ASPECTS REGARDING THE FUNCTIONING OF A TURBINE DRIVE OF THE IMPELLER OF A SYNCHRONOUS GENERATOR OF 330 MW ACCORDING TO THE THERMIC RESTRICTIONS ACCEPTED BY IMPELLER BODIES

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Abstract:The paper proposes to carry out tests on the behavior of the turbine case with action arranged in the same tree line with the impeller of an electric generator with 330 MW power unit.The case study aims turbine operating after switching load with steam inlet only in medium pressure turbine body.

Key words: turbine, electric generator, power medium pressure shaft, period of operation

1.Introductions

Production of electricity and thermal energy by electric groups with power of 330 MW that are part of power plants, represent the feedback of a technological flow at which contributes more basic units and installations that aim mainly the rotating of the synchronous generator. Starting from this premise, it can be said that the paper had as milestones the importance of turbines entering in the configuration of electric groups of 330 MW within the technological flow of producing electricity and heat.

F1C type turbine is a turbine with a single intermediate overheating and it represents the primary drive motor of the impeller of the synchronous generator with 330 MW which is brought by a system controlled by the steam inlet at synchronous speed.

F1C type turbines have a special architecture composed of four bodies which depending on the steam pressure are structured as it follows[1-2]:

- a high-pressure body;
- a medium-pressure body
- two low-pressure bodies.

The steam that runs successive through the four bodies of the turbine, is produced as chain of transformations of energy (chemical-mechanical power-heat-electricity) that takes place in a boiler flow of 1035 t / h [1- 2].

Admission of the steam in the bodies of turbine type F1C is controlled and regulated by means of closing valves hydraulically driven by actuators. Both the shut-off valves and control system of the admission of steam in the turbine bodies are controlled and monitored by a computer entering the configuration process of an automatic control system wherein the performance is the shut-off valves. The process computer incorporates multiple control loops that make up the architecture to monitor and control the functioning of the whole energy group for defaults parameters of reference.

Closing inlet valves for steam turbine F1C bodies are distributed on each body of the turbine as it follows [1-2]:

- four fast closing valve mounted on the high pressure steam circuit;
- Two quick closing valves mounted on medium pressure steam circuit;
- In the four and quick closing valves medium pressure.

Quick-closing valves are arranged directly on the turbine bodies, symmetrically arranged about the turbine axis two at the top and two at the bottom. The layout of the quick-closing valves of the steam turbine inlet is designed to reduce steam volume left in the pipes at the start of the turbine. Closing valves steam turbine inlet bodies are designed to act on an "all or nothing" principle [1-2].

In the interior of the high pressure turbine body, occurs the expansion of steam produced by the boiler, from the inlet pressure until the entering pressure in an intermediate overheating circuit. Inside the body medium pressure the steam relaxes from the pressure stabilized at the exit from overheating intermediate circuit until the inlet pressure into the two low pressure bodies. The steam expanded in the turbine medium pressure body is routed through the four outer tubes, provided with expansion joints, to the two bodies of low pressure. Inside the bodies of low pressure occurs the steam expansion from the medium pressure body until the specific input pressure in a capacitor where it takes place the steam volume reduction and its condensing [1-2].

The condenser for the turbine is a surface heat exchanger arranged downstream of the two bodies of low pressure turbine.

2.Case study on turbine operation after tipping load

The steam produced by steam boilers, supports multiple thermal processing on the circuit. The characteristics of the variation related to these transformations are shown in Figures[3-4]:

As it can be seen in Figure 1, the variation characteristics 1-2 indicates an expansion of the steam produced by the boiler and superheated in a intermediate superheater, in the high pressure body of the turbine[3-4].

Expending of the steam in high pressure turbine body is an ideal process organized as a adiabatic transformations. But real progress of this, due to the irreversibility of this is achieved with an increase of entropy[3-4].

Starting from these premises, it appears that it will result a actual fall of enthalpy (h_r) less than the theoretical fall enthalpy (h_t). The steam expanded in the high pressure body of the turbine is subjected to intermediate heating that is accomplished by bringing steam back to the boiler and being passed through a heat exchanger of intermediate surfacer[3-4].

The theoretic process of steam intermediate overheating is achieved as an isobaric transformation, but in reality this process is underway with a loss of pressure (Δp_{SI}), which appears in the pipes that connect the average body of the turbine and the intermediate superheater entering in the configuration boiler steam (Figure 2) [3-4].

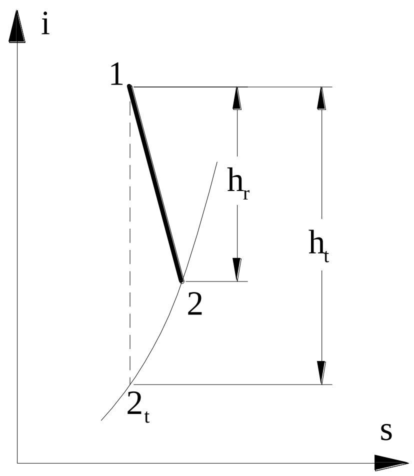


Figure 1

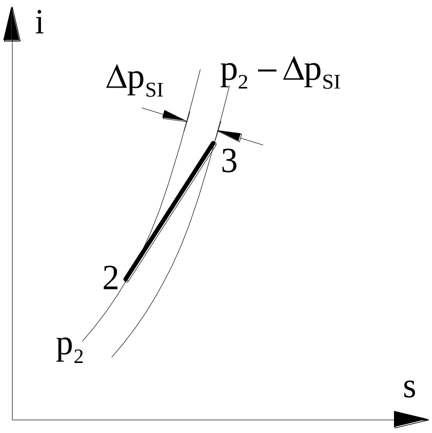


Figure 2

The superheated steam in the intermediate superheater boiler, is sent to the bodies of average or low pressure turbine which hosts its expansion.

Similar to the expansion way of steam in high-pressure body, in the body of the medium pressure the theoretical expansion process is adiabatic, but the actual expansion process is performed by the entropy growth.

The fall of the actual enthalpy is less than the theoretical and the actual amount of moisture end point of relaxation is less than the theoretical one[1-2].

Given the breadth of design and complexity of a turbine F1C, the paper was limited to a partial study which covered the running period after switching task when the turbine can operate only with domestic services with admission steam only in the body of medium pressure.

The operating situation of a turbine-type F1C only with internal services and admitting steam only in medium pressure body is a situation of exceptional functioning and is limited to a certain number of functioning in a year, depending on the thermal restrictions admitted at impeller bodies.

The number of functioning turbine in this situation can be determined by using the expression[1-2]:

$$n = 20 - \frac{(VT-1,5)*t}{1,5} \qquad (1)$$

where:

V_T - Internal high pressure body temperature variation during insular operating[°C/min];

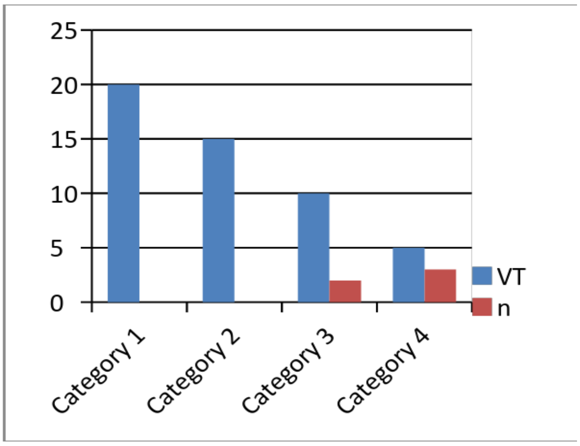
t - the time required for stabilization of the internal high pressure body temperature during insular operating[minutes]

Based on statistical data of the operating of the turbine type F1C related to a group electricity power unit of 330 MW, it was established the metrics regarding the variation of temperature of the high pressure internal body during insular operating(Table 1)[1-2]:

Table 1

No.	Internal high pressure body temperature variation (IP) during insular operating V_T [℃/min]				Number of turbine functioning according to thermal restrictions admitted at impellers n			
1.	1,5	1,75	2,0	2,5	20	15	10	0

Starting from the values of the temperature variation in high-pressure body of the turbine and assuming an insular operating mode, it was determined the number of functionings of the turbine according to the thermal restrictions admitted at impellers for a period of 30 minutes. Based on these values was drafted variation features shown in Figure 3.



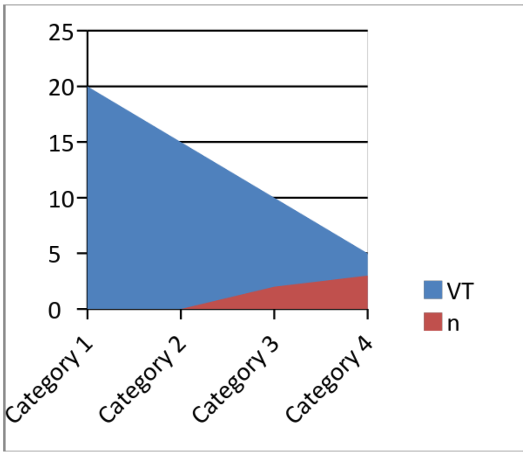


Figure 3. Variation features n=f(V_T)

3.Conclusions

Considering the values obtained and the characteristics of the variation shown in Figure 3, we can draw the following conclusions:

1. The operating situation of a turbine-type F1C only with internal services and admitting steam only in medium pressure body is a situation of exceptional functioning.
2. This situation is limited to a certain number of functioning in a year, depending on the thermal restrictions admitted at impellers.
3. From the variation characteristic n=f(V_T) it can be seen that for a time of 30 minutes allocated to insular operating modes, the number of functionings of the turbine in a year varies inversely with the variation of internal high pressure body temperature.

4. Bibliography

[1]. Cartea tehnică a turbinei de tip F 1C
[2]. Instructiuni de exploatare a turbinei F 1C
[3]. B.M. Diaconu –Centrale termoelectrice. Editura Sitech, Craiova, 2005
[4]. C. Moțoiu - Centrale termo și hidroelectrice.Editura Didactică și Pedagogică, București,1974