THE SYSTEM MATURES

Dam Safety, Aging Equipment, and Alternative Funding

A large portion of the value derived from any resource is obtained from the invested capital and the resulting fixed and operating expenses. There is no line of development of natural resources so universally safe that such development must not be regarded as largely speculative and subject to many risks and contingencies.

DANIEL WEBSTER MEAD, *WATER POWER ENGINEERING*, 1920

The Rivers and Harbors Act of 1925 authorized the US Army Corps of Engineers to study potential flood control projects throughout the United States. The following year, they recommended further investigations of 200 rivers in House Document 308-69/1. The studies were authorized during the next Congressional sessions and the subsequent "308 Reports" laid the foundation for massive civil works projects in the United States, including the multi-purpose projects of the Southeast.[1]

Following World War II, the Corps began dozens of multi-purpose civil works projects in the southeastern United States based on those surveys. Twenty-two of the projects included a hydropower component, the energy from which would ultimately be marketed by the Southeastern Power Administration.[2] The first generating units came online in 1948 at Dale Hollow in Tennessee and over the next few decades, more federal power was generated for the preference customers.

Like any piece of equipment, hydroelectric structures and components have a limited life-cycle. Many are estimated to have fifty years' worth of reliable service. By the 1990s, the electrical equipment and associated systems supplying power to the people of the Southeast began to show signs of age-related wear and tear. Fatigued units failed and half-century old dams sprouted leaks primarily due to the limited technology and engineering practices at the time of construction. When units fail or water quantity is restricted, federal power is not produced or sold. Contractual obligations must be met with replacement power and repayments to the treasury are deferred. Those projects managed by the South Atlantic Division were some of the hardest hit in the federal

Left: Like any piece of equipment, hydropower projects suffer from age-related wear. Over the last two decades, project reliability issues affected SEPA's ability to get power to the preference customers (Corps photo).

REPAYMENT STATUS OF ALL PROJECTS AS OF SEPTEMBER 30, 2012[3]

System	Initial Year of Repayment Studies	Cumulative Revenue	Cumulative Expenses and Interest	Total Investment to be Repaid	Investment Repaid to Date	Unpaid Balance of Investment
GA-AL-SC	1950	$3,629	$3,282	$1,720	$347	$1,373
Jim Woodruff	1957	$195	$175	$71	$20	$51
Cumberland	1949	$1,336	$1,048	$415	$288	$127
Kerr-Philpott	1953	$497	$406	$186	$91	$95
Total*		$5,657	$4,911	$2,392	$746	$1,646

** all dollars are in millions*

SEPA MARKETING AND SALES, 1990-2010[4] (BY FISCAL YEAR)

Fiscal Year	# Customers	KW Capacity	KWH Sold	Total Sales
1990	297	3,134,100	8,656,881,880	$136,568,985.21
1991	297	3,323,100	7,830,508,381	$145,861,205.49
1992	293	3,047,100	6,889,231,185	$146,212,253.86
1993	293	3,047,100	8,744,817,519	$164,857,959.06
1994	293	3,047,100	7,887,226,630	$155,932,438.08
1995	294	3,047,100	6,828,571,435	$155,298,716.73
1996	293	3,047,100	8,602,216,245	$164,455,717.06
1997	306	3,049,100	8,146,136,356	$163,433,202.38
1998	306	3,049,100	8,752,401,964	$168,993,561.84
1999	306	3,049,100	5,708,038,648	$147,920,567.47
2000	306	3,049,300	4,639,479,904	$142,229,319.14
2001	306	3,049,300	5,007,001,910	$142,279,362.21
2002	306	3,248,324	5,541,106,192	$151,990,777.64
2003*	495	3,363,203	8,936,876,134	$196,678,584.35
2004	495	3,363,203	7,887,523,782	$217,196,292.28
2005	494	3,363,203	8,730,070,426	$220,116,056.64
2006	493	3,365,032	5,255,629,053	$204,277,265.35
2007	492	3,365,032	5,028,335,961	$218,891,510.06
2008	491	2,416,732	4,510,972,561	$263,434,169.78
2009	491	2,416,732	5,962,980,684	$239,830,202.25
2010	489	2,416,732	7,714,721,242	$246,896,821.55
Totals		**64,256,793**	**147,260,728,092**	**$3,793,354,968.43**

** Method of categorizing customers changed in 2003*

The Secretary of War, through the Corps of Engineers of the United States Army, and the Federal Power Commission are jointly hereby authorized and directed to prepare and submit to Congress an estimate of the cost of making such examinations, surveys, or other investigations as in their opinion, may be required of those navigable streams of the United States, and their tributaries, whereon power development appears feasible and practicable, with a view to the formulation of general plans for the most effective improvement of such streams for the purposes of navigation and the prosecution of such improvement in combination with the most efficient development of the potential water power, the control of floods, and the needs of irrigation.

Rivers and Harbors Act, 1925

inventory. At one point, the power sales revenues from the Jim Woodruff system barely covered operations and maintenance costs and no return was made on the federal investment. As far as structural and mechanical integrity, the 1990s certainly challenged SEPA in facilitating the delivery of reliable power to its customers.

THE GEORGIA-ALABAMA-SOUTH CAROLINA SYSTEM

The Georgia-Alabama-South Carolina System consists of ten Corps hydroelectric projects across three river basins. It is the largest of the four systems marketed by SEPA in terms of both capacity (2,184.2 MW) and total investment for repayment ($1.72 billion). As of 2010, the 2,184 MW of power generated at these projects served 204 preference customers in Alabama, Georgia, Florida, Mississippi, North Carolina, and South Carolina. As of 2010, $347 million of the total federal repayment costs for the system have been fulfilled. In 1993, SEPA began renegotiation proceedings for a new system power marketing policy. The former policy, established in 1980, warranted revision due to the addition of new capacity, the expiration of contracts, and new Department of Energy requirements for implementing the National Environmental Policy Act and the Energy Act of 1992. The new policy went into effect in 1994 and established its service area, allocations throughout the system, as well as anticipated capacity expected to come online with the new pumpback units at Richard B. Russell.[5]

The Savannah River Basin projects grew out of the Corps' 308 surveys completed by the Savannah District in May 1933. The Corps proposed as many as eleven multi-purpose projects in the basin, but the first of these, Clarks Hill, was not authorized until the Flood Control Act of 1944. As with other public power projects during the post-war era, Clarks Hill faced stiff opposition from one of the regional private utilities. The Georgia Power Company had once owned rights to the Clarks Hill site and maintained ownership of some of the property proposed for acquisition. As federal construction of the Clarks Hill project slowly got underway, Georgia Power appealed the condemnation proceedings and tried to usher a bill through Congress that would require a joint

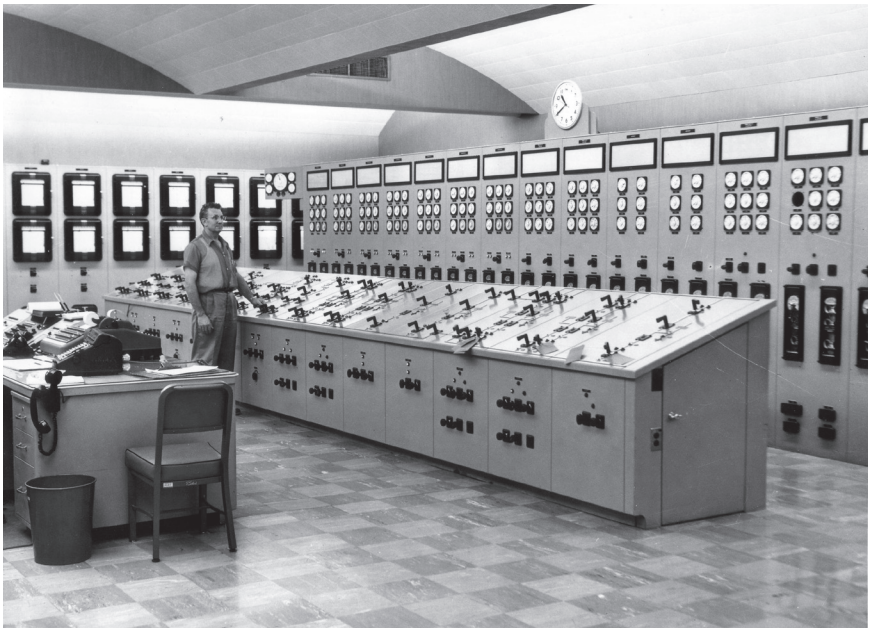
GEORGIA-ALABAMA-SOUTH CAROLINA SYSTEM, SALES AND REPAYMENT (BY FISCAL YEAR)

Fiscal Year	MW (capacity)	MWH (sold)	% Avg. Generation	Power Sales Revenue	Repayment to Treasury*
1990	1,953.3	4,385,000	125%	$84,300,000	$4,800,000
1991	2,142.3	3,350,087	96%	$92,119,402	$15,800,000
1992	1,865.0	3,259,730	89%	$95,200,000	$20,400,000
1993	1,800.0	4,705,986	129%	$110,500,000	$30,100,000
1994	1,866.3	3,228,795	87%	$99,700,000	$14,400,000
1995	1,866.3	3,575,447	100%	$102,900,000	$19,400,000
1996	1,866.3	4,168,199	115%	$106,400,000	$25,600,000
1997	1,868.3	3,476,850	101%	$101,500,000	$15,700,000
1998	1,868.3	4,531,204	126%	$110,000,000	$29,000,000
1999	1,868.5	2,628,874	67%	$98,000,000	$19,000,000
2000	1,868.5	2,330,771	53%	$97,000,000	-$3,200,000
2001	1,868.5	2,534,100	58%	$97,000,000	-$8,000,000
2002	2,067.5	2,468,463	56%	$98,000,000	$5,000,000
2003	2,182.4	3,864,082	103%	$127,800,000	$18,000,000
2004	2,182.4	3,116,359	82%	$142,700,000	$23,900,000
2005	2,182.4	4,407,686	116%	$147,500,000	$29,500,000
2006	2,182.4	2,763,285	73%	$149,400,000	$100,000
2007	2,182.4	2,631,827	65%	$168,300,000	$7,900,000
2008	2,182.4	2,612,436	59%	$215,300,000	-$18,200,000
2009	2,182.4	2,800,242	68%	$177,600,000	$3,400,000
2010	2,184.2	4,169,029	110%	$170,500,000	-$300,000

** Accounts for funds available following project operation and maintenance expenses, depreciation, wheeling, purchased power, interest, and (after FY 1999) retirement benefits*

public-private venture of the hydropower component of the project. The bill was defeated and construction continued slowly until the first unit went online in 1952. The Clarks Hill project was renamed J. Strom Thurmond Dam and Lake at Clarks Hill in 1988 to honor the long-serving US Senator from South Carolina.[6]

During the early 1990s, the project began to show signs of age-related wear and suffered from multiple forced outages of generating equipment and the transformers. In 1995, the Savannah District began a major rehabilitation effort at Thurmond, including rewinding all seven generators, replacement of the transformers and turbines, and the refurbishment and replacement of various pieces of peripheral equipment. As an added environmental benefit, the project also incorporated new Auto-Venting Turbines, which increased the dissolved oxygen levels downstream and



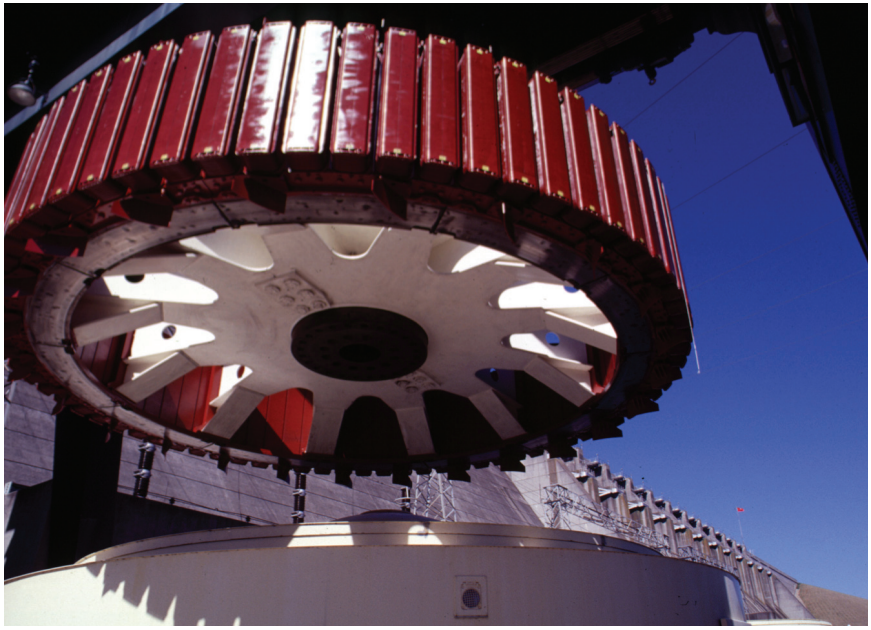
Clark Hill powerhouse control room, shortly after completion (Corps photo).

Major rehabilitation efforts at the J. Strom Thurmond project included new aquatic habitat enhancing turbines. In the center of the photo, US Congressman from Georgia, Charlie Norwood is flanked left by SEPA Administrator Charles Borchardt and right by Savannah District Commander Colonel Roger A. Gerber (Corps photo).

significantly improved habitats for the aquatic community. The rehabilitation work, which added approximately $70,000,000 to the capital repayment costs, increased capacity of each generating unit from 40 MW to 52 MW, raising total nameplate capacity from 280 MW to 380 MW.[7]

The upstream Hartwell project was authorized in 1950 at an estimated cost of $68.5 million, although project costs increased to nearly $90 million by the time construction began in 1955. The original design of the plant included five penstocks for the installation of four 66 MW units; a fifth 80 MW unit went online in 1986. Hartwell was one of the projects identified by the South Atlantic Division as needing major repairs. Forced outages during the late 1980s and early 1990s impaired the project's reliability and increased operation and maintenance costs. One unit stayed offline for nearly three years until repairs could be funded through traditional appropriations. Because of the project's decreasing reliability, the Corps approved proposals to refurbish the generators in 1993, and Congressional funding was allocated two years later; construction began on the major rehabilitation efforts in 1997. The work included rewinding of the four original generators, replacement of the transformers, and the replacement or refurbishment of other electrical equipment. The repairs, completed in 2007, increased the capacity of the four original generating units from 66 MW to 85.5 MW, or 33 percent.[8]

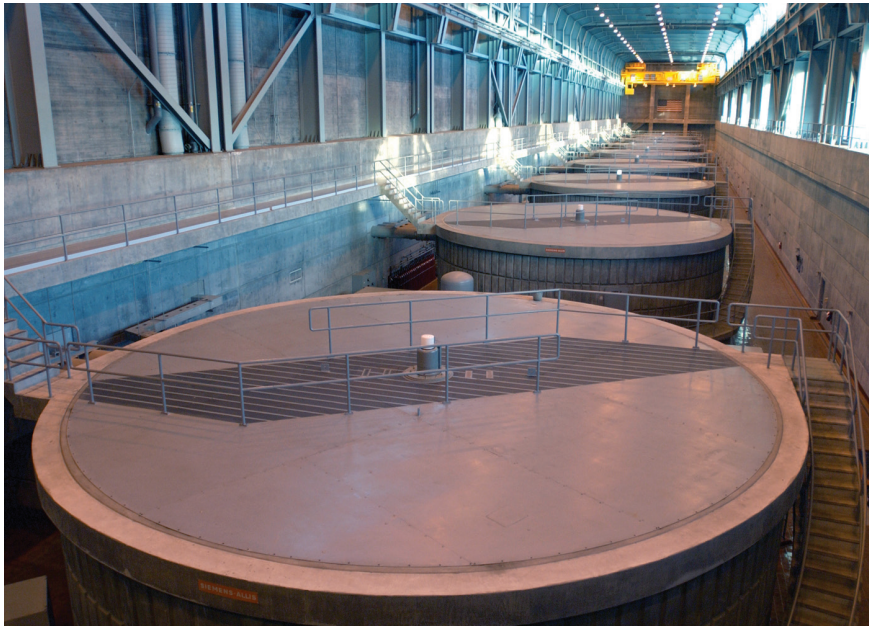
The last of the Savannah River basin projects, Richard B. Russell, went through the greatest amount of public and environmental scrutiny. The multi-purpose project, the



In 2007, the Corps completed refurbishment and uprating of Hartwell's generating units. In this photo, a 300-ton generator is lifted and moved into position (Corps photo).

largest Corps-operated plant east of the Mississippi River, was authorized in 1966 at a time of increased environmental legislation and awareness. In 1976, a lawsuit was filed to stop the project because opponents alleged the Corps violated multiple federal environmental laws. Ultimately, the project moved forward slowly to accommodate the completion of studies and mitigation efforts related to wildlife, cultural resources, water-quality, natural resources management, environmental impact statements, and geologic seismicity. In 1984, the reservoir reached its anticipated full pool level for the first time and the four conventional generating units went into service the following year.[9]

The most controversial aspect of the project, though, was a 1976 proposal by the Savannah District to add four pumped storage (reversible pump turbines) units at the dam, which would double the project's installed capacity to 600 MW.[10] In 1988, the Federal District Court of Charleston, South Carolina granted an injunction against the Corps to stop the installation of the reversible pump turbines. The states of Georgia and South Carolina, the Georgia and South Carolina Wildlife Federations, and the National Wildlife Federation charged that the Corps had failed to comply with the National Environmental Policy Act and the Fish and Wildlife Coordination Act.[11] Environmental groups, who called the project "The Big Boondoggle," were concerned about fish populations in the Savannah River. Similar pumped storage units on the Missouri River and Lake Michigan resulted in massive fish kills when the units drew water in from the tailraces. The Corps believed studies completed during the 1980s and fish protection measures adequately ensured a safer environment at the project.[12]



The reversible pumpback units at Richard B. Russell went through nearly two decades of environmental review before they were allowed to operate on a limited schedule in 2002 (Corps photo).

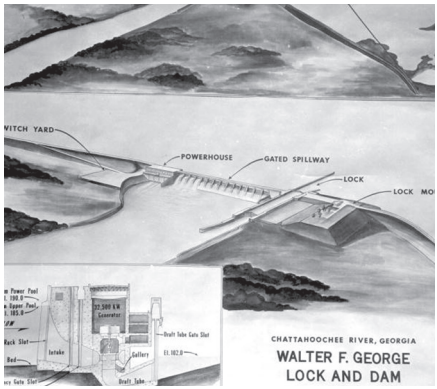
An appeals court lifted the injunction in part to allow construction of the units to begin, but the injunction was contingent upon the Corps' completion of additional environmental studies and demonstration that operation of the units would not negatively impact fish habitats. The delays resulted in a financial impact to both the project and to the government. When the conventional units began operation in 1986, the capital investment costs were incorporated into the customers' rate structure. However, until the pump units began generating power, all costs associated with their construction were transferred into a Construction Work in Progress (CWIP) account and held with accruing interest. For federal repayment costs, the delays were costly.

After fourteen years of litigation and additional environmental studies, the Corps identified suitable operating procedures under which the facility could be managed while protecting native fish habitats. In FY 2002, SEPA and the Corps signed an MOU that established the operational restrictions. These included strict compliance to nighttime pumping, limited pumping during the springtime, generation requirements for conventional pumping preceding start-up of the reversible units, requirements for fish attraction lights and sound repulsion systems, and multi-year monitoring. Following execution of the MOU, the four reversible pumped storage units at Richard B. Russell went operational for commercial power on August 30, 2002.[13] The installation of a downstream aquatic habitat enhancement system in 2011 eliminated the seasonal pumping restrictions, resulting in the full annual benefit of an additional 300 MW of critical peaking energy.

In the ACF river system, four SEPA marketed power projects were constructed as part of the Corps' efforts to improve navigation and flood control. The River and Harbors Act of 1945 approved a general plan for the basin and subsequent pieces of legislation authorized Buford Dam, Jim Woodruff Lock and Dam, Walter F. George Lock and Dam, and West Point Dam. Near the headwaters of the Chattahoochee River, construction began on Buford Dam and Lake Sidney Lanier Reservoir began in 1950 and the first generating units went online in 1957. The plant operates three units, one 7 MW and two of 62 MW each for a total nameplate capacity of 131 MW. Due to cavitation, the two larger units operate at 60 MW each. The small unit operates continually to meet downstream flow requirements.

Further downstream, West Point Dam was authorized by the Flood Control Act of 1962. Although managed today by the Mobile District, responsibility for land acquisition, design, and construction fell to the Savannah District. Construction of the multi-purpose project began in 1966 and the powerhouse generated its first power in 1975. The design of the dam included the Corps' first use of a slurry trench, a backfilled trench of Bentonite and water designed to prevent seepage below the dam structure. The West Point project was also the Corps' first usage of hydraulic, rather than mechanical, spillway gates. The project operates three units, one 3 MW unit and two of 42 MW each, with a total nameplate capacity of 87 MW.[14]

Work began on the 130 MW Walter F. George Lock and Dam in late 1955 and the first power came online in 1963. Even as construction was underway, the



Construction began on the Walter F. George Lock and Dam during the late 1950s (Courtesy of State Archives of Florida).[16]

Corps noticed sinkholes and boils along the downstream toe of the dam. Temporary repairs were made during the late 1960s and efforts continued to eliminate seepage into the 1980s; by the late 1990s, the Corps decided to install a permanent cutoff wall upstream of the main dam structure. Because Walter F. George Dam is a multi-purpose project within a broader system of impoundments along the Chattahoochee River, the decision to construct an upstream wall was a significant challenge. The Corps decided to move forward with a method of construction that included underwater diving. That allowed for construction while the reservoir was at full pool, meaning minimal interruptions to navigation and to hydropower. Planning on the project began in 1997 and was completed in 2004.[15] The Walter F. George Project operates four 42 MW generating units.

Construction on the Carters earth-filled dam required temporarily diverting stream flows through an adjacent mountain (Corps photo).

In the Alabama-Coosa River basin, the two northernmost hydroelectric projects are Carters and Allatoona. Recommended for funding in 1940, Allatoona was one of the first projects authorized in the basin, but the project was suspended during World War II. After the war, the Corps expedited its completion and contracts were let in 1946 and the project went online in 1951. The Carters plant, authorized by the Rivers and Harbors Act of 1945, is located on the Coosawattee River, a tributary of the Coosa. Construction on Carters Dam began in 1962 and was not completed until 1979, although it began producing electricity as early as 1975. Construction of the earth-filled dam involved an intricate method of diverting the water around the dam site by blasting a tunnel through the adjacent mountain. Initially, Carters was intended to operate as a 40 MW conventional plant, but the Corps later changed its design plans to incorporate four 125 MW units, two conventional and two reversible. The plant operates at a nameplate capacity of 500 MW and an operating capacity of 600 MW.

Located downstream on the main stem of the Alabama River, the Robert F. Henry and Miller's Ferry projects are both run-of-the-river facilities authorized for power production and navigation by the Rivers and Harbors Act of 1945. Site selection for the facilities began in 1956, but several years passed before construction was initiated. Construction of Robert F. Henry began in 1966 and initial funding focused on completion of the channel locks, but funding delays postponed completion of the navigational structures until April 1972. Contracts for the powerhouse, called Jones Bluff powerhouse at Robert F. Henry Lock and Dam, were let later that year and the first generating units went online in 1975. The project consists of four 20.5 MW units with a nameplate capacity of 82 MW.

Interior of the Robert F. Henry powerhouse (Corps photo).

Work began on Miller's Ferry in 1963, and while the total project was not completed for nearly 10 years, it began limited power production in 1970. The project's three generating units operate at 30 MW each, with a total operating capacity of 90 MW. Since its completion, Miller's Ferry has been plagued by operational problems. As soon as the first units went online, workers noticed unusually high noise and vibration, which over time, strained the units and accelerated deterioration. In addition, because the noise levels were hazardous to workers, the Corps enclosed the generators, but these noise abatement measures resulted in higher operating temperatures of the units, again shortening their lifespan. Though less than 20 years old, the generating units started to fail as early as the late 1980s. Unit 3 failed in 1987; Unit 1 failed in 1992; and Unit 2 failed in 1995. While repairing the units, forced outages ranged from just under a month to almost four years. SEPA estimated these outages resulted in a loss of 31 MW of energy capacity between 1987 and 1995. Contracts for long-term repairs were funded in 1996 and were completed in 1998, greatly improving the plant's reliability.[17]

THE JIM WOODRUFF SYSTEM

The Jim Woodruff Lock and Dam is a multi-purpose Corps project managed by the Mobile District on the Apalachicola River. Located at the base of Lake Seminole at the Georgia-Florida border, Jim Woodruff is the smallest of SEPA's marketed systems and serves six preference customers, all in northern Florida, in addition to one investor-owned utility, Progress Energy Florida (Florida Power Corporation). Authorized by the Flood Control Act of 1944, construction began on the run-of-the-river plant in 1947. The

During the 1970s, the original variable pitch turbines at the Jim Woodruff project were periodically shut down due to severe vibration. In 2002, the Corps completed a major rehabilitation effort, greatly improving the plant's efficiency (Corps photo).

project, containing three generating units with a combined nameplate capacity of 30 MW, began producing power in 1957.[18]

As a result of its initial design, the power plant has been beset by multiple operational problems since it went into operation. The plant was constructed with three variable pitch turbines, designed primarily for run-of-the-river facilities; the design allowed for the variable blades to operate at various positions to improve efficiency across a range of water flow conditions. Years of downstream channel erosion, however, increased the operating head of the dam and the turbines were unable to be submerged for optimal periods. This resulted in severe vibration of the blades. Consequently, beginning in the late 1970s, units were frequently shut down for repairs ranging from a few days to almost a year.

To limit the number and severity of the outages, the Corps welded the blades in-place during the late 1980s, which increased overall reliability but reduced efficiency

JIM WOODRUFF SYSTEM, SALES AND REPAYMENT, FY 1990 – FY 2010

Fiscal Year	MW (capacity)	MWH (sold)	% Avg. Generation	Power Sales Revenue	Repayment to Treasury*
1990	36.00	211,193	77%	$3,000,000	$0
1991	36.00	215,797	84%	$3,500,000	$800,000
1992	36.00	222,214	87%	$4,700,000	$2,280,000
1993	36.00	206,042	77%	$5,030,000	$1,680,000
1994	36.00	217,614	88%	$5,600,000	$2,300,000
1995	36.00	218,892	86%	$5,600,000	$2,300,000
1996	36.00	216,843	87%	$5,300,000	$2,600,000
1997	36.00	218,735	85%	$5,400,000	$2,200,000
1998	36.00	200,686	74%	$5,300,000	$1,500,000
1999	36.00	205,107	69%	$5,200,000	-$500,000
2000	36.00	183,728	28%	$5,000,000	-$2,000,000
2001	36.00	185,961	47%	$5,200,000	-$2,000,000
2002	36.00	193,683	61%	$5,300,000	$400,000
2003	36.00	228,141	93%	$6,270,000	$300,000
2004	36.00	232,747	99%	$6,400,000	$1,100,000
2005	36.00	242,256	101%	$8,300,000	$1,600,000
2006	36.00	233,133	91%	$8,300,000	$900,000
2007	36.00	212,486	77%	$7,500,000	-$1,400,000
2008	36.00	230,323	73%	$7,800,000	-$3,200,000
2009	36.00	213,290	76%	$7,700,000	-$3,300,000
2010	36.00	223,662	68%	$13,200,000	$400,000

** Accounts for funds available following project operation and maintenance expenses, depreciation, wheeling, purchased power, interest, and (after FY 1999) retirement benefits.*

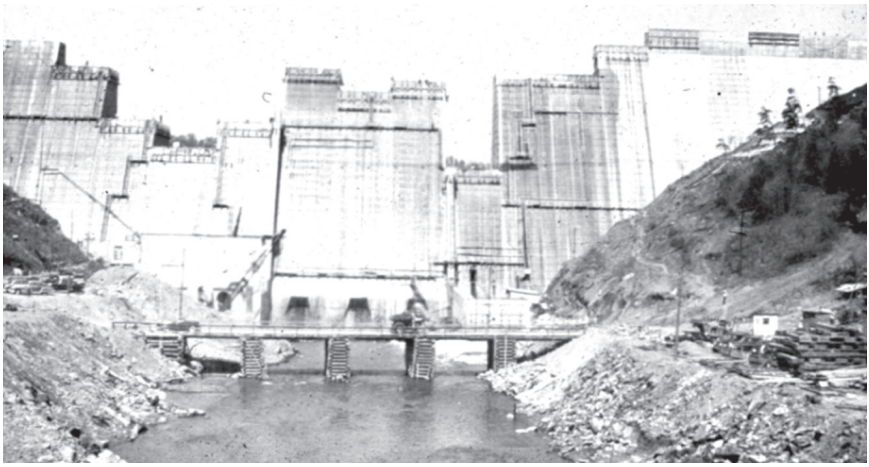
because the blades could not be adjusted to capitalize on variable water releases required for navigation at the dam site. The plant's annual power generation dropped by seventeen percent and jeopardized SEPA's ability to fulfill contracts with its customers. During the late 1980s and early 1990s, drought, the loss of available power, and increased operations and maintenance costs, resulted in a lack of revenue for the project and repayment costs to the US Treasury were deferred. Drought was not the only weather contribution for loss of available power. During the summer of 1990, because of high flow events, the Corps passed some water through a single unit to generate power, while the remainder was released downstream to prevent excessive vibration of the other two units. For two billing months in 1990, for example, revenue loss at the project reached nearly $200,000 and replacement power was purchased. To alleviate the deficits, SEPA was forced to raise the wholesale rate for its customers. Between 1991 and 1993, the average rate for Jim Woodruff customers increased by nearly 100 percent.[19]

The Corps began a rehabilitation study in 1991. The final report, completed in 1993, recommended replacement of the turbines, rehabilitation of the generators, and replacement of the transformers. Because Jim Woodruff necessitated major rehabilitation efforts, several years passed before Corps Headquarters approved of the engineering plan. Finally, in November 1995, Congress appropriated initial funding of the project. Early rehabilitation costs for the project were estimated at $30.6 million. The rehabilitation was completed in 2002 and the new units went online, bringing the plant's operating capacity to 43.35 MW. As of 2010, Jim Woodruff revenues had contributed $20 million or 28% to the total federal repayment costs.

KERR-PHILPOTT SYSTEM

In 1934, the Corps' Norfolk District completed a survey of the Roanoke River Basin, but the federal government found that comprehensive development of the area was not justified at the time. Following a 1940 flood of the Roanoke River, the government asked the Corps to reevaluate the earlier study and provide recommendations for basin redevelopment. The Flood Control Act of 1944 authorized John H. Kerr (then called Buggs Island) and Philpott as the initial steps of the project. The John H. Kerr project lies in Virginia and North Carolina; it was completed in 1953 at a cost of $87 million. Philpott dam and reservoir lies wholly within Virginia and was completed in October 1956. Initially, Norfolk District managed both projects, but a Corps reorganization in 1961 shifted the district's boundaries northward, transferring responsibility of the projects to Wilmington District. The marketing policy for the Kerr-Philpott system was established in 1985 and as of 2010, the power generated at the projects was marketed to 76 preference customers in North Carolina and Virginia. To date, the system has paid $91 million or forty-eight percent of the total $186 million federal capital repayments.[22]

The John H. Kerr project underwent rehabilitation in 2004. The work included installing new transformers, generator breakers, switchyard breakers, 115 kV cables,



Construction of the Philpott project on the Smith River in Virginia during the early 1950s (Corps photo).

aerating turbines and generator windings. The work added $95 million to the capital investment, but increased reliability and increased the nameplate capacity to 295 MW. Philpott has never been authorized for a major rehabilitation effort, though various components, such as transformers, have been replaced as necessary.

THE CUMBERLAND SYSTEM

Even before legislation authorizing the 308 Reports was passed, the Cumberland River basin had received the attention of the Corps' Nashville District.[23] The earliest recommendations, in 1923, suggested federal construction of the locks and dams at three locations with private power development at those sites. Subsequent 308 surveys for the Tennessee River recommended several dams along the main stem and its tributaries; seven of those would be high-head with the ability to generate power. In 1933, Congress stripped the Corps of flood control powers in much of the Tennessee basin when the TVA was created. As Norwood noted, part of the reason for this was because the Corps had failed at Wilson Dam at Muscle Shoals to adequately market the hydroelectricity at a rate sufficient to repay federal capital investment. The recipient of the power, Alabama Power Company, made huge profits by selling the low-cost federal electricity at more than a two-to-one margin. Establishing the TVA was the "first step" in relieving the Corps of marketing responsibilities and ultimately led to the creation of power marketing administrations.[24]

The Flood Control Act of 1938 instructed the Corps to study the Cumberland River and planned the first of four power-producing dams: Wolf Creek, Dale Hollow, Center Hill, and J. Percy Priest. In 1941, Congress authorized the upstream storage reservoir, Wolf Creek. When the United States entered World War II, Wolf Creek, Dale Hollow

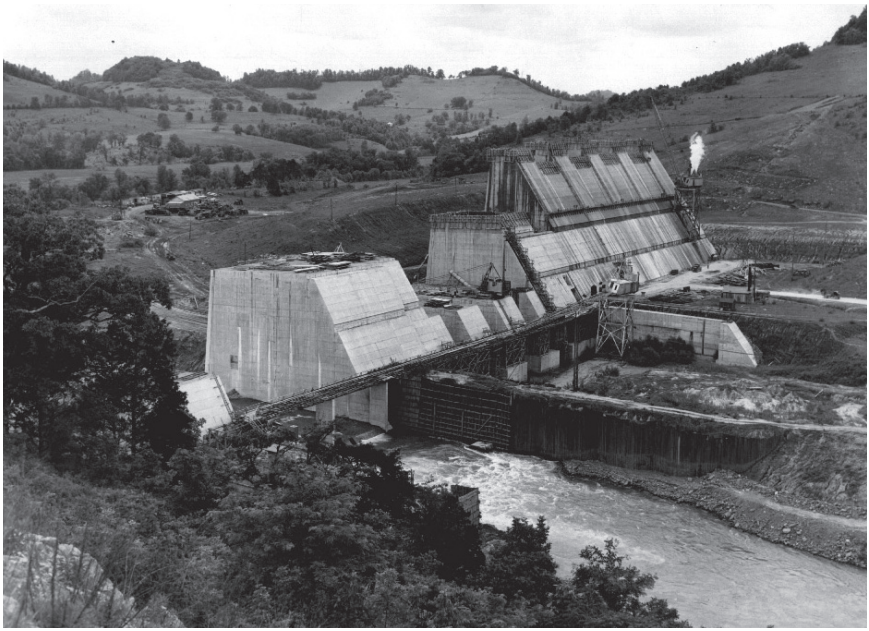
KERR-PHILPOTT SYSTEM, SALES AND REPAYMENT, FY 1990 – FY 2010

Fiscal Year	MW (capacity)	MWH (sold)	% Avg. Generation	Power Sales Revenue	Repayment to Treasury*
1990	196.50	597,006	120%	$11,700,000	$2,600,000
1991	196.50	524,883	121%	$11,100,000	$2,600,000
1992	196.50	339,000	78%	$11,200,000	$2,400,000
1993	196.50	629,258	145%	$13,300,000	$4,400,000
1994	196.50	499,283	114%	$12,300,000	$3,200,000
1995	196.50	381,159	87%	$11,300,000	$2,200,000
1996	196.50	591,441	136%	$12,700,000	$3,200,000
1997	196.50	558,349	129%	$12,600,000	$2,400,000
1998	196.50	622,325	142%	$13,000,000	$3,400,000
1999	196.50	220,631	51%	$9,100,000	-$200,000
2000	196.50	327,317	75%	$9,800,000	$700,000
2001	196.50	235,676	54%	$9,100,000	$1,400,000
2002	196.50	149,705	25%	$10,600,000	-$2,200,000
2003	196.50	835,851	191%	$15,800,000	$4,000,000
2004	196.50	483,490	107%	$12,900,000	$600,000
2005	196.50	451,442	103%	$10,800,000	$600,000
2006	196.50	262,066	58%	$9,400,000	$1,200,000
2007	196.50	417,364	93%	$13,300,000	$2,300,000
2008	196.50	211,999	48%	$13,100,000	-$1,300,000
2009	196.50	295,100	73%	$11,400,000	-$3,300,000
2010	196.50	615,814	137%	$19,000,000	$200,000

** Accounts for funds available following project operation and maintenance expenses, depreciation, wheeling, purchased power, interest, and (after FY 1999) retirement benefits.*

and Center Hill received priority funding for national defense. Due to labor and material shortages, the Corps suspended construction at Wolf Creek and Center Hill, with work at Dale Hollow focused on flood control only. In 1948, Dale Hollow was the first of the projects to begin producing power, followed by Center Hill in 1950, and Wolf Creek in 1951. The remaining six projects in the Cumberland River basin, Old Hickory, Cheatham, Barkley, J. Percy Priest, Cordell Hull, and Laurel came online during the next two decades.[25]

When the Cumberland projects first came online in 1948, the Secretary of the Interior transferred marketing and transmission responsibilities to TVA at least until 1968. With more projects coming into the system, and Congressional freezing of the TVA service area, SEPA sought renegotiation of the contract in 1963. The new contract enabled SEPA to serve customers outside of the TVA service area, with TVA providing transmission services. This met with some resistance by the private



Completion of Center Hill was prioritized for national defense during World War II, but due to material shortages construction did not commence in earnest until the late 1940s (Tennessee State Library photo).

Dale Hollow was the first of the Cumberland basin projects to begin producing power in 1948 (Tennessee State Library photo).

CUMBERLAND SYSTEM, SALES AND REPAYMENT, FY 1990 – FY 2010

Fiscal Year	MW (capacity)	MWH (sold)	% Avg. Generation	Power Sales Revenue	Repayment to Treasury*
1990	948.30	3,463,484	113%	$37,600,000	$15,100,000
1991	948.30	3,739,741	120%	$39,200,000	$16,500,000
1992	948.30	3,068,206	100%	$35,100,000	$10,650,000
1993	948.30	3,203,531	104%	$35,900,000	$11,500,000
1994	948.30	3,941,534	126%	$38,300,000	$13,400,000
1995	948.30	2,651,714	87%	$35,400,000	$8,800,000
1996	948.30	3,624,576	115%	$40,000,000	$13,800,000
1997	948.30	3,892,202	124%	$44,000,000	$15,500,000
1998	948.30	3,398,187	109%	$40,900,000	$12,800,000
1999	948.30	2,653,427	86%	$38,300,000	$4,000,000
2000	948.30	1,797,663	61%	$30,600,000	$3,500,000
2001	948.30	2,051,165	68%	$31,100,000	$5,000,000
2002	948.30	2,729,255	89%	$38,000,000	$2,700,000
2003	948.30	4,008,802	127%	$46,800,000	$18,100,000
2004	948.30	4,054,926	136%	$55,200,000	$19,700,000
2005	948.30	3,628,687	122%	$53,600,000	$19,000,000
2006	948.30	1,997,145	70%	$37,100,000	$4,800,000
2007	948.30	1,766,660	63%	$29,800,000	$7,200,000
2008	**n/a	1,456,215	53%	$27,300,000	-$6,600,000
2009	n/a	2,654,349	92%	$43,100,000	$4,600,000
2010	n/a	2,706,215	93%	$44,100,000	-$2,300,000

** Accounts for funds available following project operation and maintenance expenses, depreciation, wheeling, purchased power, interest, and (until FY 1999) retirement benefits*
*** Capacity varied due to ongoing dam safety remediation*

Kentucky Utilities, which charged that TVA's agreement to transmit power outside of its service area was not an authorized use of its power. The Federal courts intervened and ruled that SEPA's power was only limited by the coverage area dictated by the Secretary of the Interior.

The rate design for the Cumberland System diverged from SEPA's traditional use of a two-part demand and energy rate pattern. In the Cumberland System, the TVA contract allowed for variation of an annual charge based on stream flows discharged from the storage basin at Wolf Creek. A second difference is the use of a demand-energy rate pattern with a capacity/energy split, which allocated 40 percent of the generation costs to capacity and 60 percent to energy. In 1994, SEPA conducted a repayment study and determined that the rates in use at the time were not sufficient to repay capital investments of the projects. Since 1994, customers have received

1,500 hours of energy per kW that was included with the capacity charge and paid an additional energy charge for all energy received above 1,500 hours per kW. Customers outside the TVA system pay for the TVA transmission charge. That rate design remained largely in place until capacity at Wolf Creek and Center Hill were impaired by dam safety issues and the reservoir levels were lowered in 2007 for emergency repairs.

The total installed capacity of the Cumberland projects is 914 MW, which generates an average of 3,114,000 MWh annually. In FY 2010, the power generated at the projects was sold to approximately 25 preference entities and 213 preference customers. The Cumberland System customers are located in Tennessee, Kentucky, Mississippi, North Carolina, Alabama, Georgia, Virginia, and southern Illinois. As of FY 2010, project revenues have contributed $288 million or 27 percent toward the total $1.048 billion federal repayments.[26] The Cumberland System projects have been well-maintained by the Corps, and although they represent some of the oldest structures in the system, have been subjected to relatively few emergency outages.

LAST IN-FIRST OUT: THE STONEWALL JACKSON PROJECT

The Stonewall Jackson Project, located on the West Fork River in North Central West Virginia, was authorized by the Flood Control Act of 1966. The project was delayed first by lawsuits claiming the Corps failed to conduct an adequate environmental analysis and second by negotiations with the state of West Virginia regarding cost-sharing. Construction began during the 1980s. The Corps of Engineers installed a single 300 kW unit to operate the station and it estimated an annual excess of 1.4 million kWh that could be marketed to preference customers. The project went online on August 30, 1994 and became SEPA's 23rd project for marketing power. SEPA initially determined that the new project would be placed into the Cumberland System of projects; however, no preference customers in the area were able or willing to receive the power and SEPA sold the excess electricity to a private utility, the Monongahela Power Company. Stonewall Jackson was de-authorized as a federal power project in 2006 and its excess energy was no longer under the purview of SEPA. As of 2011, other private utilities are looking to capitalize on the clean energy and are in the process of applying with the FERC for permission to further develop the project.[27]

A NEW ERA FOR HYDROPOWER

A second Corps flood control project at Bluestone Dam in Hinton, West Virginia also received attention for possible hydroelectric development. Bluestone Dam was authorized by the Flood Control Act of 1938 and completed as a flood control project in 1949. When the Corps began work on the project in the 1940s, penstocks were included but the power generating facilities were not constructed. In February 1992, the Hinton-White Sulphur Springs-Philippi Power Authority (now the Tri-Cities Power Authority) entered into an agreement with the Corps to

The Corps' Pittsburgh District began construction of the Stonewall Jackson Dam project during the 1980s. This was the last project to enter SEPA's market, and the first to be de-authorized (Corps photo).

The future for untapped potential? Since 1992, the Tri-Cities Power Authority has studied the feasibility for developing power generation facilities at the Corps' Bluestone Dam near Hinton, West Virginia (Corps photo).

study the feasibility of developing hydropower potential at the Bluestone Dam. The Water Resources Development Act, passed by Congress in 2000, modified the project's authorization to permit construction of hydroelectric facilities at the dam by the Power Authority. As proposed, the Power Authority would construct the facilities, deed title to the Corps, and excess power would be marketed by SEPA for the purpose of reimbursing the Power Authority. By 2010, despite government support, the project had not moved beyond the feasibility stage.[28]

Section 1834 of the Energy Policy Act of 2005 required the Secretary of the Interior, the Secretary of the Army, and the Secretary of Energy to "conduct a study assessing the potential for increasing electric power production at federally owned or operated water regulation, storage, and conveyance facilities." The study found that 64 of 871 federal dams warranted additional study and had the potential to add 1,230 MW of additional capacity and 1,283 MW of capacity available through refurbishment of existing facilities.[29] Hydropower generation facilities require a tremendous amount of capital investment. Moreover, in 2008, the nation entered an economic recession and funding for new government construction of civil works is highly unlikely. However, new clean energy tax credits and a more restrictive operating environment for coal-fired plants may encourage private hydropower development at existing federal dams. As the nation's demand for electricity grows, there are certainly opportunities for public-private partnerships at existing dams. As the federal government's designated marketing administration in the Southeast, SEPA will likely play a role in getting power to the people, whether directly or indirectly.

PROJECT AGE AND RELIABILITY

During the 1990s, many of the Corps' hydroelectric projects in the Southeast began reaching the end of their expected life-span. In 1992, SEPA reported that 348 MW, or one-sixth of the total 2,154 MW capacity of South Atlantic Division operated dams, was either unavailable or operated at less than optimal because of needed repairs. These included outages required to rewind two of the conventional units at Carters, and failure of the stator clamping bolts, both of which were repaired in 1993. Other outages that year were due to the rewinding of the units at R. F. Henry and Millers Ferry.[30]

Unit reliability became an increasing issue to federal power customers as well as for SEPA, which worked on behalf of its customers to purchase replacement power

AVERAGE AGE OF CORPS, BUREAU, AND PRIVATELY-OWNED HYDRO UNITS, 1999 (FROM GAO REPORT)

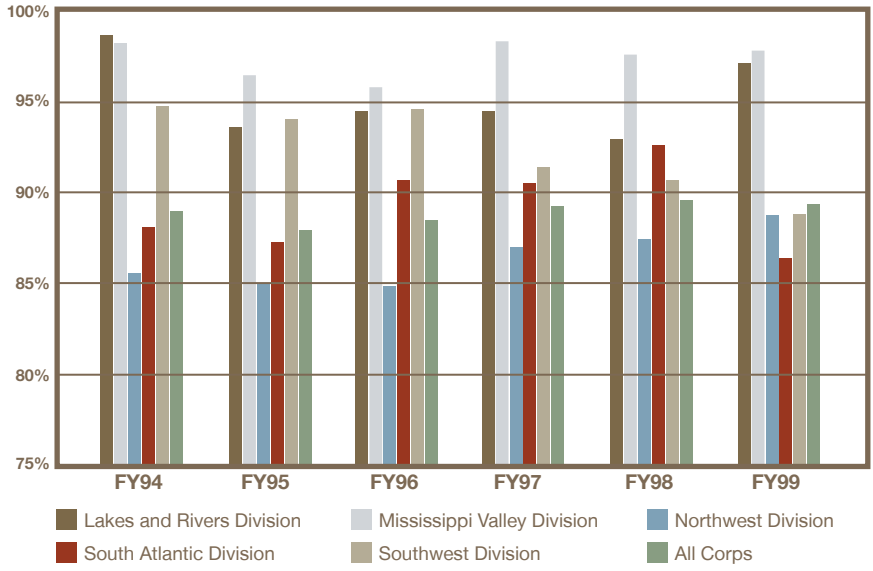
Agency	Average age of generating units (years)	Number of generating units	Nameplate capacity (MW)	Average nameplate capacity (MW)
Bureau of Reclamation	41	188	14,515	77
Corps of Engineers	33	349	20,720	59
Nonfederal	48	570	34,770	61

to meet contractual obligations. In 1996, the US GAO issued a report regarding the reliability of 11 federal hydropower plants in the Southeast.[31] The 11 plants included those operated by the South Atlantic Division in the Georgia-Alabama-South Carolina and Jim Woodruff systems. Together, these plants constituted approximately 71 percent of the total power sales revenues in FY 1995 and 63 percent of SEPA's total generating capacity. In testimony to Congress, the southeastern federal power customers summed up their frustrations:

> *The lack of funds to maintain, operate, and rehabilitate these infrastructure facilities is not justified. Not only is the restoration of the nation's infrastructure one of this Administration's priorities, but the power marketing program is one of the few federal programs where the consumer repays the federal investment. Appropriated funds for the operation and maintenance of Corps projects are reimbursed through rates hydropower customers pay to SEPA. In fact, funds have already been paid through rates – for rehabilitation and replacement which has not yet been performed.*[32]

One of the chief causes of federal power being less reliable is because of the funding process. Revenue generated from power sales goes directly to the US Treasury and the monies cannot be reserved for repairs or upgrades. Funding for repairs are typically obtained through Congressional appropriations for Corps Civil Works Operations and Maintenance general budgets. According to the GAO, because of the lengthy budgeting

SOUTH ATLANTIC DIVISION'S HYDRO UNIT RELIABILITY, FY 1994 – 1999



and justification process, the "funding for repairs can take years to obtain and is uncertain. As a result, the agencies delay repairs and maintenance until funding becomes available" resulting in "inconsistent, unreliable performance." Major rehabilitation efforts require intensive field studies to justify the capital expenditures to the Department of the Army. The initial studies for the Jim Woodruff rehabilitation work began in 1991, but because of multiple reviews and required revisions to project justification, the project was not approved and funded until the mid-1990s. Complicating the effort, the Corps had a "No New Starts" policy in place during the early 1990s for Construction General Funding. Any major rehabilitation effort was a challenge to get funded.[33]

In the early 2000s, West Point dam experienced outages of three generators that remained offline for nine months for a loss of 127,700 MWh. In working within existing budgets to quickly bring downed units back online, repairs were frequently reactive and short-term solutions. In some cases, repairs that were undertaken merely delayed required major rehabilitation efforts. For example, in 1989, the Hartwell Project's Unit Number 1 failed; the Corps conducted intermediary repairs to bring the unit back online, but at a reduced capacity. By early 1990, the unit was shut down for nearly two months while a part was replaced, but the unit failed again in 1992, and thereafter was not operated until wholesale rehabilitation efforts could be funded. The Corps determined the units failed because of the turbines were oversized, not atypical of contemporary turbine design, and capable of overloading the generator. Corps and SEPA management routinely operated and marketed Hartwell generators at 125% and 135% of nameplate rating, which they understood would shorten the expected machine lifetime. Major repairs for the Hartwell plant were finally undertaken during the late 1990s and were completed in 2007.

Corps contractors rehabilitate one of the units at the Thurmond project in the Georgia-Alabama-South Carolina System (Corps photo).

Meanwhile, the preference customers are left with no choice but to purchase expensive replacement power through private, investor-owned utilities. For example, between 1989 and 1990 alone, wholesale power rates increased 22 percent for customers in the Georgia-Alabama-South Carolina system. Between March 1990 and March 1992, forced outages at the Carters units forced preference customers in Alabama, Georgia and Mississippi to purchase $8.6 million in replacement power. In the Jim Woodruff system, the unreliability of the units combined with severe drought in the region, resulted in a nearly 100 percent wholesale rate increase. Further, the purchased power is often generated from polluting fossil fuel plants rather than renewable resources.[34]

DAM SAFETY: WOLF CREEK, CENTER HILL, AND THE EFFECT ON CUSTOMERS

While age affected the reliability of equipment, recent concerns regarding dam safety has impacted power production at two SEPA projects in the Cumberland system. The federal government owns nearly 4,000 dams and though that is a relatively small percentage (4.7%) of all dams in the United States, many of the federal dams are large and represent iconic engineering projects of the early to mid-twentieth century. Of the 692 dams managed by the Corps, more than half have reached 50 years of age. Because many of the dams were also built for flood control purposes, any potential for structural failure is a calculated risk.[35]

Though concerns over dam safety are not new to the federal government, a heightened awareness emerged following the terrorist attacks of September 11, 2001. In addition, the power of Hurricane Katrina in August 2005, which compromised the structural integrity of the complex levee system surrounding the city of New Orleans, revealed the power of nature against the nation's man-made infrastructure, particularly those built using outmoded engineering methods. Following Katrina, the Corps evaluated its infrastructure and prioritized structures in need of repair. Two hydroelectric dams serving SEPA customers, Wolf Creek and Center Hill, were designated Class I Action (urgent and compelling) for dam safety remediation by the Corps.[36]

Since their completion in the early 1950s, Wolf Creek and Center Hill have suffered repeatedly from leakages and seepage beneath the dam structures due to a natural system of voids in the limestone karst foundation. While the dams were designed and constructed according to standard practices of the 1930s and 1940s, the voids then were simply filled with residual soil. Over time, the high head of the reservoir pressured the infill, and the water scoured out larger holes within the limestone karst foundation. Larger holes resulted in a higher velocity of water and greater erosion. Ultimately, sinkholes appeared as surface material was undercut by erosion. As early as 1967, Nashville District detected leakages under the Wolf Creek dam where the earthen and concrete sections connected. Emergency grouting temporarily alleviated the problem and included drilling large holes into the dam, two hundred feet down to bedrock, with each

hole filled with a steel casing and concrete. These emergency repairs saved the dam, but engineers realized that long-term stabilization would require major rehabilitation efforts.

Piezometers to measure leakages were installed throughout embankments at both projects in the late 1960s. In 1975, Nashville District began construction on a large concrete cutoff or diaphragm wall at Wolf Creek. The work, which cost more than the original construction cost, took five years to complete.[37] Work also commenced on an embankment grouting program at Center Hill in the 1980s. Despite the remediation measures conducted at both structures since the 1960s, sinkholes and significant seepage continued. In 1991, during a record high pool, the Corps calculated that 3,823 square meters of chert (sedimentary rock) and clay discharged from one seepage at Center Hill, resulting in a sinkhole 25 feet in diameter. New sinkholes appeared at Wolf Creek in 2004.

According to the Corps' more dire predictions, a breach or failure at Wolf Creek or Center Hill could have caused a similar, if not greater, impact on downstream lives and property than Hurricane Katrina in lower Louisiana. Lake Cumberland, impounded by Wolf Creek dam, is the largest reservoir east of the Mississippi River and with 6.1 million acre-feet of water is the ninth largest reservoir in the United States. The Corps estimated that floodwaters could reach the city of Nashville, located 280 miles downstream, within 24 hours and inundate most of the downtown area. To prevent a catastrophic failure, the Corps began a nearly $600 million emergency rehabilitation project to implement long-term structural integrity.[38]

Structural repairs on Wolf Creek began in March 2006 with new grouting (injecting cement-like material) of the caverns and constructing a cutoff wall below the base of the caverns down into the bedrock foundation. To release stress on the dam structure while repairs were underway, on January 22, 2007, the Corps made an

A sinkhole opened at Wolf Creek in 1968. This small hole represented big problems (Corps photo).

emergency decision to lower the level of Lake Cumberland from 723 feet mean sea level to 680 feet mean sea level. At Wolf Creek, a minimum of 673 mean sea level is required to generate power and the new elevations resulted in a lower headwater and operational restrictions on the generating units. Maintaining the new pool level required discharging excess water during high inflow events and a loss of potential power. Because Wolf Creek is near the head of the Cumberland system of projects, reducing the amount of water in the storage pool impacted all downstream uses, including recreation, fish and wildlife, water quality, and navigation.

For hydropower, Wolf Creek holds the majority of the system's water storage; downstream run-of-the-river projects are dependent upon regular releases of water. In addition, because it is one of nine hydropower facilities in the Cumberland basin marketed collectively to the regional preference customers, in effect, that results in rationing of the available power. As a result of the interim operating procedures, SEPA revised its marketing strategy to provide power to customers as it became available, which represented a significant impact on the preference customers. Hydropower is a valuable commodity in that it can be turned on (or off) quickly. In times of high energy demand, such as winter mornings or summer afternoons, hydropower is the cleanest, greenest and most reliable generating resource to offset expensive peaking costs from other alternative sources.

In 2007, SEPA estimated (for Wolf Creek and Center Hill) that several hundred megawatt hours would be lost, and would require acquisition on the open market. Cost estimates for replacement power ranged from $20 to $40 million dollars annually. Moreover, this was a difficult time for water management in the Cumberland Basin because it was recently removed from a period of severe drought, which added to power generation challenges. The first stage of the Wolf Creek

Nashville District contractors work on the Wolf Creek cutoff wall (Corps photo).

remediation project, grouting, was completed in the fall of 2008 and the Corps estimated the cutoff wall would be completed in FY 2014. The work at Center Hill, also a combination of grouting and a cutoff wall, began in November 2006 and is estimated to be completed in FY 2015.

The full financial impact on customers will not be realized until the two dam safety projects are complete and the costs are transferred back to the hydro projects. The Corps estimated in FY 2009 that rehabilitation and construction costs for both projects would exceed $800 million. Under Section 1203 of the Water Resources Development Act of 1986, the Corps will determine whether the rehabilitation work qualifies for recovery expenses either through the Dam Safety Major Rehabilitation Program, the Dam Safety Assurance program, or perhaps both. For the Cumberland System customers, rates could increase between $3.3 million (7%) and $22 million (45%) annually depending on the qualifying costs.[39]

A BOLD STEP: CUSTOMER FUNDING

Many hydropower projects are reaching 50 years of age and their equipment and infrastructure is reaching the end of its life expectancy. Because of budget cuts, non-routine maintenance and rehabilitation work on Corps hydropower projects has not been conducted. The TVA and the BPA operate on a different financial foundation than the remaining PMAs. Their enabling legislation allows those two agencies to fund projects through general revenues and have borrowing authority approved by Congress. That authority provides greater flexibility in terms of financing non-routine capitalized projects. Historically, the smaller PMAs (WAPA, SWPA, and SEPA) have relied on the Corps to request capital funds for hydro operation and maintenance, requests that then require Congressional approval. As federal hydro facilities aged and operational and maintenance expenses increased, the reliability of federal power decreased and SEPA negotiated replacement power on the open market to secure contracted loads for the preference customers. Alternatives for financing federal hydro rehabilitations had been studied in the past. Such alternatives included placing a percentage of power sales into a "trust fund" or a "revolving fund," but because these type funds could be politically challenging, the ideas were ultimately abandoned.[40]

Because of the outages at South Atlantic Division hydro facilities during the 1990s, SEPA and the southeastern federal preference customers began searching for a mechanism to fund hydropower repairs and maintain the reliability of each system. In July 1996, the Army General Counsel wrote an opinion that the Corps had limited authority to accept customer funding, except in cases where the work was considered part of normal Corps maintenance. Secondly, the Army determined, the Corps could not undertake any work that would increase the capacity or efficiency ("uprating") of the units unless the uprating fell within the Congressionally authorized capacity of the project itself. In the Water Resources Act of 1996, two proposals were submitted for hydropower work. The first was to allow funding from the preference customers and the second would allow the Corps to uprate its

In carrying out this section, the Secretary may accept and expend funds provided by preference customers under Federal law relating to the marketing of power.

Water Resource Development Act of 2000, Section 212.

hydropower facilities. Ultimately, Congress rejected the customer funding option, but allowed the Corps to seek unit uprating as long as the funds were made available through appropriation acts.[41]

Finally, the Section 212 of the Water Resources Development Act of 2000 (WRDA 2000) authorized the Secretary of the Army to accept funds provided by preference customers for use in the maintenance, rehabilitation, or modernization of equipment at the hydroelectric projects owned by the Corps. The framework and authorization for the responsibilities are established in Memoranda of Agreement (MOAs) among the customers, the Corps, and the PMA. Typically, the MOAs establish minimum and maximum benchmarks for the projects and the documents can be terminated or revised as needed. Individual sub-agreements detail specific work items to be performed, how the work will be executed, and how it will be funded. SWPA was the first PMA to develop such an agreement under WRDA 2000. That MOA, established among SWPA, the Corps and the City of Jonesboro, Arkansas, provided for customer funding of non-routine maintenance actions. Under the SWPA arrangement, the three partners prioritized maintenance projects and discussed the progress of those underway. Between 2000 and 2005, SWPA customers provided $36 million for funded projects.[42]

In December 2004, after more than a decade of discussions, SEPA, the Corps, and the federal power customers signed an MOA establishing the framework for customer funding-projects in the Georgia-Alabama-South Carolina system. Under the agreement, the participating customers provide one hundred percent of an agreed upon funding requirement, specified in the individual sub-agreements for work items. During the MOA negotiations, one of the customers' greatest concerns was the ultimate financial liability for individual work items, particularly given the age of many of the hydro projects. The MOA stipulates that if the Corps anticipates funding changes before or during construction, it will notify the customers who must unanimously approve of the modification or the sub-agreement is terminated.[43]

Similar MOAs were negotiated with the Cumberland and Kerr-Philpott systems in 2007.[44] The Cumberland System funding efforts began as short-term agreements until a long-term agreement was negotiated in August 2011. The 2011 Cumberland System MOA provided for up to $25 million to address the decreasing reliability of the nine aging projects in that system. The Cumberland System contains 28 individual units generating 3,114 gigawatt hours (GWh) annually. The decreasing reliability of these units, compromised by age and deferred maintenance due to limited funding, led to a comprehensive system-wide evaluation of each hydroelectric project. The second phase of the evaluation identified 242 work orders, which were prioritized based on (1) the potential for catastrophic or extended outages and (2) the return on investment.[45]

In the Cumberland System you have nine projects and, in reality, all of them need rehab. It is a significant expense. But, through the years, the Cumberland System has done a good job of maintaining their equipment. You can be a victim of your own good work, though, and there's only so many miles that you can put on the equipment. It's been a challenge to make sure the program moves forward. We're relying on customer funding, particularly in the Cumberland System. They're all businessmen and they know the value of a dependable resource. It's not in their best interests to let the systems decay.

Herb Nadler, Assistant Administrator of Power Resources, SEPA

In many ways, the funding mechanism represents a true partnership between the federal government and the preference customers. "The biggest advantage is that it puts the customers at the table. They are part of a team," noted Leon Jourolmon. Whereas the Corps historically was accused of making autonomous decisions on repairs, and the costs ultimately passed to the customers through rates, now the customers provide critical input and participation in the decision-making process. A Project Review Committee (PRC) composed of representatives of the Corps, the customers, and SEPA, evaluates and prioritizes individual work items for a particular fiscal year. Individual selected work items may be individually funded or combined with other tasks being funded through conventional appropriations.[46] The work items are outlined in a sub-agreement to the MOA and none begin until all parties have signed the document.

According to the Corps, SEPA, and the federal power customers, the value of customer-funding cannot be overstated. It represented a different framework under which to operate and inject much-needed financing of capital improvements. Between 2000 and 2010, customer-funding provided financing for three marketed systems in the Southeast federal power region. Negotiations also began for a customer funding MOA for the Jim Woodruff System by the end of 2012. Given the economic recession that began in 2008 and the anticipated reduction of federal expenditures, the Corps will face the challenge of funding its Civil Works program on a skeleton budget. In addition to its hydropower responsibilities, the Corps Civil Works program manages navigation locks, recreation facilities, and environmental programs; funds will be rationed and some programs, such as recreation or navigation, may operate on a limited schedule.[47] Fortunately, through their successful dialogue, the public power customers and their federal partners have established a framework for unconventional financial mechanisms to support reliable power.

While customer funding has narrowed the gap of funds necessary to stabilize the reliability of units, hydropower facilities continue to age. In FY 2010, the median age of Corps hydropower projects nationwide was 47 years, with 90 percent of the projects over 34 years of age. The Corps' goal for unit availability is 95 percent, but according to a 2008 report, none of the Corps Divisions reached that number. In SAD, hydropower

PROJECTS FUNDED BY SEPA CUSTOMERS, FY 2004 - FY 2010

Year Funded	System	Project	Work Item	Funded Cost
2004	Cumberland	Center Hill	Rehabilitate Powerhouse Crane	$5 Million
		Wolf Creek	Rewind Generator 6 Asbestos & Lead Abatement	
2005	Cumberland	Basin Wide	Condition Assessment Study	$8 Million
		Barkley	Replace Transformer Cooling System	
		Center Hill	Replace Coolers & Bearings Generator 2	
		Old Hickory	Rehabilitate Powerhouse Crane Replace Generator Cooling Piping	
		Wolf Creek	Replace Coolers Generators 4 & 6 Replace Generator Thrust Bearing Lift Pumps	
2006	Cumberland	Basin Wide	Program Management & Contingency Reserve	$7 Million
		Dale Hollow	Repair & Replace Intake Gate Hoists & Cables	
2007	GA-AL-SC	Allatoona	Replace Transformers	$3 Million
		Carters	Generator Cooling Water Study	
		West Point	Replace Excitation Systems Generators 2 & 3	
2008	Cumberland	Basin Wide	Replace Transformers Replace Turbine Governors	$21 Million
		Barkley	Rehabilitate Powerhouse Crane	
		Center Hill	Repair Penstock & Water Passages	
		Old Hickory	Replace Turbine & Generator Design	
	GA-AL-SC	Allatoona	Replace Switchyard Components	
		Carters	Repair Excitation Generator 4	
		Hartwell	Repair Rotor Rim Generator 5	
		R.B. Russell	Realign Generator 2 Install Circuit Breakers Generators 1-4	
		W.F. George	Replace Transformers	
2009	Cumberland	Basin Wide	Replace Generator Circuit Breakers	$22 Million
		Barkley	Rewind Generator 1	
		Center Hill	Replace Turbine & Generator Design	
		Old Hickory	Rewind Generator 4	
	GA-AL-SC	R.B. Russell	Repair & Realign Generators 5-8	
	Kerr-Philpott	John H. Kerr	Replacement 115kV Oil Filled Pipe Cables	
2010	GA-AL-SC	Allatoona	Replace Generator Control System	$20 Million
		Carters	Replace 230kV Reversing Switch Rewind Generators 3 & 4	
		Hartwell	Repair Stator Winding Generator 3	
		R.B. Russell	Replace Switchyard Components Replace Draft Tube Trash Rack Screens	
	Kerr-Philpott	Philpott	Replace Breakers, Exitation & Governors	

CUSTOMER FUNDING TOTALS BY SYSTEM (FY 2000 – FY 2010)

Georgia-Alabama-South Carolina	Kerr-Philpott	Cumberland
$54,862,509	$8,450,000	$74,314,385

units hovered below 85 percent reliability. Between FY 2000 and FY 2008, total generation continued to decrease. The downward trend for appropriations directed to hydropower infrastructure rehabilitation is not expected to change and, therefore, customer funding will continue to play an important role in filling the gap of federal funding.[48]

ENDNOTES

[1] For a more detailed discussion of the implementation of the 308 Reports, see Barber and Gann, *Savannah District*; Jeane and Harvey, *Mobile District*; Johnson, *Ohio River Division*; Johnson, *Engineers on the Twin Rivers*; and Ronald B. Hartzer, *To Great and Useful Purpose: A History of the Wilmington District Corps of Engineers* (Bloomington, Indiana: David A. Clary and Associates, 1984).
[2] During a brief period, SEPA marketed power from a twenty-third Corps project, Stonewall Jackson in West Virginia. That project has since been de-authorized.
[3] SEPA, *Annual Report*, 2010.
[4] The data presented in this table was compiled from SEPA's *Annual Reports*, 1990-2010.
[5] SEPA, *Annual Report*, 2010.
[6] For a detailed history of the hydroelectric projects in the Georgia-Alabama-South Carolina system, see Barber and Gann, *Savannah District,* 419-464; and Jeane and Harvey, *Mobile District.*
[7] COL Mark S. Held, *Testimony Before the Committee on Resources Subcommittee on Water and Power, US House of Representatives*, September 27, 2004.
[8] Barber and Gann, *Savannah District*, 434-442; Held, *Testimony*; USACE News Release No. 07-14.
[9] The R. B. Russell project is detailed more thoroughly in Barber and Gann, *Savannah District*, 442-452. Some of the more significant pieces of legislation include the Fish and Wildlife Coordination Act (1958), the National Historic Preservation Act (1966), the Wild and Scenic Rivers Act (1968), National Environmental Policy Act (1969), and the Clean Air Act (1972). As part of the massive mitigation efforts, for example, the Corps conducted large-scale archaeological studies that identified approximately 600 prehistoric sites and 70 historic sites. The Corps also conducted interviews with residents and archival research to assist in preserving the cultural heritage of the area.
[10] The pumped storage process allows for water discharged during conventional hydro operations to be stored in a lower (below dam) reservoir, and then drawn back into the turbines and re-used in generating electricity at peak demand times.
[11] Barber and Gann, *Savannah District*, 442-452. In addition to fish protection issues, the project also raised concerns from local governments because it included a 300-foot setback for private development along the shoreline; however, the Corps responded that "economic development" was not an authorized project purpose and that all Corps lakes completed after 1974 implemented shoreline protection measures.
[12] Barber and Gann, *Savannah District;* Brockington and Associates*, South Atlantic Division*.
[13] For information on cost recovery at Richard B. Russell, see GAO, *Cost Recovery*, 32-34; COL Roger A. Gerber to Charles Borchardt, 30 August 2002 (SEPA archives).
[14] For additional information on West Point, see Barber and Gann, *Savannah District*, 455-463. Although the project was under the jurisdiction of the Mobile District, Savannah District managed the design and construction phases of the project. This was part of a broader Corps effort to balance the workloads of their districts, see Brockington and Associates, Inc., *South Atlantic Division*.
[15] For more on the Walter F. George project, see Jeanne and Harvey, *Mobile District*, 151, 155; for details on the cutoff wall construction, see Donald E. Simpson, Marilyn Phipps, and Arturo L. Ressi di Cervia, "Constructing a Cutoff Wall in Front of Walter F. George Dam in 100 Feet of Water," in *Hydro Review* (March 2006), 2-4.
[16] Obtained from *Florida Memory*, http://floridamemory.com/items/show/57549.
[17] US General Accounting Office, *Testimony. Federal Power: Outages Reduce the Reliability of Hydroelectric Power Plants in the Southeast*. Report GAO/T-RCED-96180, July 25, 1996. Hereafter cited as GAO, *Outages*. Miller's Ferry actually has a total nameplate capacity of 101.4MW (33.8 MW per unit), but operates at 90 MW due to temperature limits.
[18] For more on the Jim Woodruff project, see Jeanne and Harvey, *Mobile District*, 145, 151.
[19] GAO, Outage. Also, John A. McAllister, Jr. to Colonel Michael. F. Thuss, September 19, 1990, RG6400, SEPA Archives.

[20] During the early 1990s, the Corps had a policy of "No New Starts" for Construction General Funding, which compounded the issue of rehabbing many of the projects.
[21] SEPA, *Annual Report,* 2010.
[22] For a complete history of the Kerr and Philpott hydroelectric projects, see Hartzer, *To Great and Useful Purpose*.
[23] For a complete history of the hydroelectric construction projects in the Cumberland System, see Johnson, *Engineers on the Twin Rivers*.
[24] Norwood, *Gift of the Rivers*, 20-24; Johnson, *Engineers on the Twin Rivers*, 181-186.
[25] Norwood, *Gift of the Rivers*, 20-25; Johnson, *Engineers on the Twin Rivers*, 198, 200-231.
[26] SEPA, *Annual Report,* 2010.
[27] For more information on the Stonewall Jackson project, see Johnson, *The Headwaters District;* also Johnson, *Ohio River Division*.
[28] See SEPA, *Annual Report*, 1992; Water Resources Development Act 2000 (Public Law 106–541: Section 547); Rick Moorefield, "Tri-Cities Power Authority Holds Historic Meeting," *The Hinton News*, December 20, 2005; "Flood-control Dams Eyed for Energy Potential," *Associated Press*, December 31, 2008.
[29] US Department of the Interior, US Department of the Army, and US Department of Energy, "Potential Hydroelectric Development at Existing Federal Facilities," May 2007.
30 Southeastern Power Report, December 4, 1992. Found in "Regional Associations: Southeastern Federal Power Group, 1990-1993," RG1262, SEPA Archives.
[31] GAO, *Outages.*
[32] Testimony of Robert W. Claussen on behalf of the Southeastern Federal Power Customers, Inc. to the Committee on Appropriations Subcommittee on Energy and Water Development, March 22, 1994 in RG1262, Regional Associations, Southeastern Federal Power Customers Group, 1993-1997, SEPA Archives.
[33] US General Accounting Office. *Federal Power: Implications of Reduced Maintenance and Repairs of Federal Hydropower Plants*. Report GAO/RCED-99-63, March 1999, hereafter cited as GAO, *Implications*
[34] GAO, *Implications,* 33; also, GAO, *Outages*," 6; also "Testimony of Robert W. Claussen before the House Resources Subcommittee on Water and Power Resources, July 26, 1996," in SEPA Archives, RG5104 (Planning, Programming, and Budgeting: Congressional Briefings."
[35] Congressional Research Service (CRS). *Aging Infrastructure: Dam Safety*. March 25, 2008; also Billington, Jackson, and Melosi, *Large Federal Dams*, 406-407.
[36] CRS, *Aging Infrastructure*. A third dam in the Cumberland System, J. Percy Priest was designated Class II Action. Although the dam had not exhibited signs of immediate problems, its underlying karst foundation is similar to Wolf Creek and Center Hill and has the potential to develop seepage issues in the future (USACE, Nashville District, News Release, February 24, 2009). Also, Brockington and Associates, Inc. *South Atlantic Division*, 167-168.
[37] US Army Corps of Engineers, *Wolf Creek Dam Consensus Report: Engineering Risk and Reliability Analysis*. April 11, 2007.
[38] Ann Paine, "Nashville Could Flood if Far-off Dam Fails," *The Tennessean* (November 2, 2006).
[39] According to the Corps, the Major Rehabilitation Program allows "accomplishment of significant, costly, one-time structural rehabilitation or major replacement work" (e.g., cutoff wall). For design deficiencies, the Dam Safety Assurance Program provides for "modification of completed Corps of Engineers dam projects which are potential safety hazards in light of current engineering standards and criteria." See US Army Corps of Engineers Pamphlet No.1110-2-13, "Dam Safety Preparedness." Also, SEPA News Release, "Southeastern Power Administration Prepares Preliminary Estimates on Rate Increase," January 7, 2010.
[40] Al Pless, "Alternative to Federal Appropriations: Federal Hydropower Rehab in the Southeast," in *Proceedings of the 2005 Georgia Water Resources Conference, April 25-27, 2005*, Institute of Ecology, The University of Georgia, Athens.

[41] South Atlantic Division Corps of Engineers, Memorandum: "Hydropower Customer Funding – Draft Memorandum of Agreement," September 10, 1997, SEPA Archives; Department of the Army, Office of General Counsel, Memorandum: "Authority to Implement and Accept Contributions Towards Work on Hydropower Facilities," July 3, 1996; Department of the Army, Office of General Counsel, Memorandum: "Authority to Accept Contributions Towards Replacements and Rehabilitations on Hydropower Facilities," July 7, 1997. SEPA Archives.

[42] Pless, "Alternative to Federal Appropriations."

[43] "Memorandum of Agreement Between the United States Department of the Army, the United States Department of Energy and Southeastern Power LLC Representing Certain of the Preference Customers Served by the Southeastern Power Administration," December 2, 2004, SEPA Archives.

[44] In the Cumberland System, an MOA was developed between the Corps' Lakes and Rivers Division, SEPA, and the preference customers. A parallel MOA was also developed between SEPA, the customers, and the Corps' South Atlantic Division, to cover customer-funding for the Georgia-Alabama-South Carolina System, the Kerr-Philpot system, and the Jim Woodruff System.

[45] James F. Sadler, "Financing: Partnering to Rehabilitate Federal Hydro Plants Using Non-Federal Funding," *Hydro World*, September 1, 2011.

[46] Jourolmon phone interview, 2012; In the Cumberland System, this is called the Project Coordination Committee; for the projects operated by the South Atlantic Division, it is called the Project Review Committee.

[47] Brockington, *South Atlantic Division;* also Prince interview.

[48] US Army Corps of Engineers Institute for Water Resources, "Outlook for the US Army Corps of Engineers Hydropower Program," November 2010 (revised March 21, 2011), 9. As noted in the Corps' "Outlook" report, hydropower facilities are not the only federal infrastructure assets to suffer from underinvestment. Other public works needing reinvestment include transportation, education, water, recreation and sanitation.

THE CUMBERLAND SYSTEM

Laurel River Dam on the Laurel River in Kentucky was completed in 1974. Production of hydropower began in 1977.

Wolf Creek Dam on the Cumberland River in Kentucky began hydropower production in 1951.

THE CUMBERLAND SYSTEM

Located on the Obey River along the borders of Kentucky and Tennessee, Dale Hollow Dam began hydropower production in 1948.

Cordell Hull Lock and Dam on the Cumberland River in Tennessee, was completed in 1972.

THE CUMBERLAND SYSTEM

Completed in 1948, Center Hill Dam impounds the Caney Fork and the Falling Water River in Middle Tennessee.

Located on the Cumberland River in Tennessee, Old Hickory Lock and Dam was completed in 1954 with the first hydropower produced in 1957.

THE CUMBERLAND SYSTEM

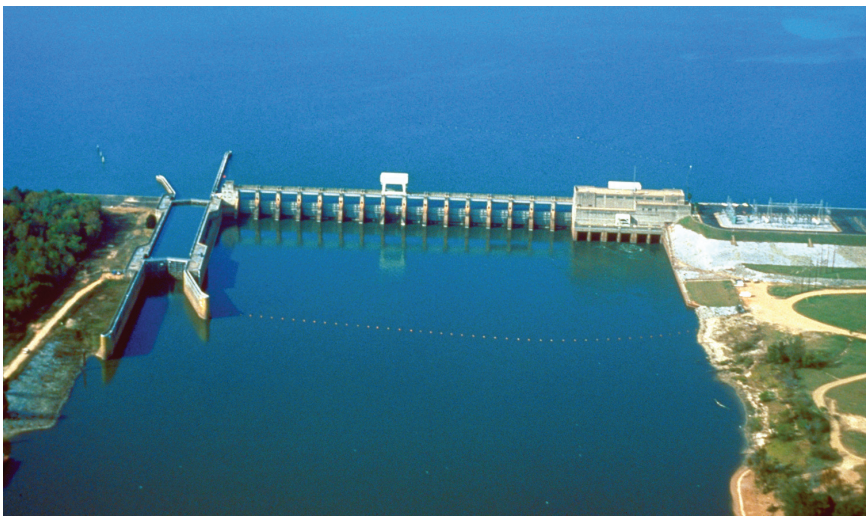
J. Percy Priest Dam on the Stones River in Tennessee was completed in 1968.

Cheatham Lock and Dam, a run-of the river plant located on the Cumberland River in Tennessee went into full commercial operation in 1960.

THE CUMBERLAND SYSTEM

Located on the Cumberland River in Kentucky, Barkely Lock and Dam began hydropower operation in 1966.

JIM WOODRUFF SYSTEM



Jim Woodruff Lock and Dam holds back the waters of the Chattahoochee and Flint rivers along the Georgia-Florida border. The power plant came online in 1957.

GEORGIA-ALABAMA-SOUTH CAROLINA SYSTEM

Carters Dam and Lake, on the Coosawattee River in North Georgia, was completed in 1977.

Located on the Etowah River in North Georgia, the Allatoona power plant began operation in 1950.

GEORGIA-ALABAMA-SOUTH CAROLINA SYSTEM

Completed in 1975, the run-of-the-river Robert F. Henry Dam is located on the Alabama River.

The Miller's Ferry Project began producing hydropower in 1970.

GEORGIA-ALABAMA-SOUTH CAROLINA SYSTEM

Buford Dam, impounding the Chattahoochee River in North Georgia, was completed in 1956.

Located on the Chattahoochee River, the West Point Dam power plant came online in 1975.

GEORGIA-ALABAMA-SOUTH CAROLINA SYSTEM

Walter F. George Lock and Dam impounds the Chattahoochee River along the Georgia-Alabama border; it began producing hydropower in 1963.

The Hartwell Project on the Savannah River began commercial operation in 1962.

GEORGIA-ALABAMA-SOUTH CAROLINA SYSTEM

Impounding the Savannah River, the Richard B. Russell Project began operation of its conventional hydro units in 1986, but litigation postposed use of the reversible units until 2002.

Originally known as Clarks Hill Dam and Lake and renamed in 1988, the J. Strom Thurmond Project on the Savannah River, began commercial operation in 1954.

KERR-PHILPOTT SYSTEM

The Philpott Project is located on the Smith River in Virginia; it began producing hydroelectricity in 1953.

The John H. Kerr Project is located on the Roanoke River in Virginia; it was completed in 1953.