

WELCOME TO  
ST. JOHNS RIVER  
POWER PARK





*Nature and technology work together at  
St. Johns River Power Park.*



*St. Johns River Power Park.*

The St. Johns River Power Park (Power Park), located on a 1,900-acre site in northeast Jacksonville, is a coal-fired electric power generating station jointly operated by the Jacksonville Electric Authority (JEA) and the Florida Power and Light Company (FPL). Each utility receives 50 percent of Power Park's capacity and energy output, which creates a good example of the continuing partnership between local government and the private sector. Power Park represents Florida's largest municipally-owned utility joining with its largest investor-owned utility to provide reliable electric energy at stable prices to their customers.

Power Park is the largest and most efficient generating plant in the JEA system and consists of two 640 net megawatt coal-fired generating units. Before they were placed into commercial operation, each unit was originally expected to produce 550 net megawatts of power. During start-up operations before Unit 1 was placed into commercial service on March 27, 1987, the unit exceeded its 550 net megawatt output rating by achieving a total of 624 net megawatts or 74 additional megawatts. Since Unit 2, which was placed into commercial service on May 27, 1988, is a duplicate of Unit 1, the combined output rating provides nearly 148 additional megawatts of power. This represents an avoided cost for the additional generation for rate payers of approximately \$200 million. At maximum capacity, the energy produced by both units is more than the energy produced by 50,000 barrels of oil a day, or more than that produced by 13 million barrels per year. In 1997, an additional 16 megawatts per unit were gained

by improvements in operational activities. The additional megawatts result in an avoided construction cost of \$28.8 million and avoided replacement power costs of \$2 million annually.



*Unit coal train enters Power Park.*

Coal-fired generation has enabled both JEA and FPL to diversify their fuel mixes, which has reduced each utility's dependence on uncertain supplies of imported oil. Coal to fuel the plant is delivered either by rail or ship, which ensures a secure supply of coal if deliveries by one mode of transportation are interrupted.

In 1997, JEA and Power Park successfully completed rigorous testing and environmental permitting procedures to utilize a mixture of petroleum coke in addition to coal as fuel in Power Park's operation. Petroleum coke is a solid petroleum-based product that remains after the crude oil refining process, and is delivered and processed in the same manner as coal. Petroleum coke has provided JEA and FPL with yet another opportunity to enhance their fuel diversification efforts, which result in lower operating costs and competitive electric rates for consumers.

The coal delivered by rail comes from mines located in Kentucky and West Virginia, and is transported by CSX Transportation Inc. on four utility-owned, 90-car unit trains. Each



*A coal car is unloaded on the rotary dumper.*

rail car holds approximately 105 tons of coal. The trains enter and exit Power Park along a three-mile railroad loop that encircles the plant. Coal is unloaded from the trains at the plant's enclosed rotary dumper facility. The rotary dumper tilts each car at a 120-degree angle and dumps the coal into a



*A ship at the Coal Terminal readies for unloading.*

moves within the coal storage area on a set of railroad tracks, stacking the coal and then retrieving it in buckets attached to a large wheel for movement into the Power Park's Unit 1 and 2 boilers on an enclosed, 2,100-foot-long conveyor system.

Coal transported by ocean-going ship or barge is delivered to the St. Johns River Coal Terminal, located on a 30-acre site on Blount Island. The coal terminal began its commercial operation on January 6, 1989 after 21 months of construction and can handle up to 3 million tons of coal per year. The coal terminal provides economic benefits to JEA and FPL since it provides an alternative to rail



*The coal stacker-reclaimer moves through the coal storage area.*

large receiving hopper. Once the coal is emptied, the car is returned to its original position without ever being uncoupled from the train. Approximately 33 rail cars can be unloaded per hour.

A conveyor is used to transfer coal from the rail rotary dumper facility to the coal storage area, which is capable of holding 1 million tons of coal, or a 90-day supply. A coal stacker-reclaimer



*Coal travels to Power Park on this enclosed conveyor system.*

delivery, which ultimately lowers overall transportation costs. It also provides further economic opportunities to purchase coal on the spot market when that coal is less expensive than coal purchased through existing contracts.

Coal is transported to the Power Park from the facility by a 3.2 mile-long, enclosed conveyor system. A 209-foot-tall ship unloader located on the coal terminal's 70.5 foot-wide, 808-foot-long dock unloads the coal from the

vessel with a grab bucket. The unloader can reach 75 feet from the dock and can travel 628 feet back and forth along the dock.

The coal is then placed onto the conveyor where it begins its 3.2-mile journey to the Power Park coal storage area. The conveyor runs at about 10 miles per hour and can handle about 1,500 tons of coal per hour, and changes direction at each of seven transfer stations.



*Coal moves up the conveyor to the boiler from the coal storage area.*

An ongoing commitment to operating in an environmentally safe manner is evident in the state-of-the-art environmental control equipment utilized at the coal terminal. The ship unloader is equipped with a dry dust collection system and a wet dust suppression system that controls coal dust during unloading.



*Coal pulverizer unit.*

system transfer stations, the stacker and the reclaimer are also equipped with a wet dust suppression system. In addition, the conveyor is completely enclosed to contain any dust.

Before the coal reaches the boiler, seven coal pulverizers for each unit grind it to the consistency of talcum powder. The pulverized coal



*Unit 1 and Unit 2 boilers.*

is then blown into the furnace where it is ignited and burned. Purified water flows through a series of boiler tubes inside the furnace. The water is heated under pressure to make steam and is further superheated to 1,000 degrees Fahrenheit. The steam from the boiler then spins the turbine, which turns the generator to produce electricity.



*Turbine generator.*

The electricity travels from the generator to a 230,000-volt switchyard located outside the plant. From there, transmission lines carry the electricity from the switchyard to the JEA transmission system, which also connects with the FPL transmission system.

Power Park operations are monitored continuously by plant personnel from a sophisticated control room, which features the latest in computer and data display equipment.

Power Park also utilizes state-of-the-



*Aerial view of electric switchyard.*



*Control room personnel monitor plant operations.*



*Unit 1 precipitator removes particulates from boiler exhaust gas.*

art technology for environmental protection. For example, approximately 35 percent, or \$480 million of the \$1.6 billion project, was used for the purchase of air and water quality control equipment.

Electrostatic precipitators for each unit are capable of removing more than 99.7 percent of solid particles from the boiler exhaust gas as the coal is burned. Electrically charged metal plates attract the particles and then deposit them in large collection hoppers at the base of the precipitators.

A flue gas desulfurization system, or scrubber, removes up to 90 percent of all sulfur dioxide from the boiler exhaust gas as it passes through the precipitator. Each unit has three absorption vessels (two operating and one spare) that use a mixture of limestone and water. The sulfur dioxide reacts with the limestone mixture to produce calcium sulfate or gypsum.

From the scrubber, the exhaust gas exits through a 640-foot-tall single concrete stack or chimney. The inside portion of the chimney houses two independent brick liners, one for each unit, and contains more than one million bricks.

Two of the largest structures at Power Park are the



*Scrubbers remove sulfur from the boiler exhaust gas.*



*This 640-foot-tall concrete stack contains two separate chimneys - one for each unit.*

reinforced concrete natural draft cooling towers. Each tower is 460 feet tall and 370 feet across at its base. They are designed to cool the main condensers of both Power Park units and use water taken from the Northside Generating Station discharge channel. This water initially comes from the St. Johns River and is used to make up for water lost through evaporation. It is pumped through the Power Park condenser to a distribution system inside the cooling tower, and flows over a structure resembling a radiator core. The design of the

cooling tower creates a natural air draft which rises through the tower and cools the warmer water as it falls downward, where it is returned to the condenser to complete the cycle. At full capacity, each tower can cool approximately 250,000 gallons of water per minute.

Wastewater generated at Power Park is collected at several collection ponds and treated in a central wastewater treatment facility. Each collection pond is lined with a high density polyethylene material for groundwater protection. This facility is designed to treat up to 3,500 gallons of wastewater per minute, an amount equal to the wastewater treatment required for a city



*Steam rises from the Unit 1 and Unit 2 cooling towers.*



*The wastewater collection pond is lined with thick plastic for groundwater protection. The enclosed coal conveyor system appears in the background.*

of 50,000 people. In addition, Power Park has its own sanitary wastewater treatment plant that can treat 30,000 gallons per day, and three on-site production wells which supply water for personnel needs, fire protection and overall plant operations.

Major plant byproducts like bottom ash, fly ash and synthetic gypsum are collected and processed for sale through Power Park's Byproduct Marketing Program or for on-site disposal at Power Park's 531-acre landfill. Bottom ash, a byproduct of burning coal, is collected from the bottom of the boilers. It is marketed for the manufacture of cement, concrete blocks, synthetic aggregate for road construction and as a synthetic soil amendment. Fly ash is collected from the electrostatic precipitators and is used by the cement and concrete industries as a bonding agent. Synthetic gypsum, which is a byproduct of the scrubbers, is sold for both



*Aerial view of wastewater treatment facility.*

the manufacture of wallboard and as a secondary fertilizer for peanut and potato crops.

Power Park's Byproduct Marketing Program helps conserve landfill



*Solid waste handling area.*

space while reducing landfill costs. As a result, Power Park's landfill life of 40 years can be extended.

The construction and operation of Power Park have and will continue to benefit the

Jacksonville economy. Power Park currently represents the largest single construction project in Jacksonville history. In early 1986, when construction was at its peak, more than 2,200 workers were on site. From the time ground was broken in December 1982 and throughout Power Park's construction period of almost six years, the total payroll was nearly \$370 million. Power Park now provides 400 Jacksonville jobs with an annual payroll of approximately \$20 million. In addition, FPL has become one of Jacksonville's largest corporate citizens, contributing several million dollars annually in property taxes to the City of Jacksonville.

Since 1991, Power Park has operated the E. Dale Joyner Nature Preserve at Pelotes Island, a 350-acre tract of maritime hammock islands located northeast of the plant. More than 6,000 visitors per year, mostly schoolchildren studying Florida plants and wildlife, the Timucuan Indians and solar energy, utilize the preserve's free environmental education programs.

We hope that your tour of Power Park has been both informative and enjoyable, and that you will visit us again soon.



## General Plant Facts

### Site Size -

Approximately 1,900 acres

### Unit 1 -

Commercial operation  
March 27, 1987

### Unit 2 -

Commercial operation  
May 27, 1988

### Unit Rating -

640 net megawatts per unit

### Earthwork -

Approximately 7 million cubic yards of dirt have been moved (excavated, backfilled and trenched) through plant completion. This would fill enough dump trucks to reach bumper to bumper from Jacksonville to Seattle, Washington.

### Electrical Cable -

Twelve million feet or 2,270 miles of power and control cable. This is equal to the distance from Jacksonville to New York City and back.

### Piping -

70,000 feet underground, or 13 miles long.  
320,000 feet above ground, or 61 miles long.

### Plant Components

#### Turbine Generator

Steam spins the turbine, which turns the generator, which produces electricity.

Operating pressure - 2,400 PSIG at the turbine high pressure inlet.

Total length - 152 feet

Weight of turbine - 1,170 tons

Weight of generator - 390 tons

Cost - \$40 million per unit.

#### Boiler

The boiler is a series of 190-foot-long water tubes suspended from four steel beams. Each beam weighs approximately 110 tons.

If these tubes were placed end-to-end, they would stretch 31 miles, the approximate distance from Jacksonville to St. Augustine.

Operating steam temperature - 1,005 degrees Fahrenheit

Dimensions of the furnace - 62'W x 68'D x 195'H

Dimensions of the steam drum - 6.5' Dia. x 100' Long

Total weight of boiler structure - 5,900 tons

Seven pulverizers grind coal to the consistency of talcum powder.

Cost - \$80 million per unit.

## General Plant Facts

### Electrostatic Precipitator

Removes solid particles from the boiler exhaust gas (smoke).

Total weight of structure and equipment - 2,000 tons.

Total number of collector plates - 3,140 per unit

Voltage on the electrically charged duartodes - 85,000 volts DC

Efficiency - 99.78 percent removal of the airborne particles

Cost - \$37 million per unit.

### Flue Gas Desulfurization (FGD)

Removes sulfur from the boiler exhaust gas, after it has passed through the precipitator, with three absorber vessels using a limestone slurry.

Efficiency - 90 percent removal of sulfur dioxide.

Residue from the FGD system may be used to produce wall-board gypsum.

Cost - \$95 million per unit

### Cooling Towers

Cools circulating water from the plant by 25 degrees Fahrenheit, at a rate of almost 250,000 gallons per minute (GPM) by natural draft.

Total height - 460 feet

Basin diameter - 370 feet  
Shell/Veil (concrete hyperbolic paraboloid) wall thickness ranges from 9 inches to 3 feet.

Cost - \$15 million per unit.

### Stack (Chimney)

Total height - 640 feet

Concrete base - 10 feet thick

Diameter of concrete shell - 78 feet

Number of bricks in brick lining - 650,000 per flue or 1.3 million bricks total

### Coal Handling System

Total length of all conveyors on site - 7,600 feet

Volume of coal unloaded per hour is approximately 3,000 tons or 33 rail cars.

Volume of coal burned - Up to 6,000 tons/unit/day.

Maximum volume of on-site storage -1 million tons or a 90-day stockpile

Length of stacker/reclaimer arm - 50 feet to center of wheel

### Wastewater Treatment

Processed in a special facility which treats 3,500 gallons per minute (equal to that of a city of 50,000 people).

### Unit 2 General Data

Duplicate of Unit 1.

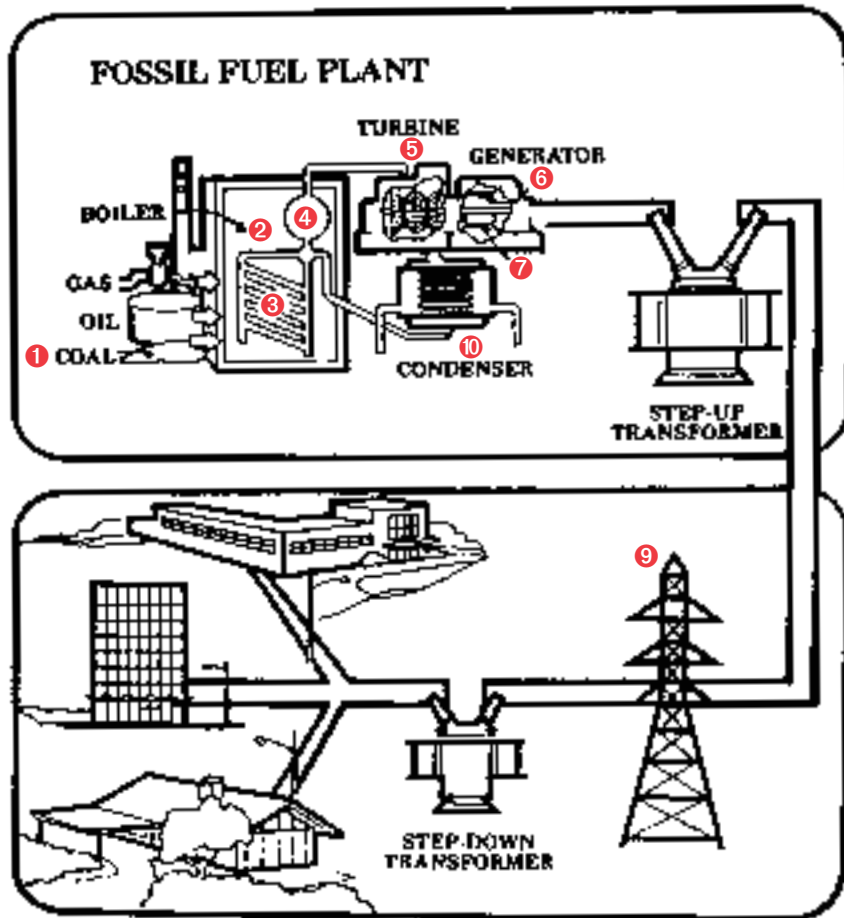
## Here's How Electricity Is Made

① Coal is burned in a large ② **BOILER**, and the walls of the boiler are made up of tubes which carry purified ③ **WATER**. The burned coal gives up its chemical heat energy to the tube metal of the boiler. The heat travels by conduction through the walls and is absorbed by the water. The water temperature increases until it is finally transformed into ④ **STEAM**. The steam, now under considerable pressure and at a very high temperature, is piped to a ⑤ **TURBINE** where mechanical energy is produced. The steam strikes the blades of the turbine and spins them, revolving the turbine shaft. The spinning shaft is connected to the ⑥ **ROTOR**, a large electromagnet. A wire coil called the ⑦ **STATOR** surrounds the rotor. As the rotor revolves within the stator, a flow of electrons, or ⑧ **ELECTRICITY**, is produced. The electricity is then collected at a predetermined voltage and frequency and distributed to you via an elaborate ⑨ **TRANSMISSION AND DISTRIBUTION SYSTEM**.

After the steam passes through the turbine, it is led into a steam ⑩ **CONDENSER**. The hot steam is condensed back into water and returned to the boiler to begin the cycle again.



# Generation of Electricity



## GLOSSARY

**Ampere** - The unit of measurement of electric current. It is proportional to the quantity of electrons flowing through a conductor past a given point in one second and is similar to cubic feet of water flowing per second.

**British Thermal Unit (Btu)** - The amount of energy needed to raise the temperature of one pound of water by one degree Fahrenheit.

**Cooling Tower** - A device used to cool power plant condenser water instead of returning it to a lake, river or ocean. The cooling tower is used to prevent thermal pollution.

**Electricity** - Energy derived from electrons in motion.

**Electrostatic Precipitator** - One of several air pollution devices used in plants that burn coal. An electrostatic precipitator gives dust and ash particles an electrical charge that allows them to be drawn out of the gas stream as if by a magnet, rather than be discharged.

**Electron** - An elementary particle with a negative charge, which circles the nucleus of an atom.

**Fossil Fuels** - Fuels derived from the fossil remains of plants and animals which lived in ages past; includes petroleum, natural gas, coal, oil shale and tar sands.

**Generator** - A machine for changing mechanical energy into electrical energy.

**Kilowatt (kW)** - One thousand watts. A unit used to measure the production capacity or capability of electric generators and also the power requirement of electrical appliances and equipment. One kilowatt is the equivalent of about 1 1/3 horsepower.

**Kilowatt hour (kWh)** - One thousand watt-hours. A unit of electrical energy equal to the energy delivered by the flow of one kilowatt of electrical power for one hour. (A 100-watt bulb burning for 10 hours will use one kilowatt hour of energy).

**Megawatt (MW)** - One million watts, or one thousand kilowatts.

**Ohm** - The unit of measurement of electrical resistance. It is that resistance through which a difference of potential - or electromotive force - of one volt will produce a current of one ampere.

**Potential Energy** - Energy that is stored in matter because of its position or because of the arrangement of its parts. Examples include the tension of a spring, water stored behind a dam, or chemical energy such as that contained in fuel.

**Power** - the rate that energy is used or generated. Power is commonly measured in units such as horsepower or kilowatts.

**Scrubber** - A scrubber is a cleansing device that chemically removes sulfur from gases that are produced in the coal-burning process.

**System Interconnection** - A connection between two electric companies that permits the transfer of electricity in either direction.

**Sulfur Dioxide** - A heavy, pungent, colorless gas formed primarily by the combustion of fossil fuels.

**Transmission** - That process of transporting bulk electricity

at a very high voltage.

**Turbine** - A rotary engine which is driven by the pressure of water, air or steam against the curved vanes of a wheel to transform heat, chemical energy or water pressure into mechanical energy.

**Volt** - The unit of electromotive force or electric pressure analogous to water pressure in pounds per square inch.

**Watt** - Measures the amount of electricity used in electric equipment. It is similar to horsepower or foot-pounds per minute or mechanical power. One horsepower is equivalent to approximately 746 watts.

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ST. JOHNS RIVER POWER PARK**

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