

More TECHNICAL BRIEFS

governors, speed matching, automatic load and frequency control, penstock valves, circuit operation, audio or sub-carrier equipment channels, emergency control, emergency power supply and other features are described.

AIEE paper No. 53-94 by the authors of this paper gives operating experiences with these automatic and supervisory controls. Capital and operating costs, performance of the automatic equipment, automatic plant troubles for 1952, troubles with operation of lamp indications, telemetering and megawatt-hour counters are presented. AIEE Paper No. 53-95.

Prime Movers

Prime Mover Speed Governors and the Interconnected System. By P. G. Ipsen and J. R. Norton, General Electric Co.

The operators of power generating equipment have long been aware of the fact that it would be desirable from a system control point of view to have all speed governors on their interconnected systems with reasonably similar steady-state characteristics. Normal load changes would then be shared by all units in proportion to their ratings and the action of supplementary controllers would be uniform. This would make system control simpler and would result in smaller deviation of frequency and load distribution from the desired values. In most cases, attempts to make all prime movers on a system respond to system changes in proportion to their ratings have been confined to setting all the speed governors so that they have equal steady state speed regulation. Tests show that the response of prime movers to changes in system frequency or to the action of supplementary controllers is of a random nature and bears little relation to machine rating or to steady-state speed regulation. This paper will outline the factors that contribute to the random nature of prime mover response and indicate how testing programs for existing units, as well as future design changes of governing systems, can produce a major improvement.

The behavior of the speed governing systems on turbines in an interconnected power system can be understood only by defining and measuring their characteristics. These are defined in the AIEE 600 Recommended Specification, published in 1949. The more important characteristics are given below:

a. *Steady State Speed Regulation* is

the change in speed when the power output of the turbine is gradually reduced from rated power output to zero power output with identical settings of all adjustments of the speed governing system. It is expressed in per cent of rated speed.

b. *Steady State Incremental Speed Regulation* is the rate of change of steady state speed with respect to power output at a given steady state speed and power output. It is expressed in per cent of rated speed when the difference is sustained speed, expressed in per cent of rated speed, for any two points on the tangent, divided by the corresponding difference in power output expressed as a fraction of rated power output.

c. *Dead Band* is the total magnitude of the sustained speed change within which there is no resulting change in position of the governor controlled valves.

d. *Stability* is the capability of the speed governing system to position the governor controlled valves so that a sustained oscillation of turbine speed or energy input to the turbine is not produced by the governing system during operation under sustained load demand or following a change to a new sustained load demand.

e. *Overspeed* is the maximum increase in speed from rated speed following a sudden reduction of turbine power output. Overspeed is expressed in per cent of rated speed.

Instruments are available which make it possible to determine any of these characteristics with reasonable accuracy. The performance of a governing system for a prime mover is most readily analyzed if it is considered to consist of two primary elements. 1. The speed sensing element or governor head and its relays including the servomotor. 2. The control valves which are positioned by the servomotor.

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following source unless otherwise stated. Order complete paper from source, not Power. American Institute of Electrical Engineers, winter general meeting, Statler Hotel, New York, N. Y. Jan 19-23, 1953. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, N. Y.

The figure shows one type of governing system for a steam turbine. The modern governor is designed to operate with a minimum of friction and the speed sensing element is required to move only a small pilot valve which in oil under pressure. Its movement is amplified many times by the relays. Dead band and incremental values should easily meet recommended specifications. AIEE paper No. 53-55.

Permanent Magnet Fractional Horsepower Motors and Generators. By R. Goss, General Electric Co.

The evolution of use of permanent magnet materials in rotating machinery is chiefly one of magnet material and methods of processing and using the material. About twenty years ago, the number 11 was beginning to be produced for commercial use.

About 1945 we designed a number of ac alternators having multiple rotating magnetic fields. These were first designed with smooth non-salient pole, permanent magnets on which the polarity was impressed during magnetizing. These magnets were very difficult to heat treat and had to be magnetized, all poles simultaneously in a multiple pole magnetizer. These machines had very good wave form outputs but the magnet was not efficiently used due to the relatively short length between poles that could be magnetized effectively.

At first these machines were cast in steel sleeves with screw inserts which caused considerable amount of cracking in the magnets. To reinforce the cracked magnets, each one was surrounded with a stainless steel, non-magnetic banding ring on each end of the rotor. In order to eliminate this difficulty, a solid cast magnet without inserts was mounted by casting it in an aluminum jacket. This construction was satisfactory mechanically but required die casting equipment that was not economical for small production. They were still inefficient magnetically and demagnetized quite easily. In order to use the magnetic material more efficiently, a redesign was made. In the construction, the flux was collected by a steel ring and fed to the air gap through fingers; all the North poles being fed from one end of the magnet and all the South poles from the opposite end of the magnet. This made the magnet more uniform in cross section and length and was easily cast, magnetized and heat treated. In many respects, the new design is a great improvement. (Continued on page 222)

MEET NEW DEMANDS ON PRESENT GENERATORS



REGULEX

Affords Maximum Safe Kilowatt Output at Any Power Factor Loading

IF GROWING PAINS are taxing your plant productivity and if ever-increasing demands require closer regulation for your present generating equipment, consider the new efficiency gained by installing a Regulex voltage regulator.

Automatic minimum excitation provided by the Regulex voltage regulator permits generator operation close to the stability limit... much closer than manual operation allows. The sensitivity and exceptional response of

the Regulex voltage regulator and associated equipment establish and maintain a safe ratio between generator load and field current... increase operating limits at any given power factor load... assure the best reactive kva division. This means maximum kilowatt output — more power to sell from your present capacity.

Get all the facts from your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4018

Regulex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

