To: Peter Alexander
From: Mark Sardella, P.E.
Re: Chavez Community Center Final Report
Date: April 25, 2001

I visited the Genoveva Chavez Community Center in Santa Fe on March 23rd and 26th to look at energy usage at the facility. I was accompanied by Peter Alexander of Rebuild, and Paul Benson and Boaz Soifer from Dankoff Solar Products. We met with Greg Neal, Director of the Center, and Troy Houtman, the Natatorium Manager.

The Center is a 170,000 square foot public recreation facility that operates weekdays from 6:00 a.m. to 10:00 p.m., Saturday from 8:00 a.m. to 8:00 p.m., and Sunday from 10:00 a.m. to 6:00 p.m. It houses an ice arena, a natatorium with four pools including a 50-meter lap pool, and a gymnasium. All areas are brilliantly daylit, as is the atrium that separates them. The roof over these three spaces is an architectural marvel -- an enormous arched standing seam aluminum deck supported by metal trusses, the longest of which spans 180 feet.

Annual energy cost for the facility are approximately $382,000, including $275,000 for 4.4 million kilowatt-hours of electricity and $107,000 for 184,000 therms of natural gas. Recent increases in the price of natural gas will likely cause the gas bill for the next twelve month period to be over $200,000. The rate of total energy consumption for the building is one of the highest we've assessed at nearly 200,000 Btu per square foot per year. Graphs showing energy consumption by month are included at the end of this report.

Building Envelope

Most of the building is exposed concrete masonry, which has been insulated to R-19 minimum. Walls in the administration area are metal stud with R-19 fiberglass batt insulation and a synthetic stucco exterior finish. The main roof is an arched aluminum deck with 5 inches of foam insulation providing about R-30. There are also several flat roofs, which are spray-foam insulated with a gray rock ballast on top. In the flat roofs there are about twenty five skylights that are each three foot by three foot, made from double-dome clear acrylic. Windows throughout the building are inoperable double pane with metal frames, and low-e glass was used on the west side of the building. Exterior doors are metal or glass panel with metal frame, and are well fitted and weatherstripped.

Lighting

The natatorium, gymnasium, and ice rink are lit with metal halide lamps. A combination of indirect and down lighting fixtures are used. Other areas use compact fluorescent lamps in recessed cans or T-8 fluorescent lamps. The elevators have T-12 lamps. All lighting is manually switched. An emergency lighting system is installed, powered by a bank of batteries that are held at full charge with a battery charger. Exit sign lights are LED. Parking lot and exterior lighting is sodium vapor.

HVAC Systems and Controls

A variety of independent systems are installed, as discussed below. Temperature setpoints for all systems can be controlled by a PC-based monitor/scheduler program, but unfortunately someone stole the PC and they haven't replaced it yet.

Natatorium - The humid air in this area is pulled into a pair of roof-mounted *Dectron Dry-O-Tron* units, where it is dehumidified by a DX cooling coil and then reheated with gas as needed before it is returned to the building. The water that is removed from the air is heated to an appropriate temperature and returned to the pool. Outdoor ducts for this system are insulated, but the thin aluminum skin over the ductwork has suffered some weather damage. The natatorium is maintained at negative pressure to prevent the humid air from infiltrating the rest of the building, where condensation has been a problem and has even caused some damage.

Gymnasium - The gymnasium is conditioned by three roof-mounted units manufactured by *Messco*. These units are combination evaporative coolers, gas-fired heaters, and 20,000 cfm air handlers. Three similar units are used for the bathrooms, pool locker rooms, and the aerobics area. A similar but smaller unit (5,700 cfm) serves the two racquetball courts.

Ice Arena - A pair of roof-mounted *York* DX package units keep the ice arena at 55˚F, and a *Munters* dehumidifier keeps the room at 40% relative humidity.

Other Areas - Roof-mounted package units with DX cooling and gas-fired heating serve the lobby area, the center atrium/hallway, and the administrative offices. The mechanical and utility rooms are served by small roof-mounted evaporative coolers for summer cooling, and these areas also have small gas-fired unit heaters for the winter.

Swimming Pools

There are four swimming pools: a 50-meter lap pool, a leisure pool, a therapy pool, and a spa, as discussed below.

The 50-meter lap pool holds 650,000 gallons, and requires approximately 1000 gallons per week of makeup water. Water is maintained at 83˚F by the roof-mounted *Dectron* system, and a 5 million Btu per hour backup boiler is also used. A 20-hp pump circulates the water continuously through the filter system at about 900 gallons per minute. The filters are backwashed once per week. A pair of 5-hp pumps recover heat from the *Dectron*'s condensate recovery system. No cover is used on this pool.

The leisure pool holds 70,000 gallons, and requires approximately 5000 gallons per week of makeup water. The pool is maintained at 87˚F by the roof-mounted *Dectron* system, and has a 1.67 million Btu backup boiler as well. A 20-hp pump circulates the water continuously through the filter system at about 600 gpm. The filters are backwashed three to five times per week. A single 5-hp pump recovers heat from the *Dectron*'s condensate recovery system. A pair of 30-hp pumps and a single 15-hp pump run 14 hours each day to provide water for the "Lazy River", the "Vortex", and the slide. To provide the correct flow the output from these pumps are throttled to 40%, 30%, and 80% respectively. No cover is used on this pool.

The therapy pool holds 40,000 gallons, and requires approximately 1000 gallons per week of makeup water. The pool is maintained at 93˚F by another roof-mounted *Dectron* system. A 5-hp pump circulates the water continuously through the filter system. The filters are backwashed once every two weeks. A second 5-hp pump is manually switched to operate the jets. Three additional pumps work on demand: a 1-hp pump for the pH control system, a 1-hp pump for chlorine injection, and a 3/4-hp pump for heat recovery from the evaporator. No cover is used on this pool.

The spa holds 7,000 gallons, and requires approximately 200 gallons per week of makeup water. The pool is maintained at 101˚F by a 500,000 Btu per hour gas-fired boiler. A 5-hp pump circulates the water continuously through the filter system. The filters are backwashed once per week. A pair of 5-hp pumps operate the jets, controlled by a timer switch. No cover is used on this pool.

Ice Rink

The ice rink is a regulation-sized hockey rink, with a 2-inch thick slab of ice on top of a concrete slab. The concrete is maintained at 20˚F by a pair of *Cimco* 75-ton refrigeration units. These units cool glycol to 12˚F and circulate it to the slab using a pair of 30-hp pumps. A third pump is installed as a backup but is never used. Below the slab is a layer of insulation, and below the insulation are more coils that carry warm glycol to prevent the ground from freezing solid. This warm glycol loop is heated by the chiller's condenser water as it returns from the cooling towers on the roof. The condenser water is sent to the cooling towers by a pair of 7-1/2 HP pumps, and on the return it passes through a heat exchanger, where it passes heat to the glycol loop. The warm glycol loop uses a 7-1/2 HP motor for circulation. The entire process is monitored and controlled by pair of control systems -- one from CSI and a backup system from Honeywell. Neither controller has setback temperature capability, and so the slab is kept at constant temperature.

The rink is resurfaced approximately 5-8 times per day with a *Zamboni*. This process uses about one thousand gallons of heated, de-mineralized water per day. After the water is de-mineralized, it is heated to 145˚F by a pair of 54-kilowatt electric hot water heaters, then loaded into the *Zamboni*'s tank. The ice that is removed from the rink during resurfacing returns to the garage with the *Zamboni* and is dumped in a pit where it melts and runs down the drain. If the pit fills up, hot water is sprayed on top of the ice to melt it and help it down the drain.

Domestic Hot Water

A one-million Btu per hour gas-fired boiler heats water to 150˚F for the locker room showers and bathrooms, and stores the heated water in a 605 gallon tank. A pump keeps this water circulating through the pipes continuously. A second gas-fired 399,000 Btu per hour water heater stores 100 gallons of 140˚F water for the commercial washing machine and the *Zamboni*'s ice pit.

Recommendations

The following recommendations should substantially reduce energy consumption and utility costs at the Chavez Center. There is likely enough savings opportunity here to allow the upgrades to be financed through savings with an energy-savings performance contract.

1. **Utilize the waste heat from the ice rink chillers.** The condenser water cooling towers reject heat that could be utilized elsewhere in the building, especially to heat the swimming pools or to pre-heat the makeup water. A fairly simple engineering analysis could estimate the resulting reduction in energy usage and cost. This analysis, together with a conceptual design and cost estimate, would lay the groundwork for a payback analysis to help you decide whether to pursue this option.

2. **Use the ice removed from the rink surface for cooling the building.** This ice could provide about 4-tons of cooling per day, or roughly 50,000 Btu per hour continuously. Your net reduction in energy usage would be even higher, since you are presently using water that you have heated to get rid of the ice.
3. **Install timers on the electric water heaters.** Using electricity to maintain this tank at 145˚F when it is not in use is inefficient. Seven-day timers should be installed and set so that the water reaches the proper temperature just before the first resurfacing of the day, then turns the heaters off just after the last resurfacing of the day.
4. **Install a solar hot water system on the electric water heaters.** Using electricity to heat 1000 gallons of water per day to 145˚F is terribly expensive! A solar heating system should be installed to pre-heat the water for this system. At the water volume you are using the payback period for a this system should be a few years at most.
5. **Consider reducing the temperature of the shower water tank.** Energy consumption will be significantly reduced if you can reduce the temperature of this tank from 150˚F to 130˚F or so. The correct temperature setting is the lowest one that still provides good hot showers at peak usage times.
6. **Install timers on all hot water circulation pumps.** A simple 24-hour timer can turn these pumps off at the same time every night, or a 7-day timer could be set to follow your exact operating hours. This saves energy as well as extending pump life.
7. **Install timers on all water coolers and vending machines.** This will similarly reduce consumption and extend compressor life. Removing the lamps from vending machines also reduces energy consumption, or alternatively the lamps can be retrofitted with motion sensors so that they turn off when no one is around.
8. **Install solar hot water systems for the swimming pools.** Swimming pool heating is one of the most cost effective uses of solar energy available, and any investment here should pay for itself quickly. The best solution is to incorporate a solar heating stage into the Dectron units, but if the manufacturer doesn't support this you will need to install a separate system. The simplest systems merely pre-heat the makeup water, but a system that is capable of heating the entire pool in summer will produce the greatest savings.
9. **Install covers on the therapy pool and spa.** About 70% of energy losses from indoor pools are due to evaporation. Covering a pool when not in use significantly reduces these losses, and also reduces the amount of room dehumidification required. Covering any of your pools would save energy but the therapy pool and spa are the easiest to cover, and the high water temperatures means the savings will be large. Manual pool covers typically pay for themselves in about one year, and automatic covers typically have a 5-year payback.
10. **Replace the leisure pool pumps with reduced horsepower pumps.** It hurts to watch an oversized pump working against a partially closed valve! An engineer should be able to calculate the correct size for a motor and pump to give the design flow without throttling the output. If some fine tuning of the flow is needed you could still oversize the pump slightly and throttle just a bit, but the pumps that are working against 30% and 40% open valves are wasting lots of energy.
11. **Reduce the pumping energy on all pools.** There are a number of ways to do this, most of which are outlined in the DOE's RSPEC website at www.eren.doe.gov/rspec. Ideas include replacing plumbing elbows with 45's or sweeps and downsizing pumps accordingly. Many of your circulation pumps are providing significantly more than the required daily flow through the filter, and reducing the flow can save energy without

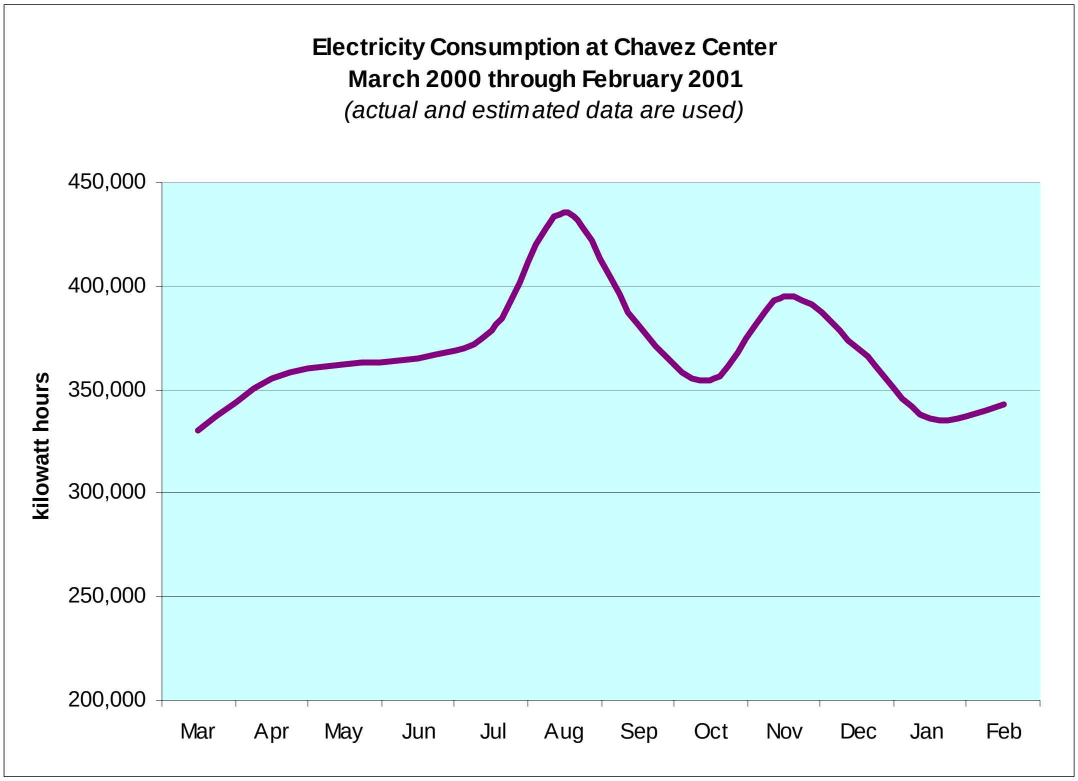
reducing water quality. Check the website for other ideas on reducing swimming pool energy costs.

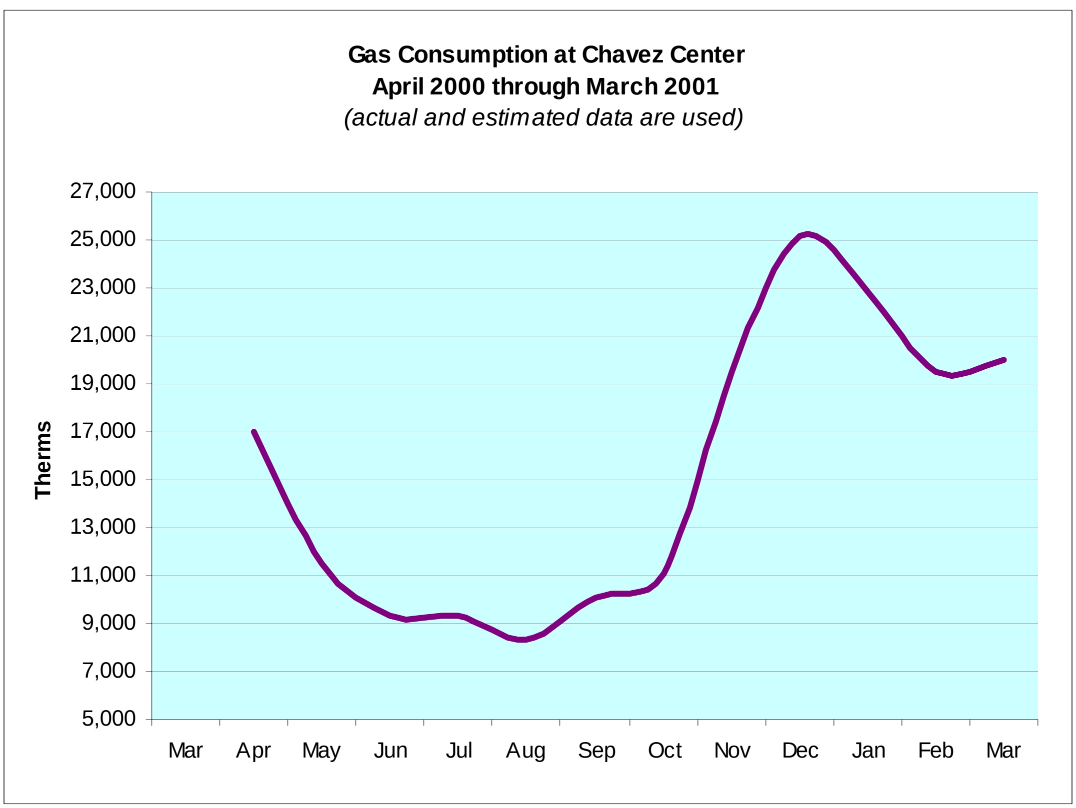
12. **Upgrade the ice rink controller for temperature setback capability.** If the rink doesn't need to be maintained at 20˚F when it is not in use, a temperature scheduler should be installed to raise the temperature a few degrees after the rink closes and restore the proper temperature before the rink opens in the morning. The savings can be estimated, and could be significant.
13. **Install a new PC for the building HVAC and lighting systems.** All areas of the building should have nighttime setback temperatures. Determining the correct setback schedule is by trial and error: every zone must return to a comfortable temperature before it is occupied each day. Lighting should be automatically controlled to ensure that lights turn off at night and also during the day whenever there is ample natural daylight.
14. **Replace T-12's in the elevators with T-8's.** Since these lights are on 24/7, the payback should be very fast. You should be able to eliminate all the T-12's in the building so that you only have to stock the more efficient T-8 replacement lamps.
15. **Install a differential pressure gauge on the natatorium.** The problems that moisture condensation has caused in this building necessitate that the natatorium ambient pressure always be kept below the rest of the building. A gauge should be installed to show the differential pressure between the natatorium and the hallway, and an alarm or other indicator could also be employed to ensure that pressure balance problems are addressed immediately.
16. **Consider correcting the power factor on your pumps.** Correcting your power factor improves efficiency and lets motors run cooler and last longer. The reduced heat generation also relieves your air conditioning load.

I look forward to continuing our support of the Chavez Center's efforts to improve efficiency and reduce their energy costs.

Sincerely,

Mark Sardella, P.E.
Rebuild New Mexico





P.O. Box 608, Tesuque, NM 87574-0608 Ph: (505) 820-2312 Fax: (505)820-1986 email: msardel@southwestenergy.org