Welcome to the U.S. Army Corps of Engineers, Savannah District

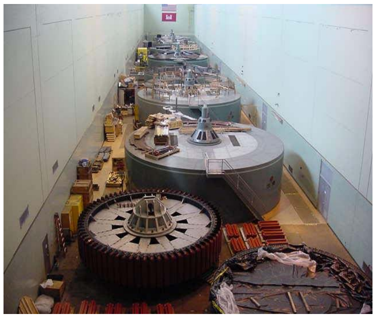
J. Strom Thurmond Dam & Lake

Did You Know?

Thurmond Dam is built of more than 1,000,000 cubic yards of concrete and more than 3 million pounds of reinforcing steel.

For More Did You Know Facts go **HERE!**

October 22, 2010



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Hydropower at Thurmond

Introduction

J. Strom Thurmond Dam and Lake was the U.S. Army Corps of Engineers First multipurpose “project” in the Savannah River Basin. Authorized by Congress under Public Law 534 in December 1944, the Thurmond Project was built between 1946 – 1954 for the purposes of hydropower, flood control, and downstream navigation. Additional purposes of the project now include water supply, water quality, recreation, and fish and wildlife management. Filling of the lake began in July 1951 and was completed in October 1952. The power plant first went on-line in November 1952.

Thurmond Dam is a concrete-gravity structure flanked on both sides by embankments of compacted earth. The concrete section is 1,096 feet long and rises 200 feet above the riverbed at its highest point. The earthen embankments on each side of the dam lengthen it to over 1 mile. The dam creates a 71,100-acre lake that stretches 29.4 miles up the Savannah River and 17 miles up the Little River.

The dam is located approximately 239.5 river miles above the mouth of the Savannah River where it empties into the Atlantic Ocean (in Savannah, Georgia) and 22 miles above Augusta, Georgia. Two other Corps projects – Hartwell Lake located near Athens (completed in 1962), and Richard B. Russell, located between Hartwell and Thurmond Projects near Elberton, Georgia (completed in 1985) – join Thurmond to form a chain of lakes 120 miles long.

The Corps of Engineers is the nation’s leading producer of hydroelectric energy and Thurmond Dam and Power plant is part of the Corps’ national commitment to this energy. Hydroelectric power generation continues to be the only pollution-free means of producing commercial energy.

Hydropower Generation

Thurmond Power plant is referred to as a “peaking” plant – which means the power plant is designed to supply dependable power during hours of “peak” daily demand. In addition to being a very clean energy source, another major advantage of hydropower is the availability to come “on-line” (begin producing power) within a few minutes. Other types of power plants such as nuclear and fossil fuels often take several

Hydropower Links

- Hydropower and the Corps of Engineers
- Value to Individuals and the Community
- How Hydropower Works
- Value to the Economy
- Hydropower and the Environment
- Sharing the Challenge

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hours, at which point the peak demand has often passed. This ability to virtually produce power on demand during peak periods helps to reduce energy shortages (especially during the summer months) and makes hydropower, and the Thurmond Power plant, an exceptional resource.

How Hydropower Works

Hydroelectric power is produced when water from Thurmond Lake flows through the intake section of the dam by large pipes called “penstocks”. The penstocks are located far below the surface of the reservoir. Water flows through these 24 ft. in diameter penstocks at a rate of 2 – 3 million gallons per minute when generating. The force of the water rotates the “turbines” which resemble large water wheels or fan blades.

The rotating turbine causes the 41-inch diameter generator shaft to spin, which then causes the rotor to turn (the rotor is a series of magnets where the magnetic field is created). The rotor turns inside the “stator” – a stationary part of the generator made of copper coils of wire called “windings”. Electricity is produced as the rotor spins past (inside of) these windings.

The generators create electricity in the form of volts. By means of transformers, the electric current produced is “stepped up” or increased in voltage from 13,800 volts to 230,000 volts for transmission to power companies or decreased in voltage for use in power plant operations. Water used in generating the power is discharged into the river below the dam, where it can be “reused” for additional purposes such as water supply and water quality needs of the Savannah River Basin.

Where Does the Power Go?

Power produced at Hartwell and all other Corps operated power plants in the southeast, is marketed by the Department of Energy’s Southeastern Power Administration (SEPA). Power is sold through SEPA to private power companies and public cooperatives in the Southeastern U.S. and from there to customers of those companies. Although electricity is not sold directly to the consumer, the underlying goal of all Corps hydroelectric projects is to provide power to consumers at the lowest possible rates. Rates are set by the marketing agency and approved by the Federal Energy Regulatory Commission. Revenue from Corps power plants is returned to the U.S. Treasury.

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Flood Control

Normally, water released from the reservoir passes through the dam and into the river below by way of the power plant. However, there are times when it is necessary to pass substantial quantities of water downstream quickly for flood control purposes. The spillway, located on top of the dam, contains 23 large gates, each 40 ft. by 35 ft., for the quick release of water from the lake. Water can be released at the rate of 1 million cubic feet per second with the gates completely open.

The concrete bucket at the toe of the spillway deflects the flow upward to dissipate its destructive energy and prevent erosion of the foundation. The training walls of the concrete structure at each end of the spillway direct the flow into the river channel below the dam. Water released through the floodgates cannot be used to generate electricity.

The floodgates at Thurmond Dam have been opened several times for flood control purposes. The three Corps managed dams and lakes on the Savannah River have prevented over $40 million in flood damages since 1954.

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Historical Photos Library

- This area is under construction as photos are located and scanned into proper format.

Facts and Figures

- When the reservoir is at full summer pool (elevation 330 ft. msl), it covers nearly 71,100 acres. Approximately 79,900 acres of public land surrounds the lake. The lake has 1200 miles of shoreline.
- The generator rotors, which are turned by the turbines, are 30 feet in diameter and weigh 300 tons each. They are the heaviest part of a generator unit.
- The penstocks are 214 ft. long, made of boilerplate steel, and are 20 ft. in diameter. Water flows through the penstocks at a rate of 37,000 gallons of water per second, enough to fill an Olympic sized swimming pool in approx. 3-5 seconds.
- It takes 138,000 gallons of insulating and lubricating oil to operate the generators. The oil is continuously recycled inside the power plant, saving millions of dollars each year.
- Thurmond Dam is built of more than 1,000,000 cubic yards of concrete and more than 3 million pounds of reinforcing steel.
- The depth of the lake behind the dam is approximately 180 feet.
- The top of the dam is 200 feet above the Savannah River Bed.

The Details...

LOCATION:
Structure completed in 1954
67.3 Miles below Hartwell Dam (Mile 305.0)
37.5 Miles below Russell Dam (Mile 275.2)
38.1 Miles Upstream of Augusta, GA (5th street 199.6)
50.3 Miles Upstream of Augusta, GA (Butler Creek 187.4)
80.9 Miles Upstream of Jackson, SC (Savannah River Plant Intakes Mile 156.8)
119.0 Miles Upstream of Millhaven, GA (Mile 118.7)
172.7 Miles Upstream of Clyo, GA (Mile 65.0)
209.9 Miles Upstream of I-95 Savannah, GA (Mile 27.8)
237.7 Miles Upstream of Savannah, GA

DRAINAGE AREAS:
Above mouth of Savannah River - 10,579 sq mi
Above Augusta, GA - 7,240 sq mi
Above Thurmond Dam - 6,144 sq mi
Local Basin - 3,254 sq mi

RESERVOIR
Bottom of Power Pool - 45,000 Acres
Top of Power Pool - 71,100 Acres
Top of Gates (closed) - 78,500 Acres
Top of Dam - 351.0 ft-msl
Conservation Pool - 340,461 Million Gal
Flood Control Pool - 127,062 Million Gal

DAM LENGHTS:
Concrete Section - 2,282 ft
Earth Embankments & Saddle Dike - 3,398 ft

SPILLWAY:
Type: Concrete Gravity ogee
Gross Length - 1,096 ft

Clear Opening Length - 920 ft
Tainter Gates - 23 40 ft X 35 ft
Type of BucketP: Submerged Roller Bucket
Radius of Bucket - 50.0 ft
Bucket Lip Elevation - Varies ~185.0ft-msl

QUANTITIES:

Concrete - 1,050,000 cu-yd
Compacted Fill - 3,500,000 cu-yd

Excavation Borrow	cu-yd
Excavation Common	cu-yd
Excavation Rock	cu-yd
Rock Toe	cu-yd
Riprap and Filter	cu-yd
Intake Section	
Length	434.0 ft
Intake Invert	228.0 ft-msl

HYDROPOWER:

Penstocks	Conventional	Service Units
Number	7 units	2 units
Diameter	20 ft	4.5 ft
Spacing	62.0 ft	
Max Velocity	15.5 ft/sec	8.2 ft/sec
Generators		
Installed Capacity	40 MW	1 MW
Gross Static Head	152 ft	
Average Head	134 ft	
Minimum Head	118 ft	

* Top of Augusta Levee

Power Marketed to Southern Company , Duke , Santee , and SCE&G

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Abbreviations & Glossary

Acre-foot (AF)	The volume of water require to over one acre to a depth of one foot. 1 acre-foot= 43,560 cubic feet or 326,000 gallons.
Capacity	The load for which a generator, turbine, transformer, transmission circuit, apparatus, station or system is rated. Capacity is also used synonymously with capacity.
Circuit Breaker	Any switching device that is capable of closing or interrupting an electrical circuit.
Confluence	The combining of two streams.
Conservation Pool	Usable storage in reservoir for hydropower, recreation, water quality, fish and wildlife management, navigation, and water supply purposes, designed to be filled during normal and high flow periods for use during low flow periods.
Cubic Feet per Second (cfs)	1cfs=450 gallons per minute (gpm)
Demand	The rate of water flow through, over, or around water control facilities. The rate of flow is measured by stream gage or calculated from predetermined rating tables. The term may be applied to the rate of flow from each individual source (such as a particular turbine) or to be algebraic summation from all individual sources (which would be the total rate of flow). Total discharge is synonymous with outflow.
Discharge	The rate of water flow through, over, or around water control facilities. The rate of flow is measured by stream gage or calculated from predetermined rating tables. The term may be applied to the rate of flow

	from each individual source (such as a particular turbine) or to be algebraic summation from all individual sources (which would be the total rate of flow). Total discharge is synonymous with outflow.
Drawdown	The distance that the water surface elevation of a storage reservoir is lowered from a given or starting elevation as a result of the withdrawal of water to meet some project purpose(s) such as power generation or creating flood control space.
Drought Contingency Plan	Detailed drought management plan that addresses current water conditions in the Savannah River Basin, and serves as a baseline for future
Drought Indicators	Mechanisms which reflect drought conditions and severity. Drought indicators consist of hydrologic indicators such as streamflow, rainfall, reservoir storage levels and groundwater levels, meteorological indicators such as rainfall, and human activity indicators, which include navigation cutbacks and reduction in hydropower generation.
Drought Response	A response network consists of trigger levels and appropriate management action. Triggers are predetermined standards reflecting drought intensity which induce responses.
Effluent	Waste material discharges into the environment.
Flood Control Pool	Storage above the conservation pool elevation designed to store floodwater and reduce flooding downstream.
Flow	The amount of water passing a given point within a given period of time.
Forebay	The impoundment immediately above a dam or hydroelectric plant intake structure. The term is applicable to all types of hydroelectric developments (e.g. storage, run-of-river, and pumped-storage).
Generating Unit	A single power producing unit, comprised of a turbine, generator, and related equipment.
Generation	The act or process of producing electricity from other forms of energy. Also, the amount of electric energy so produced.
Generator	The electrical equipment in power systems that converts mechanical energy to electrical energy.
Governor	The device which measures and regulates turbine speed by controlling wicket gate angle to adjust water flow to the turbine.
Guide Curve	(also Rule Curve or Target Pool Levels). Guides established to regulate and manage optimum pool elevations for yearly operations at impoundments. Rule curves can be designed to regulate storage for flood control, hydropower production, and other operating objectives, as well as a combination of objectives.
Hydroelectric Plant	An electric power plant that uses water to generate power.
Hydropower Power	The energy that is produced from water.
Impoundment	A confined body of water such as a reservoir or lake. Typically created by a dam to store water that is released to meet to maintain authorized purposes

Inflow	The rate of water flow into a reservoir or forebay during a specified period.
Kilowatt (kW)	The electric unit of power, which equals 1,000 watts or 1.341 horsepower.
Kilowatt hour (kWh)	Unit for measuring electric energy consumption or generation over time; it equals one kilowatt of power applied for one hour of time. A typical home uses about 800 kilowatt hours per month.
Load	The amount of electric power consumed/delivered at a given point.
Megawatt(mW)	Unit of electric power, used for measuring rate of producing or consuming electric energy. One megawatt = 1,000 kilowatts or 1 million watts. A megawatt is equal to 1,341 horsepower.
Meteorological Conditions	Atmospheric phenomena and weather of a region.
Minimum Discharge	The minimum flow that must be released from a project to meet environmental or other non-power requirements.
Minimum Pool Level	The lowest elevation to which the pool is to be drawn.
Multi-Purpose Reservoir	A reservoir planned to be used for more than one purpose.
Normal Pool Level	The elevation to which the reservoir surface will rise during ordinary conditions.
Outage	The period during which a generating unit, transmission line, or other facility is out of service.
Peak Demand Month	The month or months of highest power demand.
Peaking Plant	A powerplant which is normally operated to provide power during maximum load periods.
Penstock	A conduit carries water from the reservoir to the turbine in a hydroelectric plant.
pH	The condition represented by a number, used to express both acidity and alkalinity on a scale whose values run from 0 to 14 with 7 representing neutrality, numbers less than 7 increasing acidity.
Powerplant	A generating station where prime movers (such as turbines), electric generators, and auxiliary equipment for producing electricity are located.
Pumped storage	A hydropower facility that has reservoir pumps which also serve as generators, installed in the dam. During the night, when cheap surplus power is available, the pumps are run to pump water from a lower reservoir to an upper reservoir (upstream). During mid-day, when valuable peaking power is needed, the units are reversed and water is released back to the lower reservoir to generate electricity.
Releases	A determined amount of water that is allowed to pass through or discharged from a dam.
Reregulation Structure	Peaking power plants generally release water only a few hours per day. A reregulation structure is a smaller dam located downstream that is capable of storing the intermittent slugs of water and releasing a continuous flow.
Rule Curve	Same as “Guide Curve.”
Streamflow	The rate at which water passes a given point

	in a stream, usually expressed in cubic feet per second.
Switchyard	An assemblage of electrical equipment for the purpose of tying together two or more electric circuits through switches, selectively arranged in order to permit a circuit to be disconnected or to change the electric connection between the circuits. In a hydroelectric project, the switchyard is the point at which the energy generated at the project is connected to the distribution system.
Tailrace	The area below a dam; the channel that carries water away from a dam.
Thermally Stratify	During the warm months of the year, the sun heats the upper layers of the lake. Since the warm water rises, the surface of the lake continues to warm while the bottom layer stays cold. During the winter months, the upper layers of the lake are cooled. The warmer water on the bottom rises, causing destratification, or "turnover", of the lake.
Transformer	An electromagnetic device used to change the electricity from the generator to usable voltage levels.
Transmission Line	The high voltage lines that carry electricity from the hydropower plant to the electric distribution system.
Triggering Mechanism	An indicator that is put in place to indicate the need to initiate or terminate specific action before a crisis occurs. At the action levels, the trigger elevation will initiate a series of actions that will culminate in the reduction of releases from the projects.
Turbine	Large blades that are turned by the force of water pushing against it; is connected to the generator.
Voltage	The force which causes the current to flow through an electrical conductor.
Watt	Basic unit of electrical power that is produced at one time or rate of doing work. The rate of energy transfer equivalent to one ampere flowing under a pressure of one volt at unity power factor. One horsepower is equivalent to approximately 746 watts.
Wheeling	The transfer of power and energy from one utility over the transmission system of a second utility for delivery to a third utility, or to a load of the first utility.
Wicket Gates	Adjustable vanes that control the amount of water that can enter the turbine.

ABBREVIATIONS

AF	acre-feet
cfs	cubic feet per second
cu	cubic
ft	foot, feet
gal	gallons
gph	gallons per hour
gpm	gallons per minute
km	kilometer
kv	kilovolt
kva	kilovolt-amperes
kWh	kilowatts per hour
m	meter
mgd	million gallons per day
mi	mile

MWH	Megawatts per hour
MSA	Metropolitan Statistical Area
NGVD	National Geodetic Vertical Datum
rpm	revolutions per minute
SAD	South Atlantic Division
SEPA	Southeast Power Administration
sq	square
WES	Waterways Experiment Station
/	per

CONVERSION FACTORS

Length
1 mi = 5,280 ft = 1.609 km
1 km = 0.6214 mi = 3,281 ft
Area
1 sq mi = 640 acres = 2.590 sq km
1 acre = 43,560 sq ft = 4,047 sq m
Volume
1 AF = 325,872 gal = 1,233 cu m
1 AF = 43,560 cu ft = 1,613 cu yd
1 cfs-day = 1.983 AF
1 cubic foot = 7.48 gallons = 0.0283 cubic meters
1 cfs-day = 1.983 AF
1 cubic meter = 35.51 cubic feet
Discharge Rate
1 cu m/sec = 15,850 gpm = 70.04 acre-ft/day
1 cfs = 2,228 gpm = 0.646317 mgd = 1.983 AF/day
1 AF/day = 226.3 gpm = 0.5042 cfs
1 gpm = 8.0208 cu ft/hr
1 cubic foot per second (cfs) = 448.83 gallons per minute
(gpm) = 0.646 million gallons per day
(mgd)= 0.0283 cubic meters per second (cms)
Energy
1 kilowatt –hour (kWh) = 3,413 BTU [i]
1 kilowatt (kW) = 1,000 watts
= 1.341 horsepower
= 56.88 BTU/minute
= 737.56 ft-lbs/second

1 megawatt (MW) = 1,000 kilowatts
= 1 million watts
1 gigawatt (gW) = 1,000 megawatts

Energy Equivalents
1 barrel of oil (42 gallons) = 470 kWh at 27% efficiency [i]
= 520 kWh at 30 % efficiency
= 660 kWh at 38% efficiency [iii]
1 ton of coal = 2,500 kWh at 37% efficiency [iv]
1,000 cubic feet of natural gas = 59 kWh at 27% efficiency [ii]
= 83 kWh at 38% efficiency [iii]

[i] 1 BTU (British Thermal Unit) is the amount of energy required to raise the temperature of one pound of water one degree Fahrenheit.

[ii] Typical efficiency for a combustion turbine.

[iii] Typical efficiency for new oil- or gas-fired base load steam plant or combined cycle plant.

[iv] Typical efficiency for a new base load coal-fired steam plant.

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Interesting Hydropower Links

- National Inventory of Dams

- Southeastern Power Administration

- **U.S. Department of Energy Hydropower Program**
- **U.S. Bureau of Reclamation Power Program**
- **Federal Energy Regulatory Commission**
- **Southern Company / Georgia Power Hydroelectricity & Recreation**

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