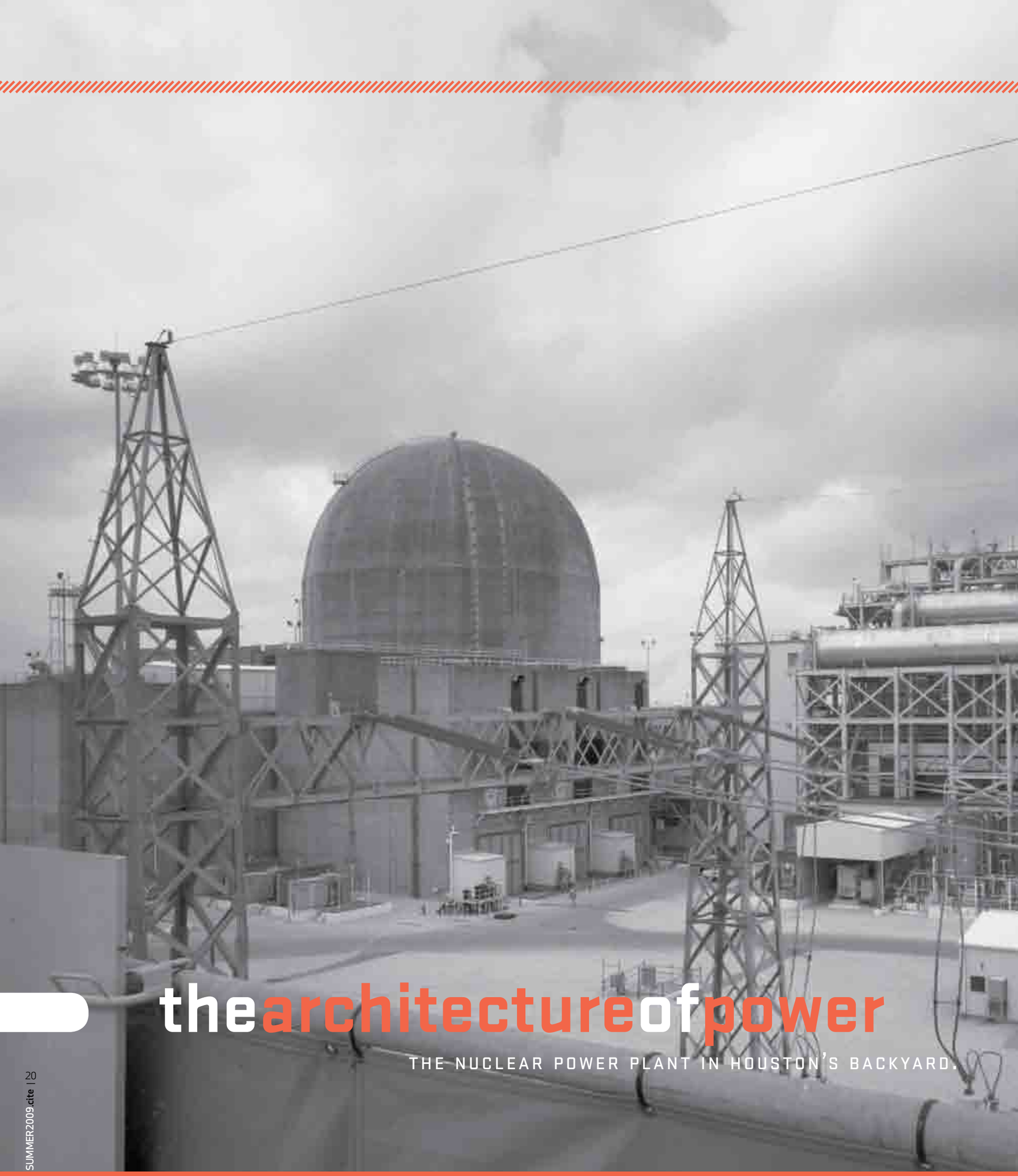


the architecture of power

THE NUCLEAR POWER PLANT IN HOUSTON'S BACKYARD.

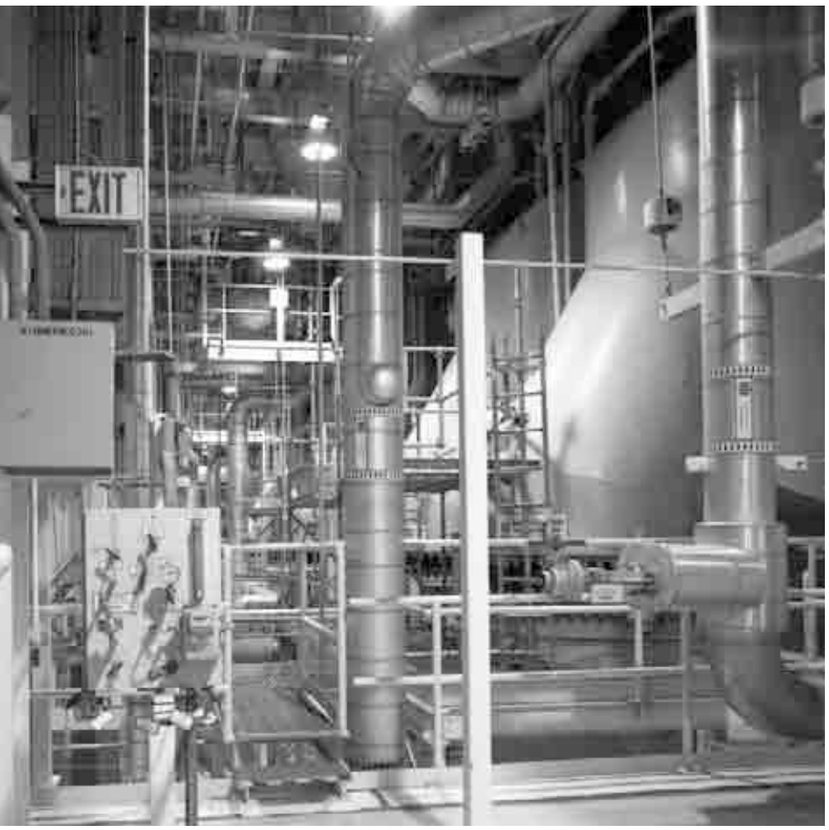
View of Unit 2 from roof of Unit 1.

by Thomas Colbert

Photography Shannon Stoney

WHEN you turn on an overhead light in the living room or a toaster in the kitchen, you probably don't think about where the electricity comes from. Few people do. But behind that flip of a switch lies a vast industry and one of the most impressive infrastructure systems in the world. Yet the artifacts of this system are almost invisible. Electric wiring is buried inside the walls of buildings. The spiderweb of overhead distribution lines connecting buildings to local substations is hidden in alleys and screened behind trees.

The substations themselves, where transmission lines connect to the much larger and much higher-voltage distribution lines, are simply overlooked, as are the towering high-voltage transmission lines. The power plants that dot the countryside around our cities are perhaps the most expensive buildings ever built, but passing motorists seldom notice them on the skyline, framed in the windshield, as the car speeds down the highway.



TOP: **Machinery and guardhouse on the roof of Unit 1, Turbine Building.**
ABOVE: **Inside the Turbine Building.**

THE GRID Electric power plants are huge and foreboding places. Seen in the distance, they sometimes resemble the medieval fortifications of Europe, like Mont Saint Michel perhaps, or ships on the horizon (but on a much larger scale). They billow plumes of smoke and steam, and cast arrays of wires in all directions, wires that step down in voltage and in height as they make their way to the electric meters on our homes. These wires and the armada of electric generating plants that feed them are known as "the grid."

The grid is enormous. It covers North America, linking thousands of power generation plants, bringing electricity to every home, office, factory, and streetlight. It begins at the power plant and ends at the electric meter. Generation plants today are located in remote areas for the most part, well away from population centers and freeways. But in the past, electric generation plants were proudly displayed in our cities. Like the great train stations of the nineteenth century, they were faced in brick and stone, and given architectural facades. The Battersea Power Station in London is the most famous example of such a building. In Houston, the ruins of such places still exist. The McKee Street Power Plant near downtown is one example. Power plants in rural areas also used to be points of civic and even national pride. After the engineering was complete, even the Hoover Dam received an Art Deco appliqué from Gordon B. Kaufmann, so that its style would be fitting for such an important public building and tourist destination. Things are different today. The architecture of power plants now assumes an unremittingly pragmatic, industrial style.

Most electric plants in Texas are powered by coal and natural gas. Only two are powered by nuclear energy. No matter what the fuel source, all electric plants are much the same, except in the way they create the steam that turns their turbines. The most remote and mysterious of the power plants that surround Houston is the South Texas Project. Located a little over 90 miles southwest of Houston near Matagorda Bay, the South Texas Project is a nuclear power plant. Driving there, one passes fields of oil drilling pipe and oversized outsider-art sculptures of cowboys, rockets, and airplanes. These are followed by scattered suburban neighborhoods, many built within the past decade and some still under construction. Once you turn off of State Highway 288, the landscape quickly becomes more rural. Overgrown pastures alternate with bands of aging farmhouses and trailer home sites with abandoned cars, machinery, and children's plastic pools strewn under groves of trees. This is a region where vultures don't look up from their meal as cars pass by.

A few miles beyond the tiny town of Wadsworth, Texas, the roadway suddenly opens up, briefly revealing the twin domes of the South Texas Project. After that, the plant remains largely hidden until you reach its gate.

THE SITE The entrance to the South Texas Project could be the entrance to almost any corporate office park. Two low, curving masonry walls and an oversized American flag flank the entrance road. They frame a panoramic view of the half mile of flat, treeless lawn that separates the outer security fence of the plant from the more heavily fortified inner perimeter. The only buildings between the two fences are a small training facility near the entrance, a guardhouse where you present your papers, and a nondescript five-floor office building close to the plant itself; this is where the permanent records of plant operations are kept and where the administration of this 12,000-acre, 1,200-employee facility is housed. The guardhouse, however, isn't like the guardhouses at corporate office parks. It is heavily protected by bollards, vehicle barriers, and bulletproof construction. The small window through which papers are passed, like identical openings on the

other four sides of the small building, was designed to also serve as a gun port.

The horizontality of the site is unexpected. The iconic, high-waisted cooling towers normally associated with a nuclear plant weren't used here. Instead, a 7,000-acre cooling reservoir (and alligator habitat) occupies the southern half of the site. Centered on the north shore of this reservoir, the two reactor units and their ancillary buildings are protected within the inner security barrier. Just outside of that security perimeter to the north is the switchyard that connects the South Texas Project site to the rest of the grid. From here, rows of towering transmission lines cut a swath several hundred yards wide through the countryside, eventually forking toward Houston, Austin, and San Antonio. These wires carry such high-voltage electricity (345,000 volts) that you can hear the hissing and crackling sound created by the electrons passing over the insulators from which they are hung hundreds of yards away. Near the switchyard (also just outside of the inner security perimeter) are a large pump house and a heavily engineered pond with specially treated water ready to instantly flood the containment building in the event of an accident.

The inner security perimeter is composed of two razor wire-topped chain link fences with a broad bed of coarse gray gravel between them. Dozens upon dozens of motion detectors, television cameras, and darkened glass guardhouses monitor every inch of this no-man's-land and the space on either side of it.

To enter the high security zone where the nuclear reactors are, one parks and walks between massive concrete vehicle barriers, through the chain link fences and their gatehouse, and into the narrow lobby of the big, metal pre-engineered Maintenance Operations Building. This is where identification is rechecked, and metal and explosives detectors are put to use, as are heavily guarded revolving security gates. Going through this gauntlet of security, you can anticipate but are never really prepared for the experience of leaving the building on its other side. Like Alice at the other end of the rabbit hole, everything is suddenly at the wrong scale. Workers in hard hats seem tiny at the foot of the looming concrete mass of the reactor buildings on one side and the equally large but intriguingly tectonic Turbine Building on the other. Taken together, these comprise one of the South Texas Project's two power generation "units." The reactor buildings have no expansion or control joints, no formwork markings, no fenestration, and no visible doors. There is nothing to give them scale. They rise 200 feet into the air and press 50 feet into the ground on top of an 18-foot thick foundation slab. After entering the Turbine Building through an innocuous double door, you suddenly find yourself in a machine world.

TOP: **Machinery on the roof of Unit 1 Turbine Building. Electrical generator on the right. Dome of Containment building beyond.**
ABOVE: **View of cooling reservoir on the left, pipes circulating cold water to the Containment Building Center. Containment Building on the right.**

TURBINE BUILDING The Turbine Building is where steam created in the reactor buildings next door is sent

to turbines that drive a generator to produce electricity. The Turbine Building is an enclosed, three-dimensional labyrinth of wires, pipes, pressure gauges, and structure. Floors and walls throb with the pulse of the steam generators and the mammoth heat exchangers and condensers. Multiple pipes, 12 to 15 feet in diameter, bring cool water from the reservoir to the condensing unit and back. Smaller (but still very large) pipes carry steam to the turbines that share the building's rooftop with the generator. Tens of thousands of circuits of control, power, backup power, and sensor wiring, as well as pipes of every conceivable size, cascade through space with no predictable order and no apparent end. Being here is like being inside a huge beast with no flesh to hide its color-coded veins and nervous system. It is a profoundly noisy beast to be inside. Even muffled by ear protection, the roar can be felt through your bones. This is a place where industrial lighting, gusts of hot air driven by strangely located fans, and the noise of pumps and turbines create an almost overwhelmingly intense sensory experience. It is with relief that you exit onto the roof.

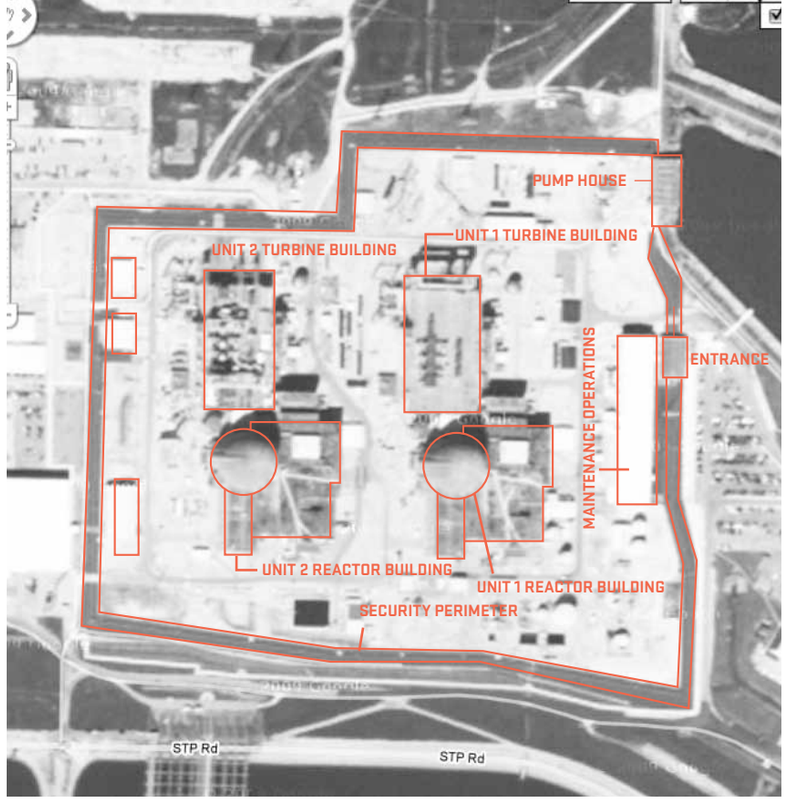
Unless a 20-year extension is granted, the buildings will be demolished and the rubble hauled off to nuclear waste sites.

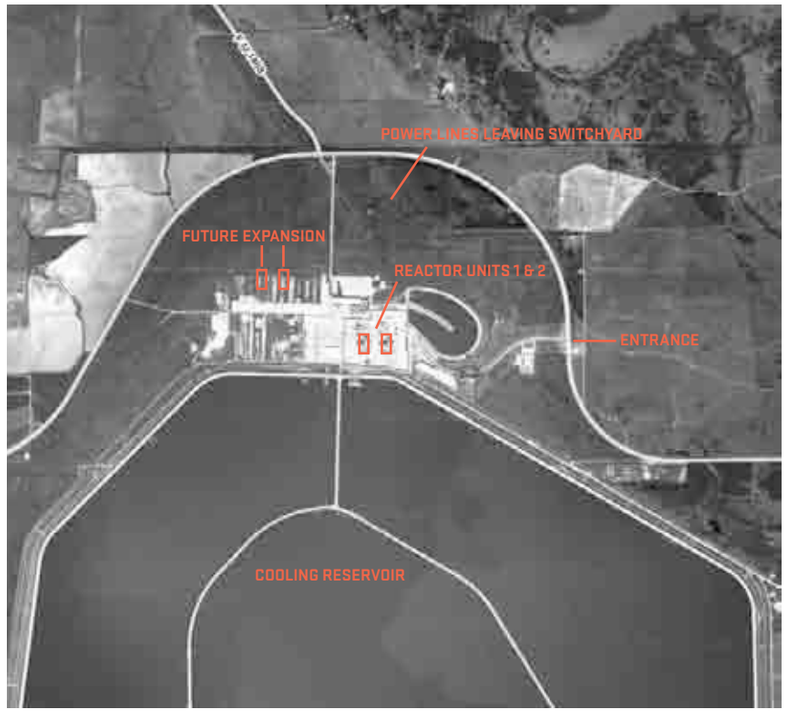
The rooftop is flat and open. The horizon is visible in all directions, except where the domes of the two reactor buildings block it. Near the center of the roof, the bright blue steam turbines and the generator line up along a common axis. These pieces of equipment are surprisingly small. The rotor of the generator, the heart of the entire plant, is only 5.5 feet wide and 48 feet long. Spinning at 1,800 revolutions per minute, it generates enough electricity to power 600,000 homes in the middle of the summer or twice that many in winter. In a coal-fired plant, this would require 20 million tons of coal a year. Electricity leaves the generator at 25,000 volts.

A permanently installed gantry crane dominates the roof. It is there to allow inspectors to open up the turbines and generator every 18 months while the fuel rods are being changed out in the reactor building. The crane and the brightly

Unit 1 Control Room.

RIGHT: Detailed aerial view of the plant.
BELOW: Aerial views of the South Texas Nuclear Plant showing cooling reservoir and surrounding area.





COURTESY GOOGLE EARTH

colored turbines and generator give the building a playful, almost Archigram-like appearance, but without the aesthetic pretension or any sense of showmanship.

REACTOR BUILDINGS The reinforced concrete structure containing the reactor is divided into three separate areas. The Containment, Fuel Storage, and Mechanical Auxiliary buildings, as these sections of the building are called, are separated from one another by extraordinarily thick concrete walls and massive steel doors. You enter via an underground tunnel that passes through the complex's five-foot thick exterior wall. The interior, a rabbit warren of rooms, industrial spaces, and passageways, is strangely quiet in comparison to the Turbine Building. Its muted gray walls and color-coded beige, mint green, and baby blue floors are kept immaculately clean. At the center is the reactor itself. Together with the steam generator, the reactor occupies the dome-topped Containment Building, whose steel-lined, five-foot thick concrete walls separate it from the surrounding wings of the building. This is where the reactor heats water to 600 degrees. That water is then pumped at 2,300 pounds per square inch to the steam generator that makes the 15 million pounds of steam per hour that are needed to drive the turbines next door.

Surrounding and attached to the cylindrical, dome-topped Containment Building are the Mechanical Auxiliary and Fuel Storage buildings. These contain the spent reactor fuel, new fuel assemblies, and areas where workers control and monitor the operation of the plant. The Control Room is also here. Its analog dials and manual switches evoke a 1950s era high-tech style that seems out of place today.

The Fuel Storage Building is contained within concrete walls that vary in thickness from five to seven feet and an equally thick concrete roof slab. Almost 200 feet long and 100 feet wide, the Fuel Storage Building extends 93 feet above and 57 feet below grade. This is where new fuel assemblies arrive and are prepared for insertion into the reactor. It is also where spent fuel is kept in a 40-foot-deep stainless-steel-lined pool. This was supposed to be a temporary storage location, a place to hold nuclear material until the recently cancelled Yucca Mountain Nuclear Waste Repository became operational. Now it has apparently become a permanent storage facility. Overhead in the dimly lit, cavelike room that is the main space of the building, yet another massive crane sits silently awaiting the next fuel service cycle. A smaller crane hovers near the foot of the pool. The water within the pool is perfectly pure and clear. At first it appears to be black. Its mirror-like surface, undisturbed by even the faintest ripple, nearly masks the dark matrix of fuel assemblies far below.

PEOPLE The people who work here include administrators, industrial workers, and guards. Most of these people seem to have worked at the plant for many years. Some have been here since before the plant's opening over 20 years ago. Administrators and workers greet each other in ways that seem overly familiar or cheerful to those accustomed to other workplaces. But the guards pass by in silence, not talking to anyone. Heavily armed, they patrol on foot, wearing body armor and carrying automatic weapons. They wear sunglasses and keep watch in armored guardhouses behind darkened glass and gun ports. They have the bearing of soldiers. Plant workers, on the other hand, are older. Their color-coded uniforms—polo shirts or button-down shirts in blue and maroon, worn with khaki pants—reflect the part of the plant they are assigned to.

CONSTRUCTION Construction began on the South Texas Project

LEFT: **Spent fuel storage pool.**

The brooding heaviness and foreboding quality of electric generation plants come from their scale, from the frightening quality of their product

in 1975. Initially, Brown & Root was the "architect" and the builder. Six years later, when the project was four years behind schedule and far over budget, Bechtel Corporation replaced Brown & Root as architect, and Ebasco Constructors took over construction. The plant eventually came online in 1988, seven years behind schedule and costing almost $6 billion, 400-plus percent over budget. Due to technical problems, both units were shut down in 1993 for over a year. Today the South Texas Plant is over halfway through its 40-year license to operate. When that license runs out, the facility will be decommissioned. Unless a 20-year extension is granted, the buildings will be demolished and the rubble hauled off to nuclear waste sites. Even as the two existing reactors are approaching the end of their life expectancy, two new units are being planned. These advanced boiling water reactors, costing an estimated $10 billion to build, will be slightly more powerful that the existing units. They will share the cooling reservoir, as well as the transmission corridor and transmission towers, with the existing units.

The brooding heaviness and foreboding quality of electric generation plants come from their scale, from the frightening quality of their product—electricity at very high voltages—and from their obscurity. Nuclear plants carry the extra burden of their radioactive fuel, the long-term safety of which remains questionable at best. As a result, the most expensive and extraordinary buildings in history are kept hidden from the public that they serve. This fact calls into question the more romantic images of aesthetic and cultural life usually associated with architecture, reminding us of the many invisible worlds that our society builds and is dependent on. The electrical grid that powers our cities is only one of these worlds.