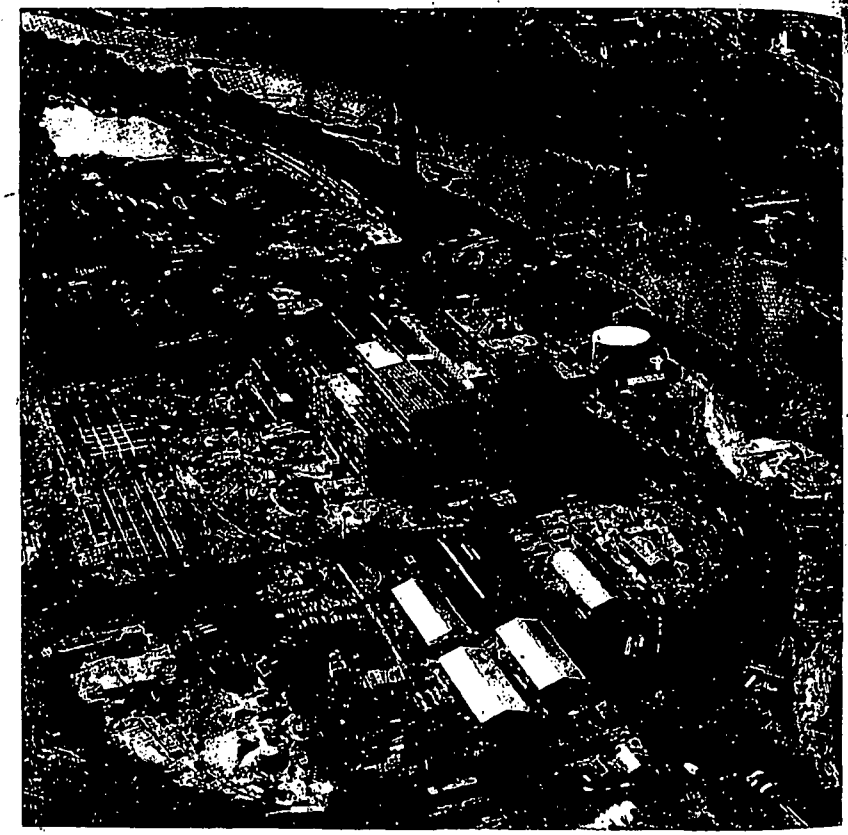


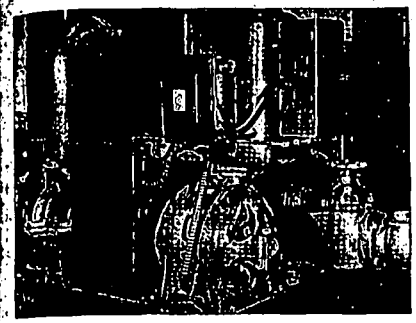
Growing Demand Expands Barbadoes

▶ As part of its plant-expansion program to meet growing demands, the Philadelphia Electric Co is adding two units in an extension of its existing Barbadoes Station. Present plant, housing two turbines and four boilers developing a total of 45,000 kw, operates with 300-psig 600-F steam. Standing on the Schuylkill River it is about 15 miles northwest of Philadelphia.

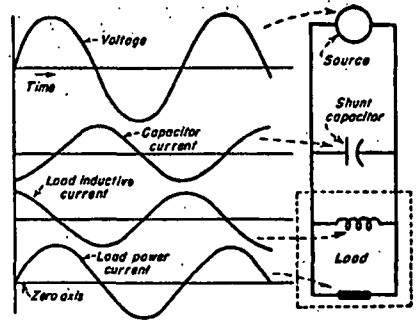
The two new preferred-standard 60,000-kw Westinghouse turbine-generators will each be supplied 850-psig 900-F steam by a single 600,000 lb-per-hr dry-bottom Foster Wheeler steam generator. No steam or feedwater connections between units or existing stations will be provided. First new unit is scheduled to go into service in Feb 1949 and the second during June 1949.

Fuel will be pulverized bituminous, at times mixed with a small percentage of anthracite. Oil can be burned during emergency conditions. Fuel is delivered by rail, and a large storage yard provided for coal.

Superheat control will be effected by partly condensing saturated steam entering superheater. Boiler and turbine controls and instruments for each unit will be placed on a common board near the unit boiler, but since the station also serves as a distributing center, the generator switching and loading will be controlled from a separate room. All five bleed points will be used to feed five closed heaters, deaeration taking place in condenser hotwell. Dravo Corp, constructors of the extension for the Philadelphia Electric Co, supplied the above photo.



1 Shunt capacitor energized with motor when the line switch is closed. Keep capacitor size less than 25% of motor kva



2 Picture o steady interchange of current between capacitor and inductive load. Source supplies only true load power

Capacitors Improve Pf and Cut Costs

Shunt capacitors are used in industrial plants to improve power factor, voltage and to cut cost of metered energy. Here's how they do it, also tips on use for best economy

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▶ Most industrial plants operate at a power factor less than unity. One practical method of improving lagging pf is the use of a shunt capacitor. When so used it supplies the magnetizing component of current, which is inherent in all inductive equipment. As a result feeders, transformers and generating equipment carry only the true power consumed by the load.

Shunt Capacitor Function. Effect produced by capacitors connected in shunt is demonstrated in Fig. 2. Sine functions of voltage and current are shown in a simple distribution circuit. A motor load connected in the system draws a power component of current I_r that is at all times proportional to the voltage and in phase with it. The motor, however, contains iron that must be magnetized. This is represented in the circuit by a parallel inductive branch. When line voltage is applied to the inductive branch, the resulting current I_m lags behind the applied voltage because of the electrical inertia of the inductive part of the load.

If a capacitive element whose rating is equal to that of the inductive branch is connected in parallel with the other two elements, the instantaneous current through the capacitive branch is always exactly equal and opposite to the inductive current. Inductance and capacitance, therefore, store and exchange energy in a way that requires no reactive current flow in the external circuit. The only current supplied by the generator in this example is the power-producing component, which no one has yet been able to cancel out.

Another basic effect produced by connecting shunt capacitors to a normal distribution circuit is an increase in voltage along the supply lines. Higher potential results at load points because of interaction between line reactance and shunt capacitance. These two circuit elements, considered apart from other impedances and loads, produce a voltage across the capacitor that is higher than the voltage supplied to the distribution line. Increased load voltage tends to develop because a remote approach to series resonance occurs between line reactance and shunt capacitance. This voltage rise is normally offset by the voltage drop associated with the power component of current I_r. At light load the voltage rise may become excessive, resulting in need for switching capacitors in response to load cycles. Fig. 3 and 4 illustrate one way to analyze voltage rise produced by shunt capacitors.

Application of shunt capacitors produces interrelated benefits, hence following list may overlap in some respects:

1. Load pf is improved.
2. Current carried by supply circuits and equipment is reduced or, conversely, more power-producing current can be transmitted over an existing circuit.
3. System losses are reduced.
4. Voltage drop in supply circuits is reduced.
5. Cost of metered electrical energy is reduced.

Selecting Proper Capacitor. Calculation of capacitor sizes is dependent on whether the unit is to be installed for correction of electrical characteristics of the power circuits or for reducing the monthly power bill. Usually it is not difficult to fit a capacitor installation to an existing or proposed load, to obtain either specified pf or desired voltage increase. A straightforward electric-circuit solution provides required capacitor bank rating.

A more detailed study is usually necessary to establish the right size of a capacitor bank when the application is primarily to reduce the power bill. Steps of kvar (kilovolt-ampere-reactive) demand in the rate schedule must be compared carefully with existing demands before the most effective correc-