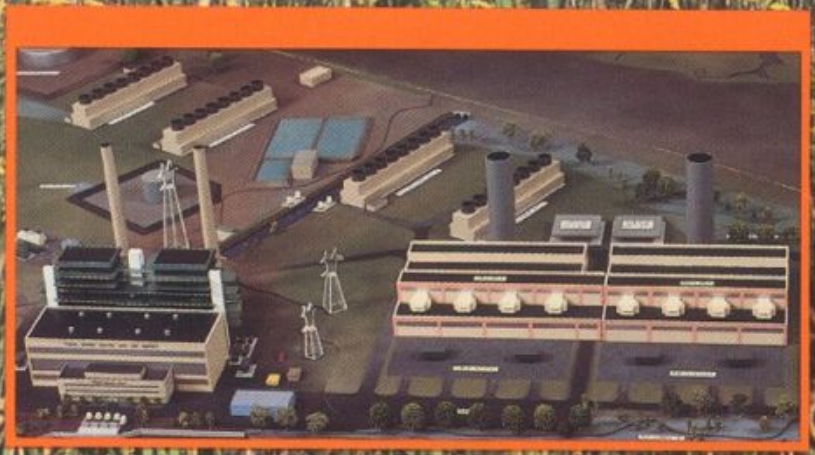
Bergen Generating Station Repowering Project

Meeting New Jersey's need for clean, efficient, low-cost energy into the 21st century.



The power is in your hands.

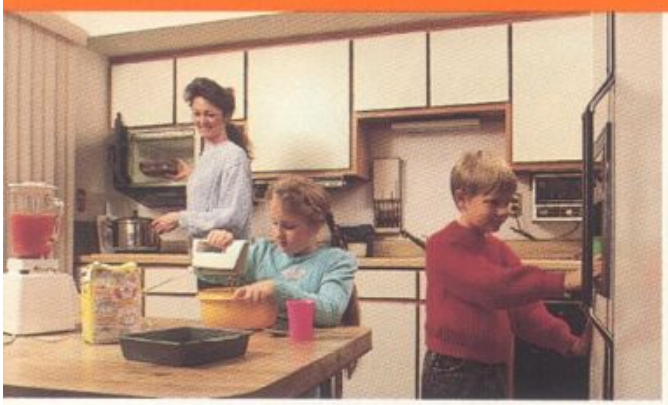
PSE&G

The Bergen Repowering Project...

By reducing NOx emisisons by 90 percent and **SO_2** emissions by 85 percent at the Bergen Generating Station, PSE&G is helping to improve our environment.

Repowering the Bergen Generating Station will not only improve efficiency and increase power output, but will also create additional jobs during the reconstruction stage. This is part of PSE&G's commitment to New Jersey's economic growth.

The repowered Bergen Generating Station will use special clean-burning combustion turbines that reduce smog and ozone-producing NOx emissions at their **source.**



Increasing the efficiency of older power plants like the Bergen Generating Station ensures clean, affordable power to meet your growing energy needs—today and tomorrow.

...a sound energy solution for a cleaner, brighter future.

All outdoor photographs were taken in the vicinity of the Bergen Generating Station

The Bergen Repowering Project/SITE PLAN

Planned improvements to the existing Bergen Generating Station.

Exhaust Stacks will be removed and replaced by new stacks almost 100 feet shorter, lowering the profile of the station and reducing its visibility to the surrounding community.

The old gas/oil-fired boiler will be removed and a modern attractive building of less than half the height will be constructed to house the new high efficiency combustion turbines and heat recovery steam generators.

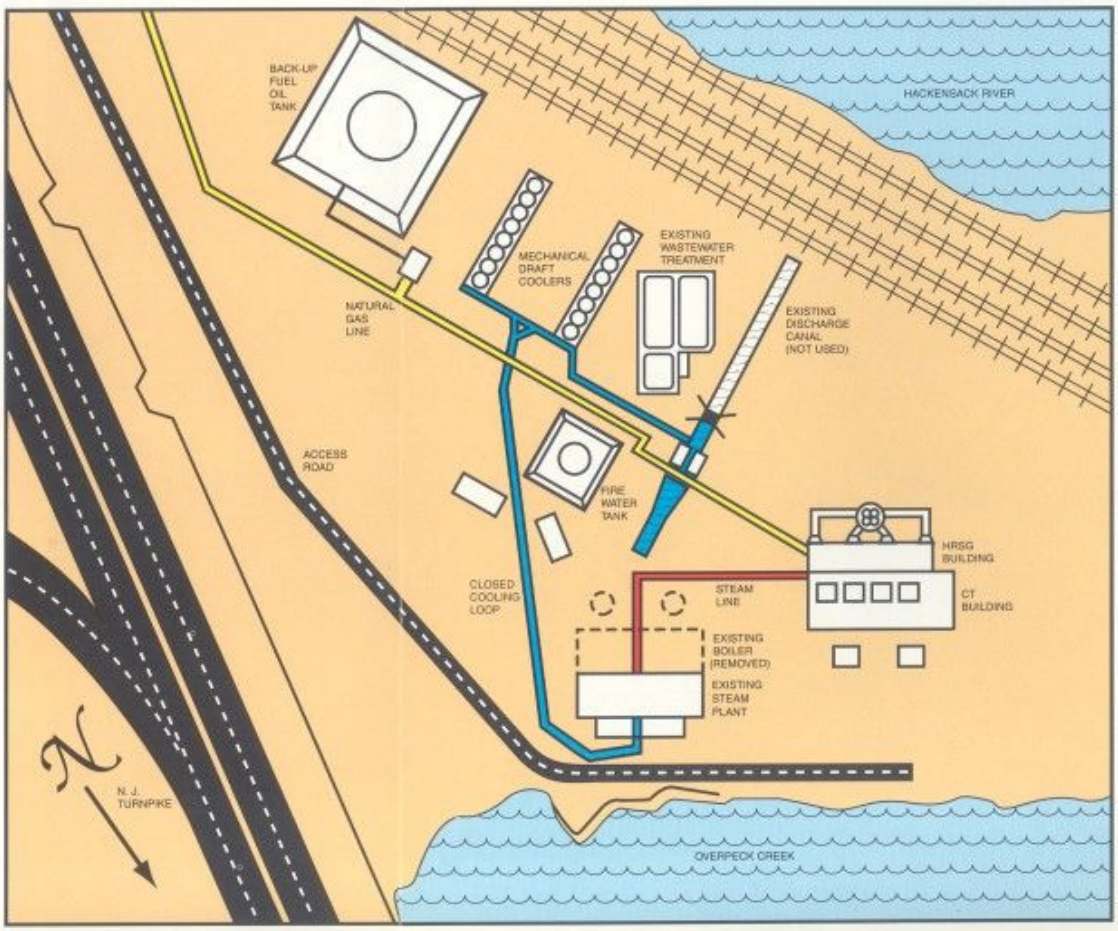
The large oil tank will be removed and replaced with one less than half the size.

Low-sulfur oil will be used as a back-up fuel only.

Thermal discharge of 400,000 gallons of heated water per minute to the Overpeck Creek will be eliminated when the existing once-through cooling system is replaced by a closed-loop system in which cooling water is **recirculated internally.**

The existing transmission lines, roads, gas supply, and most of the existing infrastructure will be retained. This lowers capital expenditures while minimizing the impact of the project on the local community.

Emissions of NOx, SO_2 and other pollutants will be dramatically reduced to make energy production cleaner and safer.



Here's how PSE&G is working to give a cleaner tomorrow today.

For decades, PSE&G has been providing reliable, high-quality, least-cost electric and gas service to meet the demands of our customers.

Today the demand for energy continues to grow. And one of the ways we're meeting that demand is by upgrading our existing Bergen Generating Station to increase its efficiency and capacity — in a manner that is both economically and environmentally beneficial.

A look at the Bergen Repowering Project

The existing operation...

The Bergen Generating Station is located on a 110-acre site in Ridgefield near Overpeck Creek, the Meadowlands, the New Jersey Turnpike, and the Hackensack River. It was built in the late 50's and currently employs more than 130 people. Two steam electric generating units burn natural gas or heavy fuel oil in conventional boilers to generate 570 MW of electric power. The plant takes in cooling water from Overpeck Creek and discharges into the Hackesnack River.

Phase I of the repowering project...

PSE&G is investing $400 million to upgrade the Bergen Generating Station using a *combined cycle technology* in which two power-generating cycles are combined in a single operation.

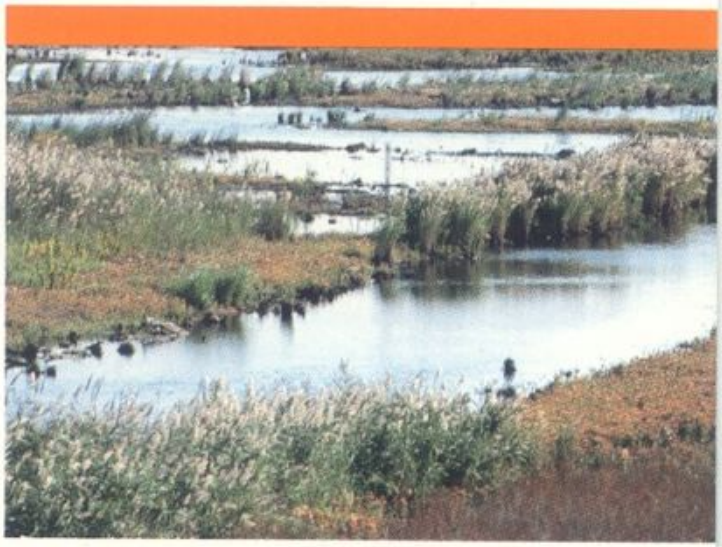
In phase I, we will install four high-efficiency, low-emission Siemens industrial combustion turbines.

Waste heat from the combustion turbines will be "captured" to produce steam driving existing Steam Turbine No.1. Capturing waste heat eliminates the need to fire the existing boilers, which will be removed.

This Phase I effort will be completed by the summer of 1995 and will result in a total plant output of 650 MW.

Phase II of the project...

The second phase of the Bergen repowering project, presently targeted for the late 1990's, involves installation of a duplicate set of four combustion turbines. In this additional combined cycle configuration, waste heat from these units will drive existing Steam Turbine Generator No. 2, adding an additional 650MW for a total plant output of 1,300MW from our existing site.



Industrial combustion turbines generate electricity efficiently and cleanly.

In the upgraded Bergen Generating Station, the Siemens V84.2 dry low NOx combustion turbine will be used as the primary source of power in the combined cycle system.

In each phase four combustion turbines will generate 425MW of power by driving electrical generators. The existing steam turbines will generate an additional 225MW.

Importantly, the Siemens unit has lead the combustion turbine market in dry low NOx technology which eliminates harmful NOx emissions at their source.

By mixing fuel and air at precise ratios and burning them uniformly at the optimum temperature without water injection, the V84.2 combustion turbines produce extremely low emissions, *eliminating the need to remove NOx* from the exhaust with "back-end technology" such as an ammonia-based selective catalytic reduction system.

That's good news for local residents and PSE&G customers. Water-injection and catalytic NOx control systems are very costly to operate.

The combined cycle combustion turbines provide safe, efficient power generation with built-in pollution control.

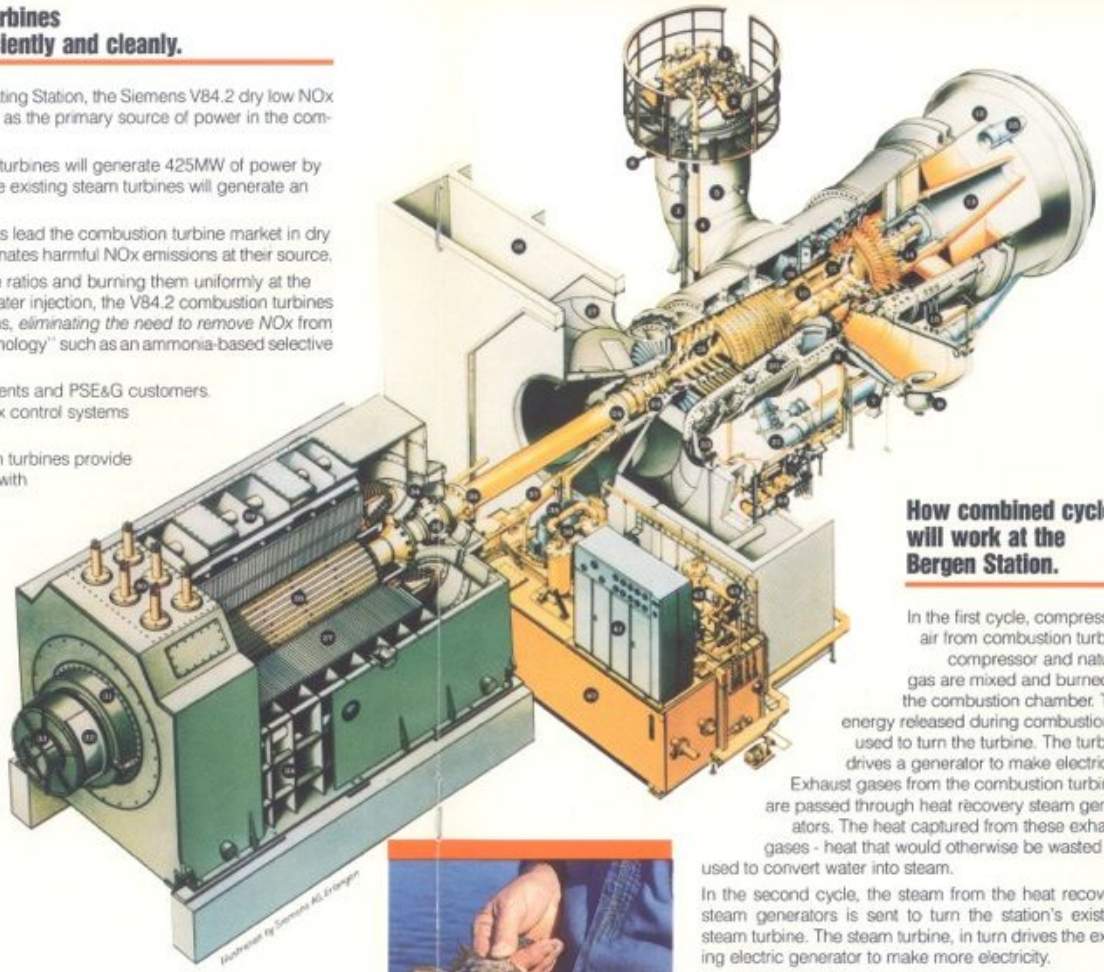


Illustration by Siemens AG, Erlangen

KEY

1 Six dual-fuel hybrid burners
2 Motor-driven liquid-fuel shut-off valve
3 Liquid-fuel supply and return pipes
4 Gaseous-fuel supply pipe
5 Silo-type combustion chamber
6 Flame monitor
7 Combustion-chamber maintenance support
8 Combustion-chamber bolted flange
9 Access manhole to combustion chamber and turbine admission
10 Rotor central through bolt
11 Turbine bladed discs
12 Turbine exhaust diffuser
13 Exhaust diffuser cone
14 Rear journal bearing
15 Rear support bar-struts
16 Air intake
17 Intake bell-mouth
18 Compressor bladed discs
19 Compressor discharge diffuser
20 Two-shell outer casing (strong/back)
21 Compressor bleed-air pipe (5th stage extraction)
22 Combined thrust and journal bearing
23 Front support bracket
24 Oil-hydraulic shaft-turning device
25 Outlet of compressor bleed-air pipe (10th-stage extraction)
26 Generator rotor with direct air-cooled two-pole field winding
27 Laminated stator core with indirect air-cooled armature winding
28 Stiffeners and cooling-air flow baffles (behind sheet metal)
29 Cooling-air outlets
30 Access and neutral electrical terminals
31 Exciter-end shield/journal bearing casing
32 Access window to excitation-current brushes and slip-rings
33 Casing enclosing overpassed hot gaseous
34 Axial-cooling-air blower intake
35 Turbine-end shield/journal bearing
36 Turbine/generator shaft-coupling
37 Lubrication-oil return pipe
38 Two-full-duty motor-driven oil pumps
39 Two-full-duty oil filters with change-over valve
40 Oil tank
41 Instrument cabinet
42 Gaseous-fuel filter
43 Variable-orifice liquid-fuel return pipe
44 Compressor bleed-air valve controls

How combined cycle will work at the Bergen Station.

In the first cycle, compressed air from combustion turbine compressor and natural gas are mixed and burned in the combustion chamber. The energy released during combustion is used to turn the turbine. The turbine drives a generator to make electricity. Exhaust gases from the combustion turbines are passed through heat recovery steam generators. The heat captured from these exhaust gases - heat that would otherwise be wasted - is used to convert water into steam.

In the second cycle, the steam from the heat recovery steam generators is sent to turn the station's existing steam turbine. The steam turbine, in turn drives the existing electric generator to make more electricity.

The spent steam from the turbines enters the existing condenser converting it back to water. This water is returned to the heat recovery steam generator completing the cycle.

The Bergen Station's closed-loop cooling system

The repowered Bergen Station will also feature a closed-loop cooling system that recycles cooling water continually rather than taking it out of - and putting it back into - the local waterways.

Circulating or cooling water from the closed-loop cooling system is used to condense the spent steam that exits the steam turbine. In this process, the cooling water's temperature rises, so it must be cooled before it can be recycled.

The cooling water is pumped from the condenser to "mechanical draft" coolers where it is cooled. The cool water then returns to the condenser closing the loop.

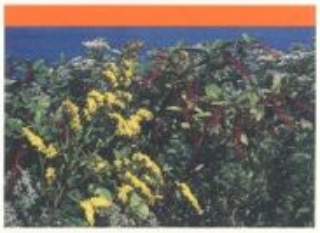
PSE&G is using "wet/dry" mechanical draft coolers which are specifically designed to minimize the amount of visible moisture coming out of the top of the coolers.

In the dry section of the wet/dry cooler, the heated water is pumped to the top of the cooler and through a set of tubes. Air is blown across the tubes. This "mechanical draft" (draft produced by a fan) partially cools the water.

The water then enters the wet section, where it cascades over a series of surfaces as it falls into a catch basin at the bottom. Evaporation in this section further cools the water so it can be reused.

The very moist air from the wet section is mixed and heated with the air from the dry section.

The wet/dry cooler will help eliminate any chance of fogging the turnpike and will significantly reduce the visibility of the moist air from the cooler.



Operational Benefits

Plant efficiency is increased by 50%

Overall efficiency of the Bergen Generating Station will be increased by 50%. This means it can generate 50 percent more power while burning the same amount of fuel.

The Bergen Generating Station will be better utilized.

Because energy production at the repowered Bergen Station will be cleaner and more efficient, we'll be able to run it more, almost twice as much.

Increased usage of the new and improved Bergen Station will enable PSE&G to cut back on operation of some of our older, less efficient plants...further improving the environment and cutting energy costs.

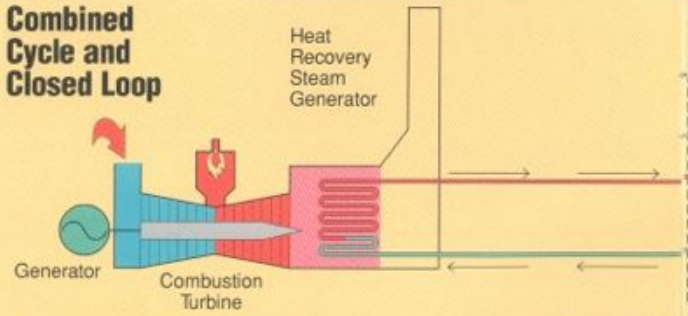
Using the existing infrastructure extends the life of the Bergen station while reducing capital expenditures.

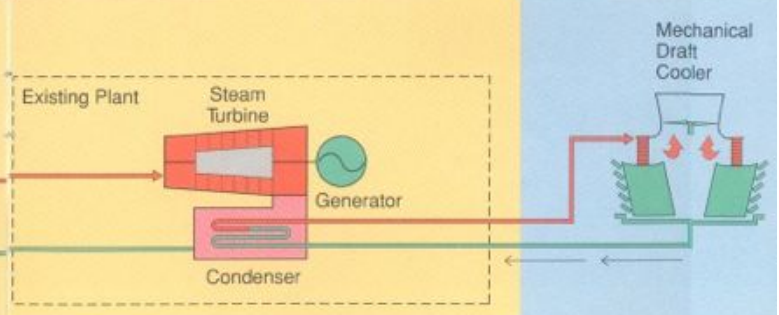
By using the in-place transmission lines, water treatment plant, transformers, roads, steam turbine generators, and infrastructure on a site already approved for utility operation, we are significantly reducing capital expenditures vs. building a new power plant from scratch.

The new and improved Bergen Generating Station will be more attractive to the local community.

The large, unattractive boilers will be replaced with a more modern, more eye-pleasing structure half the height. The new building, which will house the combustion turbines and the heat recovery steam generator, is designed to keep noise levels to a minimum.

New stacks for the repowered Bergen Station will be approximately 213-feet tall, almost 100 feet lower than the existing exhaust stacks.





Environmental Benefits

The revamped Bergen Station will eliminate more than 10,000 tons per year of nitrogen oxides from the air.

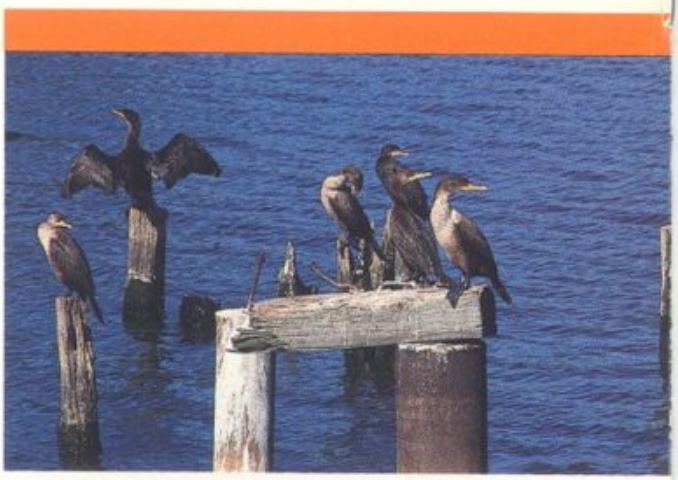
Use of dry low NOx emission combustion turbines will dramatically lower the levels of nitrogen oxide emissions, decreasing the amount of NOx released to the atmosphere by more than 10,000 tons per year - an effective reduction of over 90 percent.

Other emissions will be reduced to low levels.

The use of natural gas and lower-sulfur oil instead of no. 6 oil, combined with the clean-burning combustion turbines, will also help reduce emission rates of sulfur dioxide, and other pollutants substantially.

Thermal discharge to the surrounding waterways is virtually eliminated.

The Bergen Station currently draws 400,000 gallons of water per minute from Overpeck Creek. The water is warmed in the plant, then released into the Hackensack River.



With the installation of the new closed-loop system which recycles cooling water, the local ecosystem will be protected, virtually eliminating thermal discharges to the river. In addition, PSE&G plans to replace water lost through evaporation from the system with make-up water from the nearby Bergen County Utilities Authority's treatment plant. This will eliminate any need to draw cooling water from Overpeck Creek.

Major Suppliers For The Project

Architect/Engineer	Fluor Daniel
Combustion Turbine	Siemens V84.2
HRSG	ABB/CE
Mechanical Draft Coolers	Hamon

The power is in your hands.

PSE&G

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