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INDICATORS THE TIME PRODUCTION CYCLE TURBINE

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Abstract. A study of repair documentation turbines with a capacity of 25-150 MW and in operation for at least 20 years old to obtain statistical data on the indicators the time production cycle turbines. Keyed indicators differ from those that are used to select the duration of the overhaul time at the moment. The stated approach allows to predict an individual resource turbines on the analysis of the calculations carried out using the repair documentation.

1 Introduction

The purpose of work is to provide a method for forecasting the individual re-resources turbines, spent significant periods of time and the justification of the recommendations of on the volume and terms of repair and maintenance of turbines, preserving a certain number of defects in those or other sites, and that accumulate due to significant periods operation starts and the number of turbines [1].

Information about repair and operational characteristics extracted from the documents submitted by power plants, which employ condensation, heat supply and backpressure turbine capacity from 25 to 180 MW. The paper presents the materials carried out studies of the effect of the production cycle characteristics of an individual resource turbine T-100-130 TMZ.

2 The study

The study of individual life, that is, the total time from the moment the object control its technical condition before it transitions to the limit state, the test turbine is of considerable interest because fleet renewal is going very slowly. Existing turbines have significant wear and periodic scheduled maintenance do not provide a complete replacement of worn nodes and continue to carry the load.

The production cycle turbine is called a calendar duration of the maintenance period, from start to work after the end of the previous overhaul before the end of the subsequent planned overhaul.

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The time during which the turbine plant has a load is a major techno logical process, and regardless of the load, will be referred to hereinafter - operating time. “Reserve” turbine mode is provided for cases when turbine for operations schedule is waiting and ready to receive the load (after the start-up operations). “Repair” mode provides for the implementation of planned and unplanned repairs.

For the turbine T-100-130 average cycle time was 20761 hours (865 days), and the structure is shown in Figure 1.

Fig. 1. Structure of the production cycle turbine T-100-130 TMZ.

The structure of the production cycle turbine units operating at different power plants, practically does not differ from each other. This is due to the unity of repair and maintenance of policies and coincidence of dispatching management approaches [2].

Interest in the study of the production cycle steam turbine equipment structure is based on the fact that the ratio of operating time, and the duration of the repair reserve determine the basic characteristics of reliability - the probability uptime, uptime, time to failure, the assigned resource availability and others.

In this regard, it is important to know the extent to which the production cycle parameters change during the life of the turbine [3]. Since turbine T-100-130 TMZ, was commissioned in 1967 for two different decades showed different characteristics of the production cycle in relation to the average calendar pro-duration cycle (Table 1).

Table 1. Characteristics of industrial turbine T 100-130 cycles for two different decades.

Index	**The period from 1968 to 1978**		**The period from 1989 to 1999**	
	Number of hours	**%**	**Number of hours**	**%**
Operating time total	84089	–	71344	–
The average operating time per cycle	28029	85	14268	74
The average duration of the repair	2337	7	2356	12
The average duration of the reserve	2549	8	2652	14

These changes are caused not only by the state of turbine performance, but also the known changes in management and market reforms in the energy sector.

The average duration 20761 h turbine cycles and repair downtime – 1495 hours. This means that the individual characteristics of the turbine - components with defects, the rate of growth of defects, the duration of the turnaround time, corrective maintenance programs and other factors play a more significant role in ensuring the efficiency, than park. It detects and confirms the fact that defects arise and grow in the turbine sites differently [3]. This means that the period of the rise of the defect is mean time between failures.

Therefore, it is advisable to form a power information database for repair and maintenance services – analogue of the “Diagnostic cards” and the repair form. This electronic document allows more informed decisions about extending the operating turbine. On the duration of the overhaul time turbines, among others, at the rank, seriously affects the number of stops and starts [4]. Figure 2 shows the distribution number of starts turbine T-100-130 from 1978 to 2011.

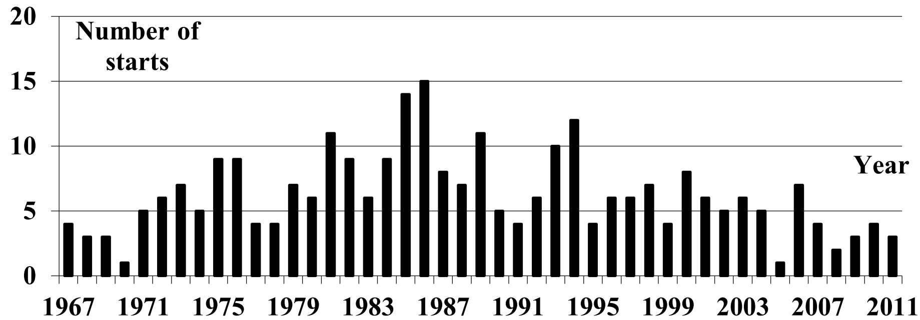

Fig. 2. Distribution of the turbine starts T-100-130, which has an operating time 316 478 h.

The average number of starts per year for the operation of the turbine period was 6. With an average cycle time 20761 h average number of starts per cycle is 13. In the assessment of individual performance reliability turbine should consider not only the achievements, but also the number of starts. Individual statistical characteristics can be easily converted into the characteristics of reliability, in this case, the calculated reliability indices for the period of 1 year [1]:

- probability of failure of 0.6;
- availability factor of 0.91;
- probable uptime after a repair 13302 hours.

On the basis of information on the repair and maintenance history for each turbine can be created "diagnostic map" in the form of an electronic database on which you can restore genuine individual maintenance portrait. This makes it possible to shape the flow of data across nodes turbine, type of defects, defect rates rise, time and other technological features. Accordingly, the reliability of the characteristics can be calculated for the individual components and turbine units. In the first place – the likely uptime of each node.

The repair history of each turbine can be recreated at each plant based on the forms of repair, defective statements, customized documents in the form of an information base.

3 Conclusion

1. This paper discusses the characteristics of the production cycle turbine, which are very dependent on the quality and quantity of repairs, as well as the consumer demand for heat and electricity in a calendar year.
2. It was established experimentally that the average time between overhauls turbine was 15369 hours, while the regulatory overhaul life for the considered turbine is 34000 hours [5].
3. Reduction of disposable resource turbine associated with a long service life and approaches the limit of the individual nodes, requires re-turn to the individual

planning repair procedures. This can be done only on the basis of the repair history for the entire period of operation.

References

1. L.V. Savostyanova, V. V. Litvak, Bulletin of the Tomsk Polytechnic University 321, 11 (2012)
2. V.V. Litvak, V.F. Panin. *The reliability of heat and power equipment and ecological environment around the TPP* (Publishing house of the YTL, Tomsk, 2009) [in Russia]
3. Rodin V.N., Sharapov A.G., Murmanskiy B.E. et al. *Repair of steam turbines* (Publishing House of the Ural State Technical University, Ekaterinburg, 2002)
4. Rezina V.F., Gladshtein V.I., Avrutsky G.D. *Increased resource continuously operating turbines* (Publishing House MEI, Moscow, 2007)
5. *SO 34.04.181-2003. Rules of the organization of maintenance and repair of equipment, buildings and facilities of power stations and networks* (Moscow, 2004) [in Russia]