rection of standardization must take into account the basic fact that the prime purpose of these turbine-generators is to supply at lowest cost the power and steam needs of industries whose job is the making of paper, or soap, or gasoline, or some other product. It would be no service to these industries to raise the cost of power.

But it is possible to suggest the elimination of certain variables that will greatly decrease the number of possible combinations. A proposal for simplifying the variables is shown in the right-hand column of page 75. These are offered with the thought that they will fit more than half the cases without handicap. It would be absurd to think that specials would no longer be required. Certainly a plant now in existence, at 50 cycles, 11,500 volts, with initial steam conditions other than standard, would find it impossible to use the proposed standard unit. In such a case the unit bought would be considered a special, but it is unlikely that it would cost more or take longer to build than if there were no standards. *Standardization does not increase the cost of specials, it reduces the cost of standards.*

Industry is not yet ready for the simplifications proposed on page 75. It still needs the type of turbine typified by Fig. 1, even for some of the smaller ratings. Such turbines commonly maintain steam pressure constant at each of two pressures, satisfy the plant requirements for power, and often maintain frequency sufficiently constant for synchronous-motor-type clocks. What then are the possibilities for standardization?

The chief hope for the benefits of standardization in this field lies in new power plants. Engineers expanding existing power plants usually have some latitude in the choice of rated output, but have little choice in the selection of some of the most important variables. If the plant has surplus boiler capacity now at 250 psig it is unlikely that 400-psig boilers could be added. If the plant distribution is now 6900 volts it is unlikely that some other voltage would be economical.

But in new plants there is some latitude. If power-plant designers could agree on a set of standards today similar to those proposed on page 75, there would be increased hope for lower costs in the future. These standards would serve as the basis for selection of equipment for new power plants. In time there would be a transition from our present multiplicity of variables to a relatively few number. With the reduction in variables would come shorter shipments, lower costs and improved designs.

A Check With the Past. The record of units ordered during the past 15 years gives important clues to what hope there may be for standardization. Fig. 2, for example, shows that main pressure has been rising steadily since 1930, and that main pressure tends to increase as units become larger in size. It appears likely that this upward trend will continue.

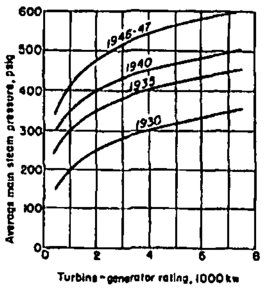
If a similar comparison of initial temperature is made it will be found that temperature increase has kept pace with the pressure increase. During the past 15 years the average throttle temperature for corresponding pressures has been as shown by Table I:

Table I—Average throttle temperature for different throttle pressures over the last 15 years.

Main pressure, psig	*Temperature, F*
150	400
200	475
400	650
600	750

A comparison of page 75 with Fig. 2 will show that the main pressures selected are equal to or higher than the average pressure in use today. Any standard should be progressive, and there is some reason to think that of the pressures suggested on page 75 it might be just as well to eliminate the 400-psig classification for any but the smallest power plants.

Not much has been said of the generators so far, but a look at page 75 shows a possible number of combinations that is measured in thousands. Of fifteen 5000-kw generators on order at the same time from one manufacturer the most that could be built from a single set of drawings was three. Users will find simplification of the number of generator variables easier of accomplishment than turbines, but it will take a program similar to that on page 75 to give direction to any such attempt.



2 Steam main pressure for all sizes of turbines has risen steadily since 1930

There has been a decided shift to larger size units in the past 15 years as is shown by Table II:

Table II—Percent number of units by sizes for today and for the period 1930-1935.

Range of ratings, kw:	*No. of units in % of total: 1930–35*	*1946-47*
Small (500-1500)	65	25
Medium (2000-4000)	25	35
Large (5000-7500)	10	40
	100	100

This shifting pattern to larger size units should materially aid standardization. Most power plants are expected to grow, so whether one 2000-kw turbine is installed every two years, or one 3000-kw turbine every three years, may not be too important. In a growing power plant the choice of ratings is less important than in one of fixed size.

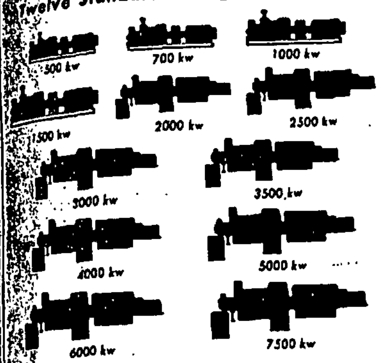
The Obstacles. Standardization of these turbines should not be lightly considered. Unless over-all power-plant costs are lowered there seems little inducement to purchasers to push such a program regardless of the gains to manufacturers of power-plant equipment. From the user's standpoint the industrial steam turbine is looked upon ordinarily as a source of both power and process steam. The user is not in the business of making power but accepts his powerhouse as one of the headaches that goes with the plant's demands for steam and power, to make paper, refine oil, or perhaps process chemicals. The nearer the turbine can be made to fit the industry, the larger the return to help pay for the capital cost. Only if the net costs of power and steam are reduced will standardization prove acceptable.

Another hindrance to early standardization is the dissimilarity of users' businesses. The oil industry has few points in common with paper making, for example, or with the small central-station power plant, or with, say, the rayon manufacturer. Yet all use turbines. To pull them together and get agreement on turbine standards may take a long time even though they

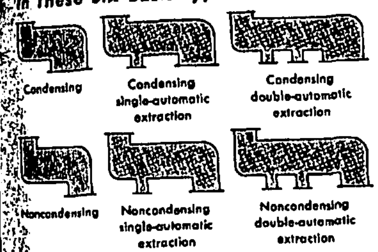
(*Continued on page 150*)

TURBINE-GENERATORS AVAILABLE TODAY

Twelve Standard Ratings:



In These Six Basic Types*:



For main steam pressures of:
0, 100, 200, 400, 600, 900, 1500 psig
For initial steam temperatures of:
500, 750, 825, 900, 950, 1000 F
For exhaust pressures of:
1 in. Hg abs to over 400 psig
For automatic-extraction and low-pressure admission pressures from: atmospheric to 400 psig and for flows from 1000 to over 200,000 lb per hr

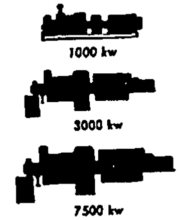
With Four Basic Air-Cooler Types:

For voltages of:
240, 480, 600, 2400, 4160, 6900, 11,500, 13,800, 14,400
For frequencies of:
25, 40, 50, 60, 100, 120, 150, 180 cycles
For power factors of: 70, 80, 90, 100 %
For short-circuit ratios of: 0.70, 0.80, 0.90, 1.00
Having fields wound for 125 or 250 v
With or without main exciter
With or without pilot exciter

*Exclusive of so-called low-pressure condensing and superposed

TURBINE-GENERATOR PROPOSED STANDARDS

Three Standard Ratings:



In These Basic Types:

Turbine-generator rating, kw	1000	3000	7500
Condensing	X	X	X
Condensing single-automatic extraction		X	X
Condensing double-automatic extraction			X
Noncondensing	X	X	X
Noncondensing single-automatic extraction		X	X
Noncondensing double-automatic extraction			X
For main steam pressures of:			
400 psig	X	X	
600 psig		X	X
850 psig			X
For initial steam temperatures of:			
750 F	X	X	
825 F		X	X
900 F			X
With exhaust pressures for:			
Condensing	2 in. Hg abs		
Noncondensing	as required		
With extraction pressures	as required		

With Only One Air-Cooler Type:

Air cooler integral with generator and above floor

For These Voltages:

Turbine-generator rating, kw	1000	3000	7500
2400/4160 v	X	X	X
13,800 v			X

And These Electrical Constants:

For 60 cycles
For 80% power factor
For 0.70 short-circuit ratio
For 125-v field
With direct-connected exciter but no pilot exciter