Table 1. Comparison between one superheater and tow superheater

Parameter	VVER600MWwith one superheater SH1	VVER600MWwith tow superheater SH1+SH2
G_0 kg/s	933.9	935.8
N_e MW	600	600
p_0 MPa	6	6
p_c MPa	0.004	0.004
η_{PP}%	0.325	0.352
η_{npp}^{net}%	0.30	0.335

Scientific adviser: A.V. Vorobyov, Candidate of Technical Sciences, Associate Professor of (SEC I.N. Butakova, ISHE) in TPU.

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EGYPTIAN NUCLEAR POWER PLANT TURBINE PROJECT

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Introduction

My research object is Established Nuclear Power Plant and Design (VVER-850) With design of Turbine from thermal and hydraulic calculation to design Egyptian nuclear power plant which before it was thermal power plant located at Banha city in Egypt Taking into account Geological area and consumers. Given the great demand for electric energy in Egypt, knowing that 105 million Egyptian citizens live only in an area that does not exceed 9 or 10% of the Egyptian land area. Therefore, a nuclear power plant must be established in the delta region of northern Egypt Because of the recent urban expansion in Egypt in terms of building new cities that need new sources of electricity and a diversity of energy sources.

In this paper, a methodology for thermal schema of nuclear power plant and turbine stage calculation

Description of the research object

At my research object I designed Thermal schema of nuclear power plant and turbine stage calculation High and Low pressure part

With Turbine plant efficiency = 32.7 %, Net block efficiency = 31%.

At Turbine consist five stages for High-pressure cylinder at modern nuclear power plants is two-flow

My nuclear power plant VVER-850 consisting intermediate Separator and superheater with two cylinders of turbine High and Low part with Geometric Profile (P-30-21A)

With (6) regenerative feed water heaters from both type open and closed reheater from side of calculation I found the flow rate and pressure at each point in the scheme

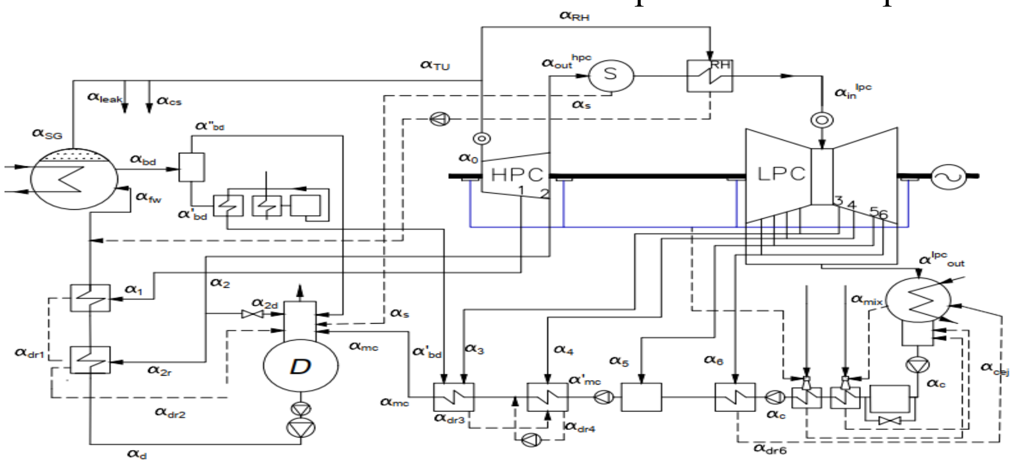

Fig. 1. Scheme of npp with flow rate directions functional dependencies

To determining steam flow to a turbine

$$G_0 = \frac{N_e \cdot 10^3}{H_i^{total} \cdot \eta_M \cdot \eta_g \cdot (1 - \sum(\alpha_j \cdot y_j))}, \quad (1)$$

Where:

η_m is mechanical efficiency of a steam turbine installation = 0,98.

η_g is efficiency of generator = 0,99 .

α_j is relative steam consumption in the j-th selection.

y_j is reproduction factor in each extraction.

N_e is electric power of NPP.

H_i^{total} is total internal heat drops in turbine, kJ/kg.

For Turbine plant efficiency.

$$\eta_{tu} = \frac{N_e}{Q_T}, \quad (3)$$

Where:

N_e is electric power of NPP.

Q_T is Thermal loading of turbine.

Calculation of the axial force on the rotor on the example of the first stage of the cylinder

The axial force acting on the rotor depends on the distribution of the vapor pressure over the surface of the rotor and is found as the sum of all axial forces:

$$R \sum_{i=1}^{n} R_a^i \,, \quad (3)$$

Within one stage, the axial force acts on the profile part of the working bladesR_a^1, the diskR_a^2, the ledges on the rotor between the diaphragms of the adjacent diaphragm sealsR_a^3, on the ledges of the sealR_a^4.

Calculate the total axial force acting on the fourth unregulated stage.

Calculation results

Turbine plant efficiency:

$$\eta_{tu} = \frac{N_e}{Q_T} = 32.7\ \% \,, \quad (4)$$

Efficiency of pipelines connecting a steam generating unit with a turbine:

$$\eta_{pipe} = \frac{Q_T}{Q_{SG}} = 0.9965 \,, \quad (5)$$

Net block efficiency:

$$\eta_{NB} = \eta_{tu} \cdot \eta_{pipe} \cdot \eta_{SG} \cdot (1 - K_{on}) = 0.31 \,, \quad (6)$$

Specific flow rate of degraded fuel for the electrical supply at nuclear power plants:

$$b_{ndf} = \frac{0.0537}{\eta_{on}^{e}} = 0.175 \frac{\text{kg}}{\text{kW·h}} \,, \quad (7)$$

The shaft is considered rigid, since the critical frequency is higher than the operating frequency. The condition must be met for a rigid shaft:

$$n_{cr} \geq (1{,}2 - 1{,}25) n_{op}, \quad (8)$$

$$\frac{n_{cr}}{n_{op}} = \frac{11478}{3000} = 3.8 \quad (9)$$

The condition is met.

Conclusions

After calculations we found that efficiency of Nuclear Power Plants is acceptable also all conditions is met for all calculation from both sides hydraulic and thermal

The design is based on the latest technologies in nuclear power plants in terms of modern turbines in design

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