HEIGH-HO! COME TO THE FAIR

BY JIM SALMONS AND DAVE FITZGERALD

It's hot as blazes and a bit humid, as Tennessee is wont to be. Sunburnt skin finds momentary relief beneath occasional maples, and a breeze from the sparkling lagoon wafts welcome relief to long queues of people.

No one leaves the lines, despite the sun. No one even looks worn. To these visitors to the 1982 World's Fair in Knoxville, Tennessee, standing in line is worthwhile: they're waiting for a peek at the future.

That's what world's fairs are all about: countries and companies convening to show off what they can do and what they can almost do, what's just around the corner for all of us. They speak to the future and they celebrate the past, reveling in the can-do attitude that has brought humankind from leaf-nibbling foragers to Tang-sucking space walkers in the blink of a cosmic eye.

Today, we measure our growth by our technological advancement; it is the measure of our copability in all areas of life but the arts. Just as we stand our children tall against the edge of a closet door to mark the march toward adulthood, we stack up our technology at a world's fair to benchmark just how far we've come since the one before.

This time, between the last world's fair in 1975 and this one, our technology in electronics and information advanced so fast that one entire genre missed its opportunity to stand in the sun. In 1975, there were no Apples. In 1982, they are so common, so accepted, that in their world's fair debut they aren't seen at all. The Knoxville World's Fair's Apples are workhorses, not peacocks.

Dozens of Apples populate the areas backstage, running the exhibits that make this the most uniquely informative exposition since the first, the London World's Fair of 1851. Visitors actually use Apples, interact with Apples, through specially designed keyboards and divers screens; but the fancy keyboards merely transmit their input to the Apples in the wings, and the Apples answer for them—rather like Cyrano beneath the balcony speaking for Christian to Roxanne.

The Apples share a purpose with all the people and products at the fair: to enhance the meaning of the fair's theme, Energy Turns the World.

Tokyo, Rome, Madrid—and Knoxville. Of all the places you might consider for a world's fair, Knoxville seems an unlikely choice. Prior to the fair, its popular claim to fame was as that place through which ten million vacation-goers passed on their way to the Great Smoky Mountains National Park, the most visited park in the nation. Short of throwing tacks on the highway, Knoxville had been unable to lure these mobile Americans within its city limits.

Not as often considered is that Knoxville, with its surroundings, has first dibs on the title of energy capital of the United States. It's the home of the Tennessee Valley Authority, the nation's largest public utility. The University of Tennessee, whose main campus borders the fair site, is an academic leader in advanced energy research for government and industry. And nearby Oak Ridge harbors the National Atomic Laboratory, the world's leading nuclear research facility.

Which Came First, the Chicken or the Egg? The answer, of course, is: the idea. In Knoxville's case, the idea sprang from the mind of one Jake Butcher.

Knoxville's one hundred eighty thousand residents have seen their share of the inner-city decay that plagues most American cities; unemployment and shifting business populations have hit hard. Jack Butcher thought he saw a way to reverse all that.

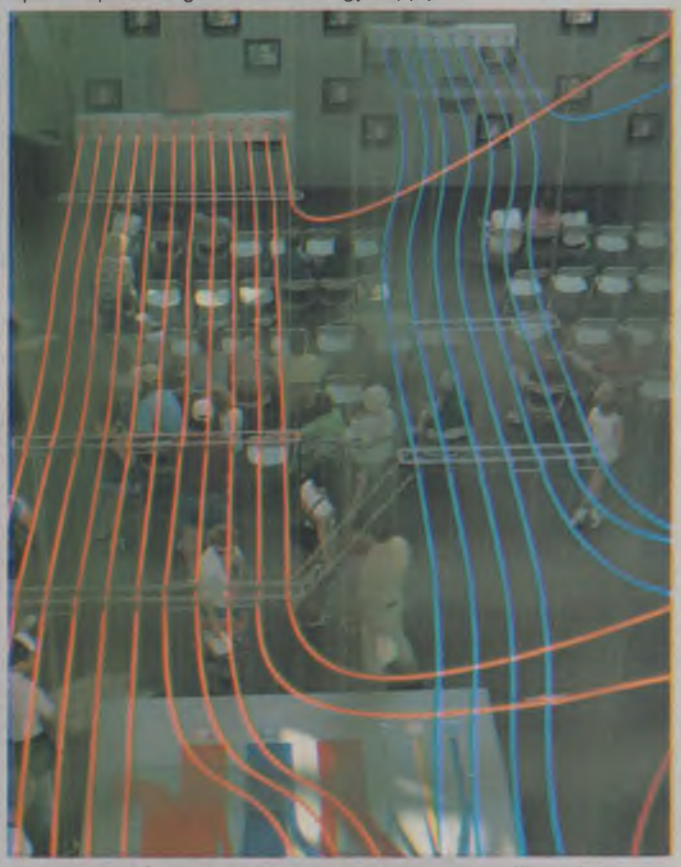
In a scenario that reads like a movie script, this rags-to-riches mogul pulled every conceivable corporate and political string to realize his vision of a world's fair within the shadow of his United America Bank, Knoxville's largest—and one of five that Butcher owns. He and his cohorts believed the fair would provide the impetus and the financial op-

portunity to redevelop Knoxville's ailing central business district in one fell swoop.

Ordinarily, today's world's fairs are financed by local municipal bond issues or other public funds. Not so in Knoxville. With his friends, Jake Butcher negotiated a thirty-million-dollar line of credit from a consortium of forty-three banks. The 1982 World's Fair is the first such exposition funded totally by private-sector investment.

The Way It Was. At first, world's fairs were mammoth spectacles. Designated as universal expositions, fairs were held in internationally significant cities such as London, New York, and Paris. With each participating country funding and constructing its own pavilion, the event attempted to showcase the total spectrum of human accomplishment.

The Sunsphere (far left), theme structure of the fair, dominates the view of the site across the Waters of the World. The U.S. pavilion, The Energy Place (left), is the fair's largest national exhibit and a showcase of Apple-controlled videodisc displays. The Debate Wall (below), twenty video monitors controlled by three Apples, as seen through The Neon Way, a colorful light sculpture representing American energy supply and demand.



As the world became more diverse and complex, and just plain bigger, mounting the world's fair extravaganzas became impossibly costly and unwieldy. The traditional metropolises balked at the prospect of trying to outdo Busby Berkeley but didn't want to undershine the previous host. World's fairs were in danger of extinction.

Yet the benefits of the fairs to the cities that hosted them couldn't be denied. Smaller cities, needing the stimulation of economic activity the fairs inevitably caused, couldn't afford the traditional fairs, but they also didn't feel the need to compete with previous events. They lobbied for smaller, focused world's fairs.

So the Bureau of International Expositions sanctioned a second category of world's fair: the specialized fair, a global event focusing on a particular aspect of human endeavor.

In a unique partnership, local developers front construction funds and lease space to participants who share pavilions. Jobs are created, many of which last after a fair is over, and the new or revitalized buildings are put to use in reenergizing the local economy. Like the extravaganzas of yesterday, a specialized world's fair can turn a city around.

Childhood's End. The Knoxville World's Fair highlights world achievements in energy. Diverse potential solutions to the world's energy problems abound in the pavilions.

Displays stress conservation and efficient use of energy. Demonstrations of fuel-efficient cars, energy-efficient buildings, and labor-saving but low-energy appliances offer glimpses of a more energy-conscious future. And the renovation of a Victorian house on the fair site shows that we can tackle the problem without rebuilding our cities.

More exciting are the displays of new technologies exploring different sources of energy. Windmills and solar collectors abound on the fairgrounds. Seeing one beside the other is like seeing the old world juxtaposed against the new; actually, both are part of the future. Indoor exhibits attest to the monumental effort industry is putting into developing methods of recovering and using uranium, deuterium, coal, and oil shale.

Many exhibits at the World's Fair use Apples, but three of the largest pavilions use them in such quantity and so integrally that they merit closer looks. Follow now as we visit the United States pavilion, the pavilion of the America's Electric Energy Exhibit, and the Tennessee Valley Authority exhibit.

The United States pavilion, The Energy Place, is the centerpiece of the 1982 World's Fair. The six cantilevered stories of the U.S. pavilion extend majestically over an edge of the three-acre Waters of the World, a beautiful reflecting pool created especially for the fair. Open-air balconies overlooking the lake give pavilion visitors a breathtaking view of the Sunsphere, the 266-foot theme structure of the fair. On the opposite side of the building, an IMAX theater presents the film *Energy, Energy* on a screen ninety feet wide and seven stories tall—the largest in the world.

The Energy Place practices what it preaches: energy conservation and innovation. A network of computer-controlled sensors constantly monitors and adjusts the climate within the pavilion. This super-intelligent thermostat will even open the windows if the system determines that outside air is the most effective way to keep the building within environmental standards. State-of-the-art insulation techniques and a 4,100-square-foot solar collector contribute to the building's energy efficiency.

Escalators shuttle crowds to the top of the pavilion. Here, they begin a gradual descent down broad ramps through a series of displays that unfold America's energy past, present, and future. Throughout the descent, visitors are afforded an unobstructed view of the entire pavilion from the railing-lined ramps and broad landings. Even the cavernous open space in the center of the pavilion is filled with energy-related items suspended from the ceiling by wire.

The firm of Ramirez and Woods, eighteen-year veterans of exhibit design, brought together numerous historical artifacts, from Jeffersonian bedwarmers to the first solar-powered airplane, to give concrete examples of the evolution of our diversified uses of energy. Artistic expressions are also included to convey the elusive concepts relating to energy.

The Energy Time Curve presents a three-dimensional view of our increasing demand for energy and our varied sources of it. Beginning with a six foot tall pedestal representing the use of steam and animal power in 1800, a succession of pedestals grows to more than twenty-seven feet, the tallest representing energy demands in 1980. This towering demand is now being met by a variety of sources, including nuclear and solar power. A second artistic exhibit, Energy: The Neon Way, provides a similar dramatic graphic representation of energy supply and demand.

While these historic and artistic displays are informative, they are static. But Ramirez and Woods didn't stop here and have incorporated interactive displays that advance the state of the art in exhibit design.

Grown To Loan. Steve Gregory, cofounder of the New England Technology Group (NETG) and professor of computer graphics at MIT, began consulting with Ramirez and Woods in January 1981. Their collective effort was intended to break new ground in the application of computer and interactive videodisc technology within exhibit design. Buttressed by the loan from Apple Computer of fifty computers, the U.S. pavilion is a resounding statement of the success of the collaboration between NETG and the exhibit design firm.

"When we learned of the Apple computer loan, we were truly excited," Steve Gregory recalls. "Having been in business for a while, we had occasion to work with the Apple for some of our clients. We found it to be a very flexible, capable, and reliable machine."

In fact, the pavilion demonstrates an evolving sophistication in NETG's application of Apple computers within interactive information retrieval and presentation.

The most basic interactive display is a high-tech version of the "push-a-button, get-a-message" exhibit technique. The topic of the exhibit is "embodied energy," the energy it takes to produce a product rather than what it takes to use it.

Backlit photographs of sixteen everyday products invite visitors to examine more closely the embodied energy used to produce each item. By touching the picture of a product, a visitor calls up a brief audio-visual presentation that explains how that item is made and the surprising ways in which energy is essential to the process.

An Apple computer controls access of specific segments of a laser videodisc. By issuing the videodisc a start and stop frame number, the Apple directs the rapid access of stored information much as it would with a standard disk drive. The difference is that the information is interpreted and presented by the videodisc player as an audio-visual message rather than being fed into the computer for traditional number-crunching. While the results are dramatic, the videodisc is actually nothing more than a sophisticated data storage and retrieval peripheral for the computer.

Left: Three of more than thirty Apple computers housed in the glass-walled control room at the U.S. pavilion. Center: Spectators control the flow of discussion by means of touch-sensitive video monitors at the Debate Wall. Right: Jim Ogul, U.S. pavilion site manager, explains the evolution he has seen from early static exhibits to the exciting interaction of microcomputer controls.

A more innovative application of the Apple is the use of touch-sensitive screens. These devices provide the ultimate in user transparency. The user's attention is not divided between viewing and keyboard operation. Instead, with a simple touch of a finger, the viewer controls the presentation much like a wizard would cast a spell with the wave of a hand.

The magical touch screen is a product of Elographics of Oak Ridge, Tennessee. This high-resolution screen, providing a four thousand-by-four thousand point grid, consists of a glass sheet coated with a transparent resistive substrate. The substrate is separated from a plastic cover sheet by tiny plastic beads. This cover sheet is sprayed with a transparent conductive coating of gold.

A Touch of Glass. When the two layers are pressed together by a touch, an electric circuit is completed. A variable resistance calculation generates a unique (X,Y) coordinate. The Apple can as easily interpret this position coordinate as a key-tap signal from a traditional keyboard.

The Energy Glossary stations are a step up the ladder of sophistication in application of the touch screen-computer-videodisc configuration. For those visitors unfamiliar with the new terminology, a number of stations provide access to a Buck Rogers dictionary of five hundred energy terms used in the pavilion's exhibits.

The viewer steps up to a monitor and touches a small horizontal scale at the bottom of the screen to access the dictionary. Where the scale is touched determines the direction and rate of speed at which the terms are scanned in the alphabetical master list. Moving forward through the list, a term materializes in a queue in the background of the screen. As each term's turn to be accessed approaches, it zooms into the foreground. Touching a term as it zooms past retrieves its definition.

Definitions are presented in a variety of formats. The screen may simply fill with a concise definition in easy-to-read text, highlighted words indicating which words within the definition may be touched to access additional terms in a nested search. In other cases, a computer-generated graphic or still frame from a videodisc may be superimposed with text enhancement. More than one hundred different terms access short, explanatory video segments. In all cases, an Apple II Plus is controlling the system.

The Energy Data Center allows visitors to consolidate and investigate their special interests in energy. Six personal-sized monitors with touch-screen controls allow individuals to interact with the system. Six seventy-two inch projection television sets act as slave monitors for each of the stations, allowing easy observation by nearby visitors.

Unlike the glossary exhibit, the Energy Data Center deals almost exclusively in dynamic video and computer-generated graphic images. Rather than simply searching from a master list, the Energy Data stations utilize sophisticated branching within an ongoing retrieval of information.

For example, a monitor might show a speeding train rolling out of West Virginia. When a viewer touches a coal-laden car, the image freezes while computer-generated graphic information is superimposed. A band of images indicating related coal topics lets the viewer's fingers do the walking through a vast storehouse of information related to coal.

As sophisticated as these various Apple-controlled exhibits are, NETG's crowning achievement at the U.S. pavilion is the Debate Wall. This exhibit demonstrates a mixture of old and new information presentation techniques. In presenting a diverse set of taped expert opinions on various energy-related issues, the exhibit uses multi-image audio-visual display. The new technological twist that has been added is audience control of when or even if a speaker's opinion will be heard.

Meeting of the Micro Minds. A wall covered with twenty video monitors faces the seated and standing audience. A series of sound effects, short comments, and visual images introduces the Debate Wall. Then one of thirty energy experts makes a leading statement, while his or her image is shown on fifteen of the twenty monitors. The debate has begun.

While this initial comment is playing, the remaining five touch-screen equipped monitors display still images of possible follow-up speakers. Each of the five pictures is superimposed with an invitation to touch the screen to hear the pictured speaker respond. With each new comment, five additional carry-on choices are presented. Remarkably, the Apple-controlled videodiscs have enough opinion segments stored to take the discussion in literally hundreds of directions.

Revealing the challenge involved in execution of this exhibit, Steve Gregory explains, "The most difficult exhibit from a hardware integration standpoint was the Debate Wall. It features three Apples controlling ten videodisc machines, with each player capable of sending picture and audio into one of the twenty monitors.

"Two of the Apples are what we call slaves," Gregory continues. "Each of the slaves is responsible for controlling five of the videodisc players. These slaves act under cues from the master computer."

The master Apple also sends signals to a custom-designed switcher that channels all video output throughout the monitor network. The master also detects presses on the touch screens, which indicate the fol-

lowing speaker and statement to be retrieved from the videodisc database.

"The exciting thing about all the efforts that went into the World's Fair project," Gregory concludes, "is that we were able to extend our knowledge in the application of microcomputers to videodisc control and sophisticated graphics generation. New England Technology Group now has a full range of salable Apple-based laser-disc and enhanced graphics products and services."

Such private-sector benefits are the just desserts of a job well done. In all probability, NETG and all those who contributed to the realization of the U.S. pavilion have given us the most uniquely informative and entertaining exhibit in the entire history of the World's Fair. And Apples played a big part.

Keys of the Kingdom. At 15,000 square feet, America's Electric Energy Exhibit is the largest corporate pavilion in the 1982 World's Fair. The $2.5 million twin-domed structure includes an AEEE exhibit, general exhibition space for other participants, and a multimedia theater.

The theme of the AEEE exhibit is: Electric Energy—Key to a Better Future. Some of the exhibits focus on ways that utility companies are working to meet the need for increased amounts of energy through both conservation and new and improved technology. Additional exhibits illustrate the contributions made by various energy sources and the central roles of coal and nuclear energy in meeting electrical demand.

Left: One of two floating barges converted by the Tennessee Valley Authority to house its Apple-using exhibit, The Valley Adventure. Center: Main floor of a TVA barge exhibit. Behind the wall of displays, under the air outlet in the upper right, is housed the Apple computer control room that powers the Load Control Center. Right: Jay James, TVA manager of special projects, designed the barge exhibit. In addition, James did the actual programming of the Load Control Center simulation.

Upon entering the vaulted cavern of the AEEE dome, visitors immediately find their attention drawn to a giant video screen suspended from the ceiling. The subject of this overhead station, one of four, is coal. The other stations spotlight nuclear energy, conservation, and supplemental energy technologies. Just in front of each suspended screen, an angled tube juts out from the floor. Each tube is capped by a colorful, flat, touch-sensitive keyboard that controls the corresponding overhead display.

The four stations encircle an exhibit highlighting the Clinch River Breeder Reactor, and a fifth keyboard, similar to the other four, controls the display of an eye-level monitor in the breeder reactor exhibit.

Throughout the day, visitors position themselves at the keyboards and gaze at the monitors overhead. They are responding to the challenge of answering a series of energy-related questions. With each answer a visitor gives, the computer-generated text display disappears and is replaced by a short audio-visual presentation (film or videotape) that clarifies and supplements the answer.

In the course of the quiz, the display moves quickly and smoothly from computer text to video segment and back again. To those unfamiliar with microcomputer capabilities, this is just another magical exhibit—no explanation needed; it simply works. But to anyone who knows about microcomputers, it's apparent that something exciting is going on.

Boxing with Apples. Larry Lowe, a flight instructor, Apple enthusiast, and computer programmer, is the person who can best explain what's happening here. At the request of Roger Tierney, the exhibit design and production expert in charge of devising the AEEE exhibit, Lowe applied state-of-the-art microcomputer and videodisc technology to the AEEE project.

"In each of the five interactive stations, the configuration is as follows," Lowe explains, unraveling the mystery of the featureless white boxes that stand near each station. "Inside each box is a stock Apple II Plus, equipped with 48K RAM, one disk drive, and an Allen Communications VMI card that controls a 7820-3 videodisc player." The keyboards are Lowe's custom design "which appears to the Apple as an RS-232 serial terminal communicating at 1,200 baud through a port in the VMI card.

"It's a very straightforward set-up, really," says Lowe. "Basically off-the-shelf technology with the exception of the keyboard and a PROM I wrote to interpret the input from the keyboard to the Apple." The Apple graphics are provided by Synergistic Software's *Higher Text* package.

AEEE had a clear notion of the message it wanted to convey but was concerned that a comprehensive tutorial exhibit would disrupt the flow of visitors through its pavilion. Not wanting the Apple to function simply as an on-off button for the sequential presentation of video segments, Lowe turned to video game aesthetics to provide player and spectator interest.

The Taste of Learning. When he learned that North American Phillips was going to have an Odyssey video game display at the pavilion, he knew it meant stiff competition for instructional quizzes that take on the average of eight minutes to complete. Three aspects of video gaming—scoring, the recording and display of high scores, and a character that eats the words of an incorrect answer—were incorporated into the quiz in order to give it more of a video game flavor.

According to AEEE exhibit manager R. A. Evans, "The reaction of visitors to the pavilion has been great! Quite frankly," confides Evans, who has only recently retired from a long career with the Department of Energy in Oak Ridge, "it amazes me because this energy stuff is old hat to me. But we get folks here from the Midwest and the North and they think this is the greatest thing since chocolate cake."

As Evans sees it, people's enthusiastic responses to the exhibits can largely be attributed to the quality of the exhibits designed by Roger Tierney and his associates and the Apple Computer-run exhibits developed by Lowe and Tierney.

Judging from the volume of visitors taking the interactive quizzes daily, the AEEE exhibit certainly does grab and hold people's attention. Even so, Larry Lowe believes he has just begun to realize the potential of the computer in exhibit presentations. He's already looking ahead to 1984—in New Orleans.

Valley Apples, For Sure! Moored on the edge of Fort Loudon Lake at the south end of the fair site, two converted river barges are home to The Valley Adventure, a fiftieth anniversary celebration of the Tennessee Valley Authority. A significant part of FDR's master redevelopment plan for recovery from the Great Depression, TVA continues its partnership with the region's people in managing and improving the Tennessee Valley's resources in preparation for future energy needs.

Huge is a word that aptly describes the work of the TVA—and this is graphically communicated in the large exhibit by real pieces of equipment borrowed from the utility's hydroelectric and related facilities. Jay James of the TVA Information Office explains:

"Management came up with the idea of using a couple of barges from our existing river fleet as the foundations for our World's Fair exhibit. The TVA is the United States's largest public utility involved in soil conservation, flood control, and energy production as well as economic and industrial development. This exhibit was a huge challenge."

As manager of special projects, James was charged with developing the informational form and content of the two barges. Much of the content in The Valley Adventure is conveyed via effective traditional media. Life-size sculptures of post-Depression unemployed wait in line to be interviewed for precious TVA jobs made available during the thirties. Audio speakers resound with historical radio broadcasts of the forties. Videodisc replays of relevant television news programs remind visitors of the increasing energy consciousness that has pervaded the last thirty years.

"When it came to the computers," James begins, "I wanted to try to communicate a few of the things we have the most trouble explaining by traditional means.

"People have great difficulty understanding the job we face in economically matching supply and demand. They need to understand that the costs of such resources as coal, oil, uranium, water, and gas vary relative to each other and that the same amount of power can cost more or less depending on the mix of resources used to produce it. At the same time, they need to understand the impact of variable consumer demand, concepts we call baseload and peakload."

To explain these concepts, James picked the brains of TVA power system operators. They analyzed the demand curve for the hottest day in August of last year, a day when the midday peakload could barely be met with all available power sources. They took the nameplate ratings of all components in the power system. With the help of TVA mainframe computer experts, James developed a simulation model that TVA operators ran numerous times to determine accurate averages of how they ran the system best in real life.

The Charge of the Light Bill. These simulations confirmed that optimal operation of the system matched TVA's current electric rate of 4.6 cents per kilowatt hour. With an average residential bill of one thousand kilowatt hours, this results in a forty-six dollar monthly bill for the typical customer. With numbers in hand, James knew he wanted an exhibit-cum-computer game that would quickly show that if you ran the energy system right, the average bill would be forty-six dollars and change. But if resources were mismanaged, the customer's bill would rise dramatically.

The problem became how to present these numbers in a way that would catch people's attention without resorting to having *Pac-Man* running around eating light bulbs. "That's when I turned to the Apple," James explains. "There was such a huge library of software available, including games. To be a successful communicator you have to pay attention to your audience. In the name of the TVA, I forced myself to play countless hours of Apple video games." (Tough job.)

The result of this effort is the Load Control Center exhibit, a principal attraction at The Valley Adventure. Entering the chrome and multicolored semicircle, the visitor is treated to an environment reminiscent of the bridge in *Star Trek*. What one might mistake for the viewscreen of the Enterprise is actually a large projection television that runs a two minute overview of the cost of energy sources and general instructions on how to play the Load Control game.

On either side of the projection television are two player stations. At each station, a color monitor is recessed in a slanted panel above a ledge where four knob-topped levers protrude. Each lever is labeled either Hydro, Nuclear, Coal, or Gas Turbine. An extensive cable network runs from the Load Control Center beneath deck to the hidden computer room where lines tie the levers to the game I/O ports and the monitors to the video-out lines of four Apple II Plus computers.

Poking the Peak Load. As the big-screen instructions are playing, the four stations present colorful graphics depicting each of the four power sources. Each player then gets a practice run on the system and the graphic pictures are replaced by a colorful bar-graph plot.

At the top of the display, a bar creeps left to right reaching peakload, then recedes representing customer demand. The combined output of each of the four levers is depicted by a horizontal bar representing supply which is displayed just below demand. Broad vertical bars climb up and down the screen as the player adjusts the power-supply levers. The use of hydroelectric power starts a blue vertical bar creeping downward; this represents the falling water level in the lakes as the dams are opened.

At the conclusion of the practice run, players are given advice on how to run the system better. The screen is cleared and replotted with a message to get ready for a scored run. A full day's demand curve is compressed into a run that takes a little over a minute. The player anxiously manipulates the levers in an attempt to produce the most effective mix of energy resources to meet demand.

The computer pauses while calculating at the end of the scored run. The player is then informed what the average customer's bill would be under his or her resource management. This can either be a treat or a horror, depending upon how close the bill is to forty-six dollars.

Left: Levers in hand, visitors to the TVA Load Control Center attempt to minimize customer utility bills by manipulating the various sources of energy to meet electric demand. Center: Testing her energy I.Q., a visitor to the America's Electric Energy Exhibit interacts with an overhead video projection monitor controlled by an Apple connected to a special keyboard mounted in the floor tube. Right: Sam DeLozier, manager of Eastern Computer, is the local retailer who services the Apples at the fair. Every exhibitor gave him high marks for keeping the hardware in top shape under such high-volume usage.

"I wrote the initial versions of the game in Applesoft," James recalls. "The simulation-model calculations worked but it was slow and, honestly, I'm not too good at handling graphics. So Sam DeLozier, our local Apple dealer at Eastern Computer, introduced me to Rob Scott, a Knoxville-area high school student. He's an Apple wunderkind. Scott helped polish the program, especially the graphics.

"Sometimes I look at the Load Control game and think it isn't that impressive. You look at what the arcade manufacturers, software houses, even the bigger budgeted pavilions here at the fair are doing and ours doesn't seem like a big deal. Then I look down on the floor and see long lines of folks waiting to get at the game, kids getting back in line. Ten thousand people a day running the Load Control Center!

"Then it hits me," James concludes. "This is the most powerful tool I have ever had to interact with people in all my time in exhibit work. And we're just scratching the surface."