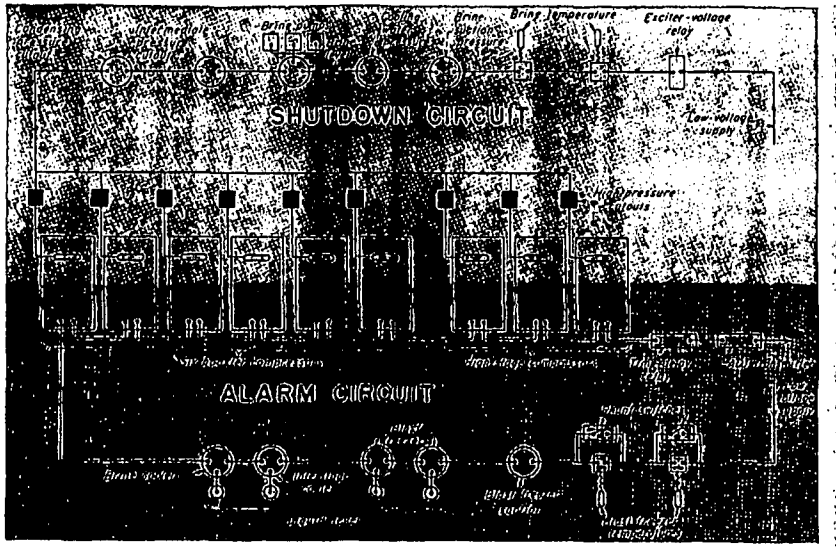


AUTOMATIC INDICATING system is divided so certain group of instruments and controls will immediately shut down the plant on trouble. Another control group shuts down but one machine. Both control groups will send an indication to the ADT office

Compressors Are Powered by Unity-Power-Factor Synchronous Motors...

► LOCKING THE DOOR on 1,750,000 cu ft of refrigerated space for 16 or more hours at a stretch calls for a dependable trouble-indicating system . . . one that shuts down one or more machines, if need be, plus sending a signal to a central office. The signal, in our case, is sent to a local office of the American District Telegraph. Circuits are like those for fire-alarm protection.

Our plant has a total refrigerating capacity of about 275 tons; 175 tons for storage purposes through a brine cooling system; remainder serves blast-freezer rooms. Blast-freezer capacity is 100,000 lb of produce for 24 hr at -30 F. Blast freezer operates through direct-expansion ammonia system.

Refrigeration equipment centers about nine 6-cylinder 720-rpm 2-stage compressors. They represent a total of 960 hp, synchronous motors. Consider the refrigeration system as operating two loads; brine-cooled storage rooms and direct-expansion blast freezers. Of the nine compressors in the plant, six handle the first stage, while three are in the second. Piping is so arranged that any of the low-stage units can be run on brine suction or blast freezing. Each compressor is well protected from accidental damage as indicated in above sketch.

Brine circulated through a fin-pipe system is cooled by multi-pass brine coolers connected to an ammonia accumulator. Banks of fin coils pick up heat, transmit it to the circulating brine. Accumulated frost is removed by circulating hot brine through the system. Compressed ammonia gas, as it is discharged from the high-stage machines, is piped to a bank of six evaporative condensers on the plant roof.

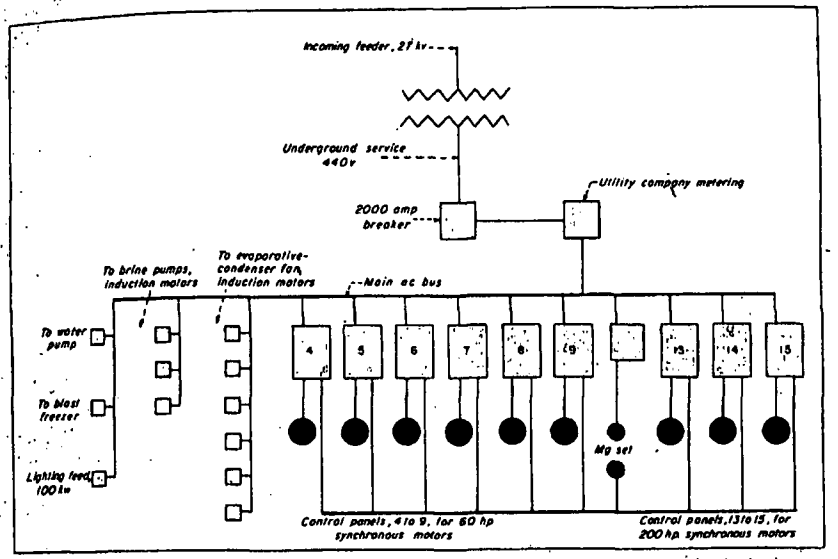
Electrical system is spread about a nucleus of nine synchronous motors. They power the refrigeration compressors. Six of the nine are 60-hp motors that drive the low-stage reciprocating compressors. These units serve for the blast freezing operation or brine cooling for storage areas. They operate at suction temperatures to -40 F. Likewise, the three remaining high-stage reciprocating compressors are each driven by a 200-hp synchronous motor. Here an mg set is used to supply the common dc bus. In our case motors were picked that will operate normally at unity pf.

Keep in mind, however, that some synchronous motors are designed to run at a leading power factor. This is important where much of the remaining load is induction motors, drawing a sizable chunk of wattless power. Size and number of leading pf synchronous motors used hinges on amount of reactive kva needed to balance out effects of inductive equipment. This consideration did not come into the picture for us. Our major power loading consists of synchronous motors; there is little lagging reactive power to account for.

All synchronous motor controls are low-voltage fuse type. They are equipped with disconnect time-lag fuses permitting full-voltage starting. A polarized field frequency synchronous-motor control system is used throughout.

The local utility company supplies all electrical power. After passing through a 27-kv to 440-v stepdown transformer, the underground electrical feed is run through a 2000-amp service. Our main ac bus is at 440 v. Each of the synchronous motors feed off this bus.

Excitation for the synchronous motors



ELECTRICAL DISTRIBUTION within the plant stems from the 27-kv feeder from local utility company. All motors are tapped into the main 440-v ac bus. Excitation for the synchronous motors comes from separate mg set. Relay indicates a dc failure

...Totaling 960 Hp

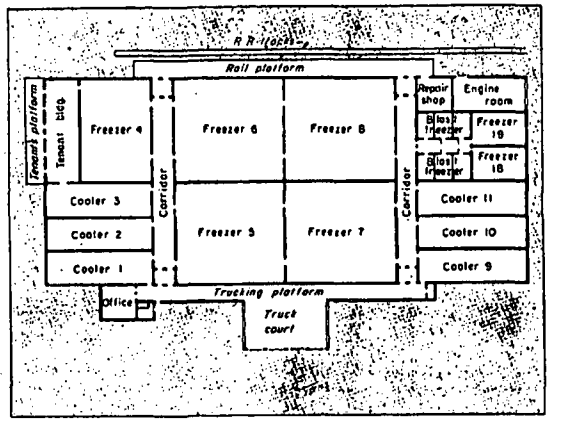
is supplied by an mg set, whose motor is tapped into the main station bus. Generator of this mg set feeds a dc bus which, in turn, delivers dc excitation power to each synchronous motor.

Remote Indication. As indicated above, the remote signaling system we adopted is a companion to the conventional protective system as far as wiring and operation go. It simply means using another circuit to the ADT office.

A signal is transmitted to the ADT office if there's a significant mechanical or electrical failure, or if an abnormal temperature or pressure is reached. When the signal is received in the central office, the ADT telephones the operating engineer at his home. If he cannot be reached, a local refrigeration service organization, previously selected, is called. The operating engineer or refrigeration serviceman then drives to the plant, locates the trouble, and puts the machine back in operation.

Controls that shut down equipment are also wired to indicating lights in the plant. When trouble pops, these lights go on and remain lit till reset by the man shooting trouble. They serve as a tip-off to the trouble source for the person answering the ADT call. In this way he can quickly tell which control device caused the shutdown.

System was designed by the author and P B Christenson, formerly with the Merchants Refrigeration Co, in consultation with J Holbrook of Bekdel-Porter Co and V Alexander, L Hanson, A Heintz of the Carrier Corp.



REFRIGERATION LOAD is supplied by 175 tons brine-cooling refrigeration working in 2-stage system. There are 100 tons of refrigeration at -30 F for blast freezing