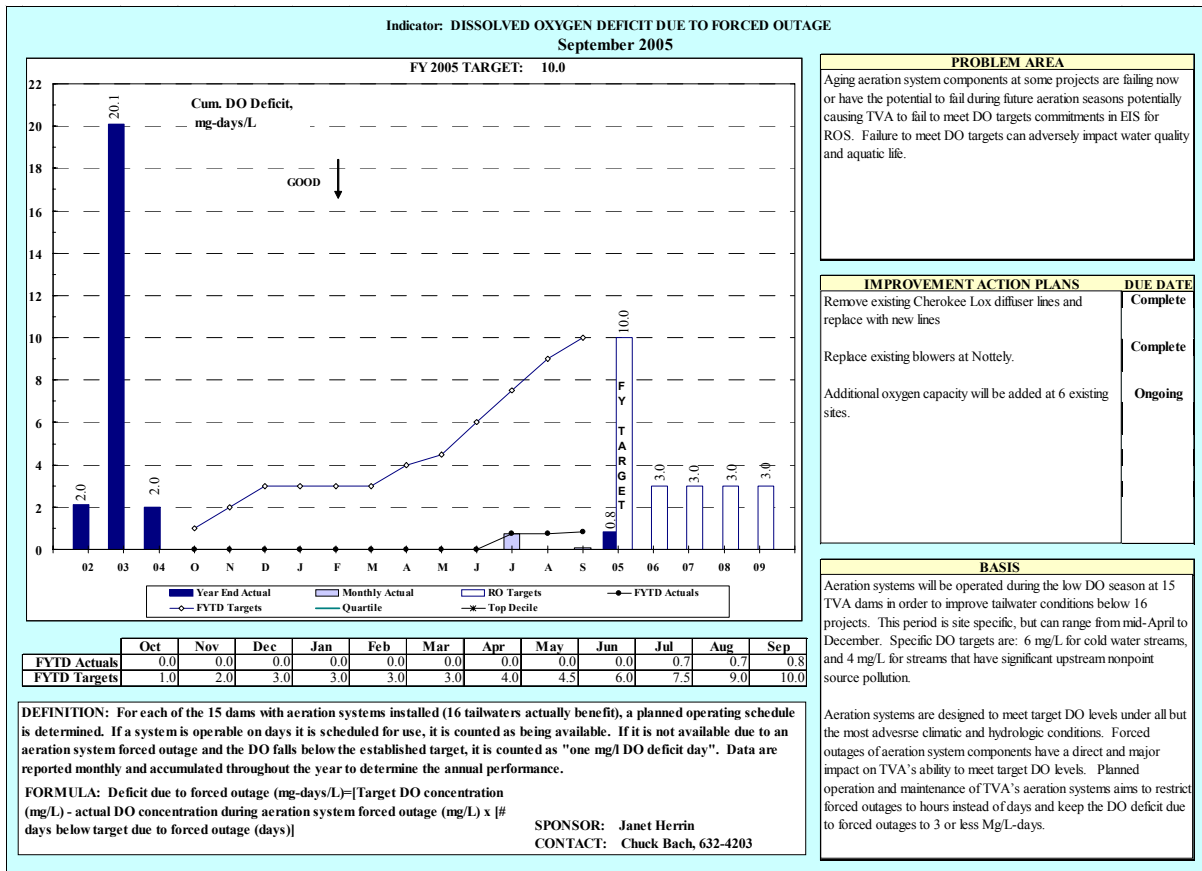
Attachment XI

FY 2005 Monthly Oxygen Tonnage Usage

Plant	Oct 2004	Nov 2004	Dec 2004	Jan 2005	Feb 2005	Mar 2005	Apr 2005	May 2005	Jun 2005	Jul 2005	Aug 2005	Sep 2005	Total
Blue Ridge	122.30	0	0	0	0	0	0	0	41.33	165.65	164.15	226.739	720.169
Cherokee	394.27	0	0	0	0	0	0	0	109.61	542.284	728.074	418.58	2192.822
Douglas	261.76	0	0	19.84	0	0	22.38	21.30	202.622	1623.988	1063.134	1120.285	4335.309
Ft. Loudoun	0	0	0	0	0	0	0	0	41.646	37.343	56.532	0	135.521
Hiwassee	522.01	175.62	22.87	0	0	0	21.43	22.44	23.00	155.12	190.239	198.313	1331.042
Norris	0	0	0	0	0	0	0	0	0.00	98.696	0	85.62	184.316
Nottely	6.14	0	0	0	0	0	0	0	0	0	88.79	0	94.930
Tim's Ford	260.62	238.11	4.95	0	0	0	19.17	0	0	46.772	44.166	171.46	785.248
Watts Bar	91.56	0	0	0	0	0	0	0	177.085	856.898	559.135	220.549	1905.227
Total	1658.66	413.73	27.82	19.84	0	0	62.98	43.74	595.297	3526.751	2894.22	2441.546	11684.58

Attachment XII

FY 2005 Performance-Measure Chart: Dissolved Oxygen Deficit Due to Forced Outage



Attachment XIII

Aeration Systems Availability in FY 2005

	Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		
	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	
Apalachia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Blue Ridge	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19.2	20	31	31	30	30	
Boone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	31	31	30	30
Chatuge	24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	22	31	31	31	31	30	30
Cherokee	31	31	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	31	31	31	31	29.9	30
Douglas	31	31	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	27	27	30.9	31	31	31	30	30
Fontana	0	0	15	15	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Fort Loudoun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hiwassee	31	31	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	31	31	30	30
Norris	31	31	30	30	31	31	10	10	0	0	0	0	0	0	0	0	0	0	0	21	21	31	31	30	30
Nottely	31	31	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22.8	23	31	31	30	30
South Holston	31	31	30	30	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	31	31	31	31	30	30
Tims Ford	31	31	30	30	27	27	0	0	0	0	0	0	0	0	0	0	0	21	21	31	31	31	31	30	30
Watauga	17	17	30	30	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Watts Bar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	29	29	20	20	9	9
Monthly Total:	286	286	171	171	80	80	10	10	0	0	0	0	0	0	0	0	0	80	80	277.9	279	330	330	309.9	310
Monthly % Avail.		100		100		100		100		100		100		100		100		100		99.6		100		99.9	
FYTD Total	286	286	457	457	537	537	547	547	547	547	547	547	547	547	547	547	627	627	904.9	906	1234.9	1236	1544.8	1546	
FYTD % Available		100		100		100		100		100		100		100		100		100		99.9		99.9		99.9	
Monthly (DO deficit due	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.74		0.74		0.10		
FYTD to forced outage)	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.74		0.74		0.84		

A= Planned operating days available
P= Planned operating days

Comments:

July: Blue Ridge DO deficit (0.55 mg-day/L) due to no LOx

July: Douglas DO deficit (0.04 mg-day/L) due to no LOx

July: Nottely DO deficit (0.15 mg-day/L) due to no blower use account index testing on large

Sept: Cherokee DO deficit (0.10 mg-day/L) due to SWPs not operating

Attachment XIV

Aeration Systems Outage Report

Aeration Syst. allability Log

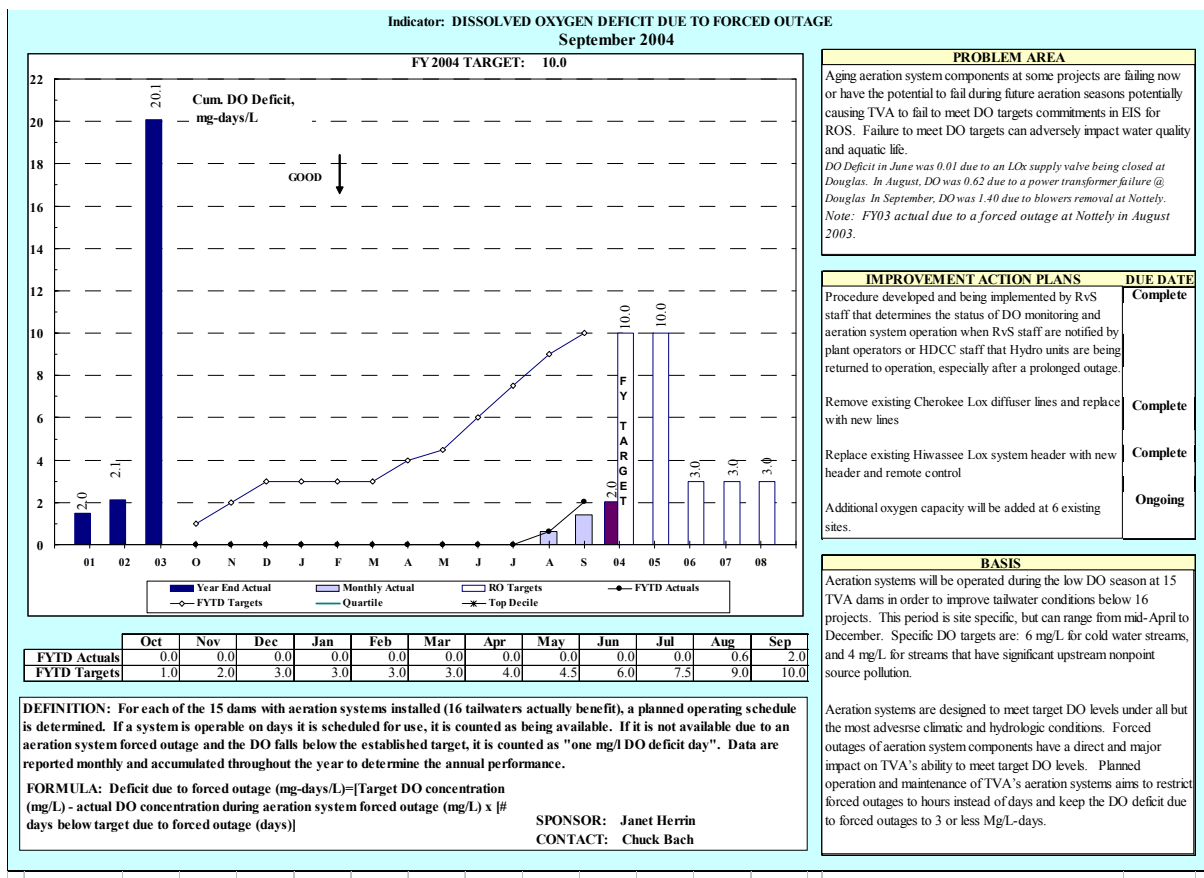
2005

	Date	Plant	Problem	Reported By	Time Out	Time In	Comments
	6/23	Tims Ford	Blower failed to start	Lee Parriss	0800		Called Chuck Amuge (welder) Expect to repair by afternoon
	6/23	"	unable to get LOX to work	"	1400		Will continue to work on this & Blower tomorrow
NO	7/10	Douglas	LOX turned off @ 1% tank full while waiting for order	Mike Clarke	1550	1630	DELIVERY SCHEDULED @ 7/11 @ 1700
NO	7/11	Douglas	LOX turned off @ 2% tank full while waiting for order	Nate Moore	1635	2200	DELIVERY SCHEDULED
NO	7/15	Nottely	Blowers getting too hot melting the asphalt, cutting back to 1 blower during large unit x	Mira Del Chuck Back			
YES	7/18	Blue Ridge	LOX turned off @ 1% tank full while waiting for order low level in tank	Lee Parriss	1020	0700 7/19	LOX expected to be delivered 7/19 AM
YES	7/22	Douglas	LOX turned off @ 1% tank full while waiting for order	Nate Moore	1910	0920 7/23	LOX expected delivery @ 7/23
NO	7/23	Blue Ridge	Ran out of LOX	Watte Moore	1940	7/24	LOX expected delivery @ 7/24 @ 1800
NO	7/24	Cherokee	LOX turned off @ 0220 Tank @ 6" Delivery scheduled @ 0230	Watte Moore	0220	0250	LOX expected delivery ??? Tomorrow after 7/24
NO	7/24	Pagitts	LOX turned off @ 0805 3% tank @ 6" delivery scheduled @ 0800		0105	1050	LOX delivery @ 11:00 generating started @ 11:00
NO	7/24	Cherokee	LOX turned off @ 2130 while waiting for order	Watte Moore	2130		LOX tank has been directed to Cherokee
?	7/24	Boone	TV unit #1 out	Lee Parriss	7/21	7/25 1415	Boone TV unit 1
	7/25	Boone	TV unit #1 Back	J. Patterson	7/21	7/25	" " " "
NO	7/25	Tims Ford	Blower turned off by accident	J. Patterson	7/25	7/25	
YES	7/27	Nottely	Blower off for index testing	J. Patterson	0700	1100	
NO	7/27	Douglas	Ran out of LOX	J. Patterson	1200		

Boone Unit 1 forced (?) out. TV not available on unit 1. TV available and operating on Units 2 & 3. Unit 1 back out of full operation at August - TV Unit 2 not available. Unit 3 reference not available.

Attachment XV

FY 2004 Performance-Measure Chart: Dissolved Oxygen Deficit Due to Forced Outage



Notes