

THIRTY-FIRST FLOOR

One (1) 1,050 ton absorption chiller
Two (2) 350 ton engine chillers
Two (2) 200 hp boilers
Heat exchangers, pumps, & fans

Total Energy System...

LACLEDE GAS BUILDING
St. Louis, Mo.

THIRD FLOOR

Four (4) 800 kW, 1200 rpm engine generators
Two (2) 550 kW, 900 rpm engine generators
Four (4) 4700 lb/h heat recovery boilers
Two (2) 2500 lb/h heat recovery boilers
Control room & spare parts

Total Energy in Office Buildings:

THE LACLEDE BUILDING

St. Louis, Missouri

THE LACLEDE BUILDING is 532,300-sq. ft. of bronze-tinted aluminum and glass elegance towering to a height of more than 400 feet above Downtown St. Louis, Missouri. Its 31 floors of plush office space house some of the largest and most prestigious firms in the country, including Bank of St. Louis, Delta Airlines, Guardian Life Insurance Company, Northwestern Mutual Life Insurance Company, American Hospital Association and Federal Deposit Insurance Corporation in addition to the major tenant, the Laclede Gas Company.

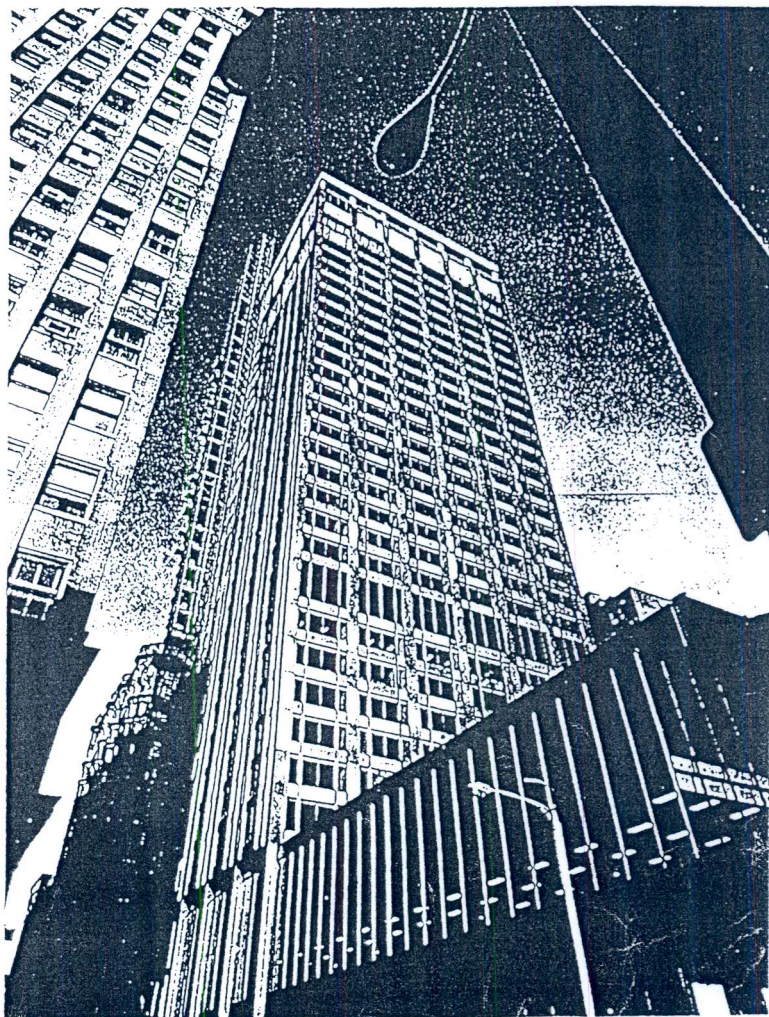
The Laclede Building was designed for the owner-operators, Arlen-St. Louis Company, by Emery Roth & Sons, Architects of New York City.

The St. Louis firm of Ross & Baruzzini is Engineer-of-Record for the 4,300-kw Total Energy plant which provides all of the Building's electricity, space heating, air-conditioning, humidity control and domestic hot water. The plant is owned by Total Energy Leasing Corporation, a publicly-owned company, and a Telco subsidiary -- Energy Operations, Inc. -- has overall responsibility for operation and maintenance of the plant.

Heart of the Laclede Building's T/E plant consists of four 800-kw and two 500-kw Waukesha Engines which operate at 1,200 and 900 rpm respectively. Electricity is generated at 480/277 v, 3-phase, 60 Hz. An ESB Minuteman control system automatically starts, synchronizes, disconnects and stops the engine-generator modules according to a programmed sequence in response to load demand.

Killebrew Entelecon heat recovery modules, fitted to each of the ebullient-cooled Waukesha gas engines, recover engine heat in the form of steam at 15 psi at a volume rate of approximately 5.5 pounds of steam per kilowatt-hour of electricity at rated load. This steam, supplemented as necessary by the output of two 200-hp gas-fired boilers, is used to provide the Building's domestic hot water supply, for space heating, and in the operation of a 1,000-ton absorption chiller for air-conditioning. The air-conditioning plant also includes two 350-ton centrifugal compression chillers, both of which are also driven by Waukesha gas engines.

Plant is served by the gas mains of Laclede Gas Company.



*The Laclede Building plant was covered in detail in the December 1969 issue of TOTAL/ENERGY.

ENGINE MAINTENANCE KEEPS LARGE OFFICE BUILDING OPERATING SMOOTHLY

The owners and occupants of a 31-story office building in downtown St. Louis rely on eight Waukesha engines for electricity, heating and cooling.

And, thanks to a thoroughly planned maintenance program, the engines have delivered reliable performance, with one operating for more than 115,000 hours.

"We have virtually no unscheduled downtime," says Robert Creech, chief engineer for the Leclde Gas Office Building. "These engines will run reliably for a long time if you maintain them as we do."

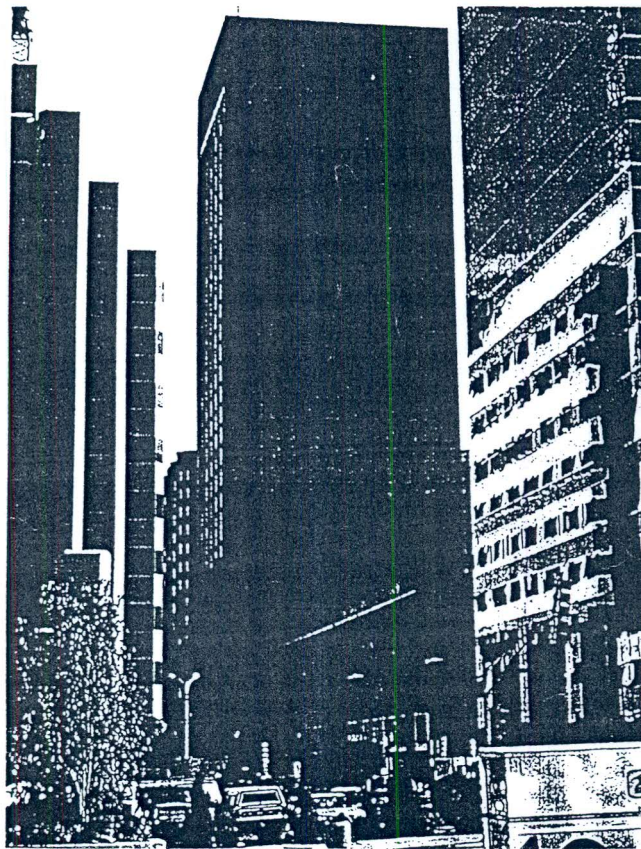
Engines supply efficient power

The 500,000-square-foot Laclde Gas Office Building is the only St. Louis office building that receives all its electricity, heating and air conditioning from gas engines. Built in 1969, the building was unable to connect to the local electric utility grid because the gas company's lease required on-site power generation.

Instead, the developers installed six ebullient-cooled Waukesha Enginotor® engine/generators, packaged by Waukesha Power Systems, and two Centrivac centrifugal chillers, powered by Waukesha engines.

The building, occupied 24 hours per day, requires around-the-clock generation of electricity. The occupants, including the gas company, a bank, a dinner and health club, radio and television transmission stations, and several microwave communication companies, create an average daily electrical load of 2,400 KW. The peaks occur at 3,200 KW, when the building is completely occupied on a hot, humid summer day.

The Enginotor units, powered by two Waukesha L7042GU engines and four Waukesha L5108GSIU engines, can provide up to 4,300 KW from the third-floor power plant. Typically, four



Gas engines provide reliable electricity, heating and air conditioning for the 31-story Laclde Gas Office Building in downtown St. Louis through a thorough maintenance program.

*We have virtually no
unscheduled downtime.
These engines will run
reliably for a long
time if you maintain
them as we do.*

— Robert Creech

of the six engines are running at a time at 75% to 85% of full rated KW output. Each engine has control systems for paralleling, safeties and speed regulation, and the individual controls feed into a master panel that controls

load sharing and load shedding.

"The idle engines are set in standby," Creech says. "Should some demand surge occur, the control system sheds 625 KW by stopping five large fan motors. It then starts an engine and puts it in parallel with the others. The shed breaker then closes, the fans restart and the increased load is handled without anyone noticing."

The Enginotor units' exhaust heat is used to generate low-pressure steam, which makes hot water for space heating and for domestic water use in the building. The steam is also piped to a 1,000-ton lithium bromide absorber, which produces about 700 tons of 42° F chilled water for air conditioning.

Supplementing this cooling system are two 350-ton chillers powered by Waukesha H2476GU engines. These Centrivac units have electronic governors that vary the engine speed from 950 rpm to 1,200 rpm, depending on the additional demand for air conditioning.

Maintenance program successful

The engines have provided extremely reliable operation, even though three of the six Enginotor units have each logged more than 100,000 hours. Key to this success has been the maintenance program instituted by General Manager David Peverly RPA and Chief Engineer Robert Creech.

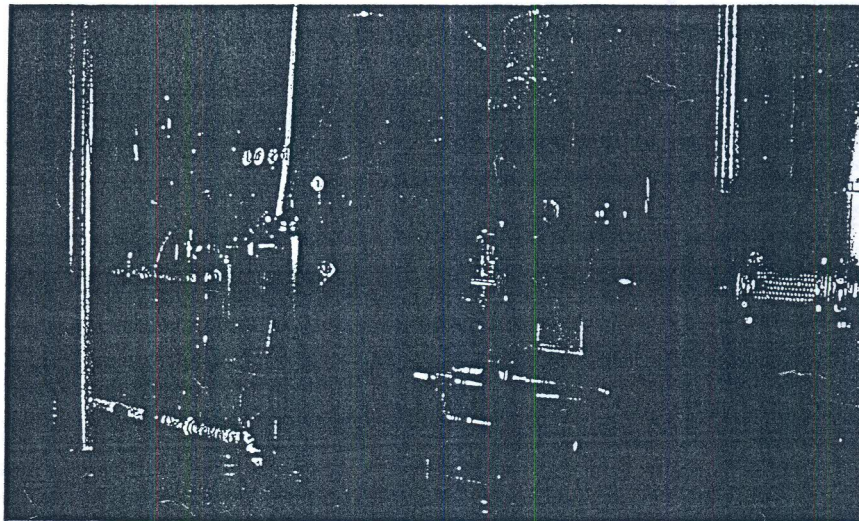
Under the program, all overhauls, repairs and preventive maintenance are performed by the in-house staff of five Waukesha-trained technicians, who are also responsible for operating and maintaining all phases of the building and heating, ventilating and air conditioning systems.

Several procedures are performed

daily, including testing and treatment of the city-supplied Mississippi River water used in the ebullient-cooled engines.

For other procedures, Creech has established a system using two sets of three-by-five index cards. One set of cards is used to schedule work based on hours of operation, while the other set is used to order procedures based on the calendar. The cards outline the maintenance and overhaul procedures as recommended by the engine manufacturer and as learned through years of experience with the engines. Creech pulls a card at the scheduled time and hands the project over to a staff member, who then sees the job through to completion.

"All our people can maintain and overhaul these engines," says Creech.



Ebullient-cooled Waukesha Enginator® units meet the average daily electrical load of 2,400 kW, while providing hot water for an absorption chiller and domestic use.

"We have sent all our people to the Waukesha Service Training Center to learn the maintenance procedures. We consider this education very important to keeping the engines operating at top performance."

Oil change intervals are based on oil analysis and presently range from 600 to 950 hours. Top-end overhauls are scheduled for every 15,000 hours on

the four Waukesha L5108GSIU engines, which operate at 1,200 rpm, and every 20,000 hours on the two L7042GU engines, which operate at 900 rpm. All the cylinder heads are rebuilt, piston rings replaced and cylinder sleeve seals replaced at each overhaul. All other parts are inspected and replaced, as necessary.

"We have had some pistons and bearings that were in service for 60,000 hours in the 900

rpm engines," says Creech. "If we pull something out at 60,000 hours and it looks good, we'll put it back together."

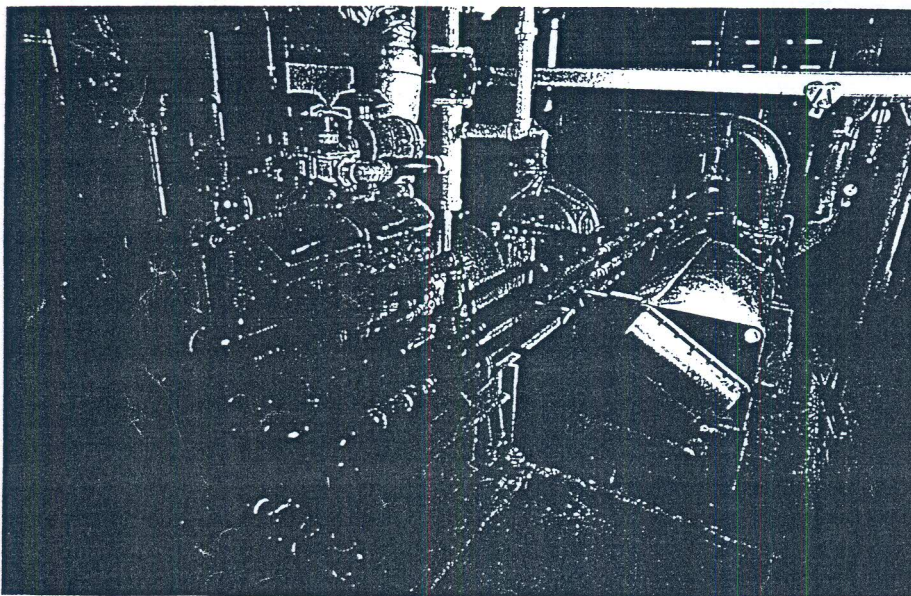
But this should not imply that Creech and his staff are not highly selective in the type of parts they install in their engines. The engine operators accept only top-quality parts. They send out all connecting rods to be remanufactured and balanced. And all piston weights have to be within two ounces to minimize vibration and extend service life.

Reliability is key

As the lifeblood of the Laclede Gas building, the energy plant deserves and receives close scrutiny from the operations and maintenance staff. And it has yet to fail the owners and occupants.

The reliability of this system is so high that two private companies, including the Gas Research Institute, are conducting studies of the building to gauge the long-term effectiveness of engine-powered office buildings.

"Mr. Peverly, Mr. Creech and staff have really shown what can be done with gas engines to provide total energy to a building," says Frank Kurz, Director of Power Systems Division of Mike's Inc., the local engine distributor. ▼



Two 350-ton chillers, powered by Waukesha H2476GU engines, supplement the absorption chilling units during hot, humid summer days.

LACLEDE GAS BLDG POWER PLANT

Engines # 1 and 2 are 818 HP, 550 KW generators, 2840 #/hr. steam

Engines 3 # thru 6 are 1072 HP, 800 KW generators, 4700 #/hr steam

Engines # 1 and 2 exh. temp. is 1050 degrees F @ 4000 CFM @ 818HP
continuous, 920 HP intermittent.

Engines # 3 thru 6 exh. temp. is 1100 degrees F @ 5400 CFM @ 1072 HP
continuous, 1330 HP intermittent.

Deduct 1% from HP rating for @ 10 degrees above 85 degrees in inter-
cooler water. Max. 175 degrees

Deduct 1% from HP rating for @ 10 degree above 100 F ambient temp.

Total BTU from enginator is approximately 187,000 which is broken
down as follows:

32% of energy used to turn generator

7% of energy lost to radiation

28% of energy goes out exhaust

3% of energy lost to lube oil

29% of energy is lost to jacket water

HRU's are rated at 5# steam/hr/KW

Evap coolers are rated @ 2.2 million BTU.

KWH generated and gas consumption figures:

1990- generated 11,933,800 KWH 100%

 sold 7,644,263 KWH 64%

 most gen. 1,150,900 KWH Sept.

 least gen. 732,700 KWH Jan.

 ave. 994,483 KWH

1980 most KWH generated 14,275,500 KWH

highest demand was 3200 KW

1990 total gas used 1,655,406 CCF

 most used 180,951 CCF Sept.

 least used 100,530 CCF Jan.

1990 chiller gas 92,597 CCF 5.6%

1990 boiler gas 5,936 CCF 0.4%

We now average 7.38 KWH/CCF gas if running at 68-88% load on eng.