

several stages thermal energy is recovered by means of waste-heat boilers, all of which feed into the 275-psig main steam system. However, most of the steam load is carried by four gas-fired integral-furnace boilers under automatic control.

Steam for process is used at several pressure levels. The gas reforming process uses steam at 65 psi and 20 psi, regeneration of purification solutions at 30 psi, while feedwater heating requires 20 psi.

The users of intermediate and low-pressure steam were supplied by back-pressure mechanical drive turbines and the original turbine-generators, as well as by direct pressure reduction.

The original plant was self-sufficient in electricity. The quantity of direct pressure-reduced steam for process was relatively small.

Revisions and additions to the ammonia plant increased the ammonia production rate by 30 per cent. Fertilizer solutions, pelleted ammonium nitrate, and ammonium sulfate were added to the product list. The consumption of process

steam and electricity increased accordingly.

The electric load exceeded the reliable capacity of the plant system. Part of the load was transferred to purchased power. Even with this relief, the plant system was loaded to capacity.

Lion's chemical plant engineers showed that additional back-pressure turbine-generator capacity to pass most of the process steam being supplied by direct pressure reduction would add at least 2700 kw to the plant generating system, and at the same time serve to desuperheat the process steam.

A combination extraction and back-pressure unit was first considered for supplying the various pressure-levels. Analysis of the steam load at the various pressures indicated that the energy recoverable from pressure reduction to 65 psi or to the lower pressure was nearly equal. Two Elliott 1500-kw back-pressure turbine-generators were installed. Both turbines operate with 275-psi 540 F steam at the throttle.

One exhausts into the 65-psi header, and the other exhausts into the 30-psi header. A pressure regulator station was installed between the 30-psi header and the 20-psi header.

The installation of the two units provided independent supply and control of the two process steam pressures, affording operating flexibility and maintenance availability.

The 30-psi unit was put in service in December, 1952. It has operated at nameplate rating and on test has demonstrated a capability beyond 2000 kw. The 65-psi unit went into service the following month. It has operated at about three-fourths load.

The El Dorado Chemical Plant's engineering staff of Lion Oil Company performed the load analysis, designed footings, piping, and the electrical layout, erected the turbine-generators, and installed all accessories pertaining thereto.

Since these turbine-generators operate without increasing boiler load, their energy cost is really low, below the incremental cost on gas-engine generators running on the system.

