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INNOVATIVE METHODS OF VIBRODIAGNOSTICS AND MONITORING OF TECHNICAL STATE OF STEAM TURBINES, CONTROL MODELS FOR MAINTENANCE AND REPAIR PROCESSES IN THERMAL STATIONS

Resume: Majority of acting thermal power stations were commissioned decades ago, and have significant wear and tear on plant and equipment.

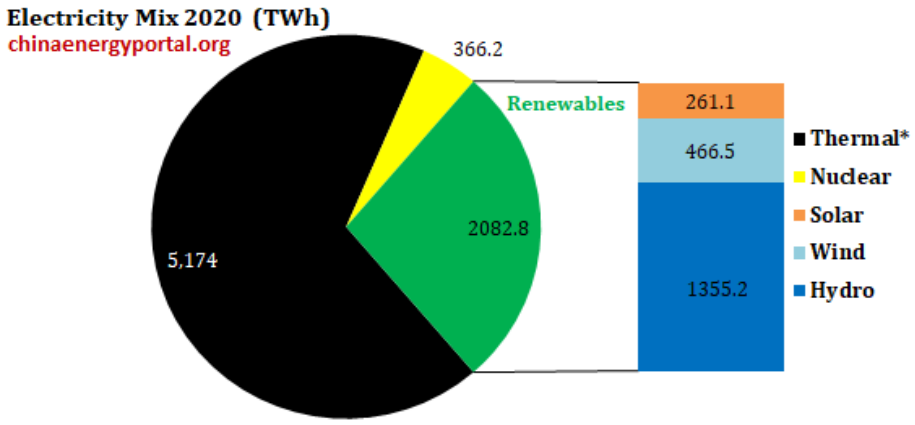
Vibration diagnostics — is a method of diagnostics for technical systems and equipment, based upon the analysis of vibration parameters, either produced by operating equipment, or being the secondary vibration, conditioned by structure of examined object.

Vibration diagnostics, as other methods of technical diagnostics, solves the issues of trouble-shooting and estimation of technical state of examined object.

Key words: Vibration diagnostics, wear and tear, maintenance and repair process, capital repair.

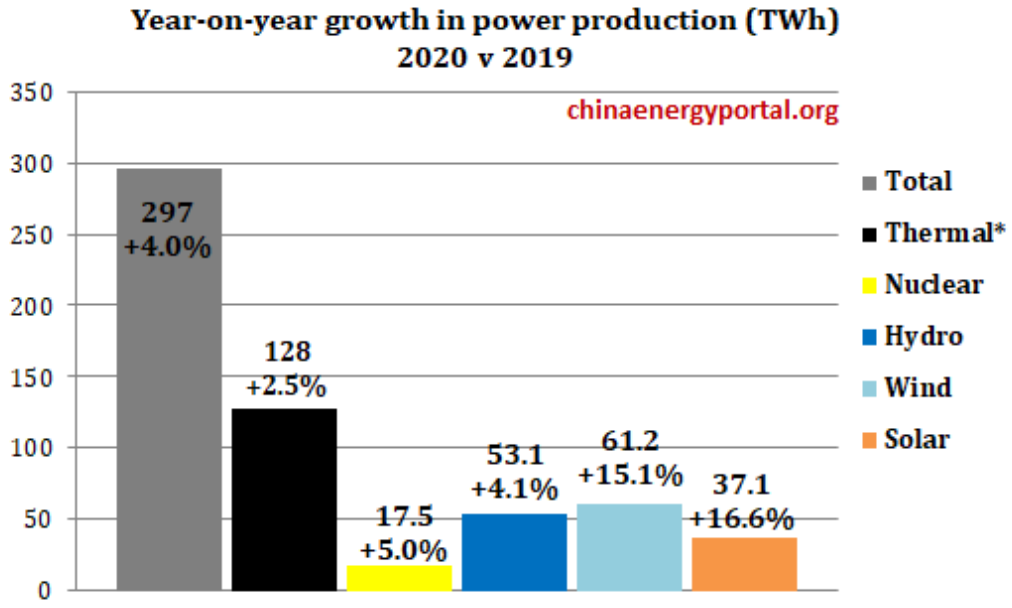
People's Republic of China (PRC) is the world leader in production of electric energy, growth velocity of PRC economics leads to the necessity of looking for new solutions for increase of electric safety of the republic and increase of production capacities.

Share of thermal power stations operating on the basis of coal, gas, residual oil and biomass takes around 5,171 TW/h of energy, which is the following share of total amount (picture 1).



Picture 1 – Extent of electric energy produced by PRC in thermal power stations at a ratio of other types of energy resources

Overall magnification of produced energy due to thermal power stations in ratio of 2020 to 2019 increased by 2,5%, which is shown in picture 2.



Picture 2 – Increase diagram of production capacities in ratio of 2020 to 2019

Share of repair expenses in total extent of charges related to production of thermal and electric energy in thermal station (TS) is varied from 10% to 24% and might be

changed in the process of exploitation. These changes are defined by wear factor of main equipment, which, in turn, depends on working schedule of stations in power energy system, quality of primary energy resources, mode and components of operating equipment in the station, and on execution level of previous maintenance and repair works. The work suggests the control models for maintenance and repair processes in thermal stations with the aim to plan the expenses for capital and medium repairs of main equipment. Solution of this issue if urgent, because the aging process is continuing in power energy, which is accompanied with growth of repair expenses.

Any objective of functioning of engineering and technical object shall have the solution in its final stage, which is directly related to selection and formation of some type of kind of control, directed onto the conscious influence on this object.

To decrease the accident risk in thermal stations, I have adopted the method of vibration diagnostics of thermal equipment structures, for alignment and due operation of power station elements.

Reasons of unbalance appearance in the equipment might be of different nature, be caused by many peculiarities of structure itself and its exploitation. In whole, after some systematization and generalization, all the range of reasons of unbalance appearance might be subdivided into several main groups.

- Factory defect of rotating rotor or its elements, at manufacturer, at repair shop, poor outgoing inspection in the manufacturing enterprise, transit drops, poor storage conditions.

- Incorrect assembly of the equipment at first assembly or after the repair.

- Presence of worn, broken, defect, missing, poorly assembled, etc, parts and joints in rotating rotor.

- Results of impact of process flow parameters and exploitation peculiarities of this equipment, causing the unequal heating and rotors deformation.

Unbalances might be subdivided to the following groups subject to their types, specificity of appearance in general vibration, peculiarities of diagnostics:

- Static unbalance.

- Dynamic unbalance.

Particularities of appearance of these main unbalances in vibrosignals and specters obtained on their bases, peculiarities of their diagnostics will be examined below in this chapter, in separate sections.

The following might be considered as main, the most frequent and familiar, indications of unbalance of rotating masses of rotors in equipment of different types:

а) Time signal of vibration is simple enough, with relatively small number of overtone frequencies and noises in the area of mechanical defects. In this vibrosignal, vibration with period corresponding with rotational frequency of shaft rotation prevails – rotational frequency of the rotor. There might be exclusions – signals where the peculiar frequencies of different nature, for example electromagnetical or hydrodynamic, present or prevail.

б) The amplitude of all overtone frequencies of “mechanical nature ” in the specter is significantly smaller, no less than 2-6 times, that amplitudes of overtone frequencies of rotational frequency of the rotor. If compare the capacities, no less than 60% of vibrosignal capacity is concentrated in one overtone frequency.