As a result of the calculated comparison of schemes with two and three HPHs, it was found that the efficiency of a power unit with three HPHs is 0,7% higher.

The preference for further development was given to a simpler scheme with two HPHs. In addition to simplicity, such a scheme requires significantly less investment.

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4. https://openedu.urfu.ru/files/book/foreword.html

Scientific supervisor: Candidate of Technical Sciences A.M. Antonova, Associate Professor of the I.N. Butakov Scientific and Educational enter of the Tomsk Polytechnical University School of Energy Engineering.

ANALYSIS OF THE EFFICIENCY OF STEAM REHEATING SCHEMES AND DESIGN OF NUCLEAR POWER PLANTS

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Goal of MSR:

Moisture separator reheaters (MSRs) are installed after high-pressure; their purpose is to reheat cycle steam and remove cycle steam moisture, High-pressure, high temperature, steam, is used to further heat the cycle steam. High pressure steam passes through the inside tube shell and tube heat exchanger on the tube side. The cycle steam passes over the outside of the tubes and is thus the shell-side fluid. The temperature of the cycle steam increases as it passes over the heat exchanger tubes, Moisture (condensate) that has been separated from the steam, is drained from the system via the condensate drain, condensate is fed back to the steam generator feedwater system. After moisture has been removed from the cycle steam, and the cycle steam has been reheated, the steam is then fed to the low-pressure turbine [1].

Comparison between Vertical & Horizontal MSR:

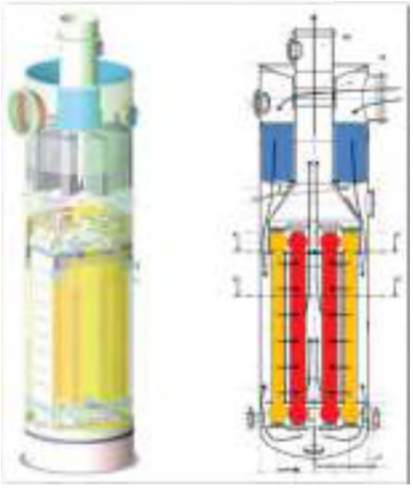

Fig. 1. MSR of the firm Black Durr for Lovisa NPP (Finland)[2]

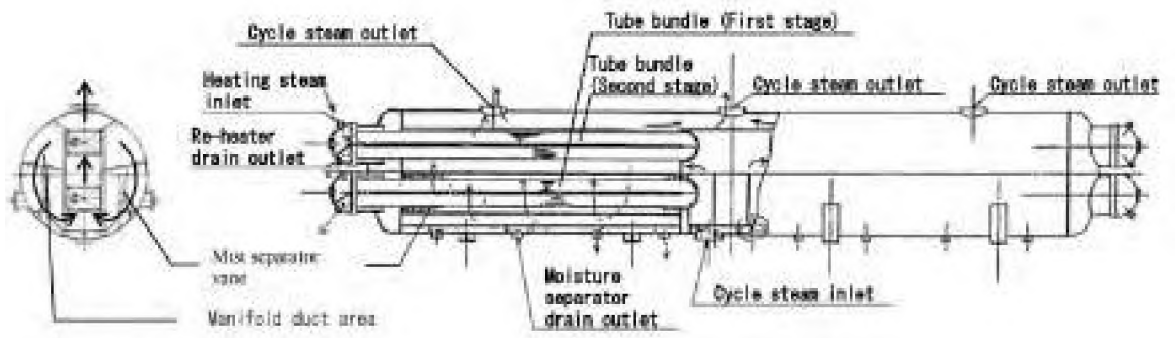

Fig. 2. Construction of the current model MSR[3]

When comparing the drawings of MSR, it can be seen that we choose horizontal MSR, because horizontal MSR has less dimension and smaller size than vertical MSR, also vertical is very high and horizontal MSR components is close to turbine

Formulation of MSR:

We will calculate number of tubes, length of tubes, pressure drop of heating steam and heated steam by changing velocity of heating steam in the range (1,5 … 4) m/s. The equations of convective heat transfer and heat transfer of a flat wall were used in the calculations.

In the power unit being developed, we choosed a two-stage reheating of steam. Parameters of heating and heated steam is determined from calculation of the thermal scheme of NPP.

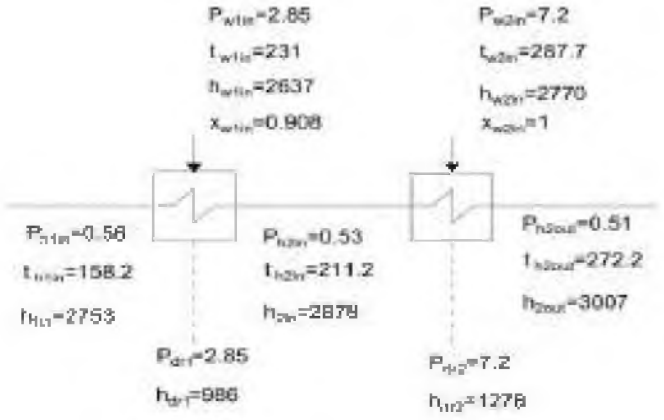

Fig. 3. Parameters of two stage reheaters

Conclusion:

We calculated the length of the tubes of the heat exchange surface is calculated, also we calculated pressure drop in tubes of heating and heated steam, for heating steam we choosed different velocity of heating steam at the entrance of tubes of 1st and 2nd stage. We realized that when we increased velocity in the 1st and 2nd stages, number of tubes decreased, number of rows of tubes decreased, length of tubes increased. Pressure losses in tubes increased but this increases not big.

So, we choosed velocity of heating steam in both stages $w = 4\frac{m}{s}$, because it gives us small number of tubes, also material cost of tubes will be decreased, and diameter of moisture separator reheater will be decreased also and so on cost will be decreased.

For heated steam velocity of steam between the tubes is $20\frac{m}{s}$ but number of rows of the 1st and 2nd stages decreased when number of tubes decreased. We realized that when length of tubes increased, pressure losses in 1st and 2nd stages decreased, but we realized that total heated pressure losses bigger $\Delta p_{heated\ total} = 9{,}36\ kPa$.That's mean that internal and relative energy drop-in low-pressure cylinder is decreased, also capacity of turbine system increased, electrical efficiency increased, and so on total NPP efficiency increased.

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3. MANABE J., KASAHARA J. Moisture Separator Reheater for NPP Turbines // Journal of Power and Energy Systems. 2009. T. 3, № 2. C. 368–381.

Scientific supervisor: Candidate of Technical Sciences A.M. Antonova, Associate Professor of the I.N. Butakov PES TPU.

DESIGN OF A NPP POWER UNIT WITH A VVER-TYPE REACTOR WITH AN ELECTRIC POWER 1000 MW

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Nuclear power plants are modern energy facilities that are the optimal source of heat and electricity. On the one hand, nuclear power plants are efficient and have a large capacity, on the other hand, they do not harm the environment, and during their operation there are no emissions of sulfur dioxide, carbon dioxide, nitrogen oxides and other harmful impurities.

In a nuclear power plant, energy is generated through a controlled nuclear fission reaction in a nuclear reactor.

My research design consists of designing a fully functional nuclear power plant by designing all the main elements of the life cycle of the plant, turbine plant, nuclear reactor, horizontal steam generator and condenser.

As part of the work, the design of the NPP thermal scheme with high and low pressure turbines and a single-stage superheater and closed-type recuperative heaters.

A separate block of work is the development of the concept of defense in depth of a nuclear power plant, since safety issues are the main ones in the operation of any facility using atomic energy.

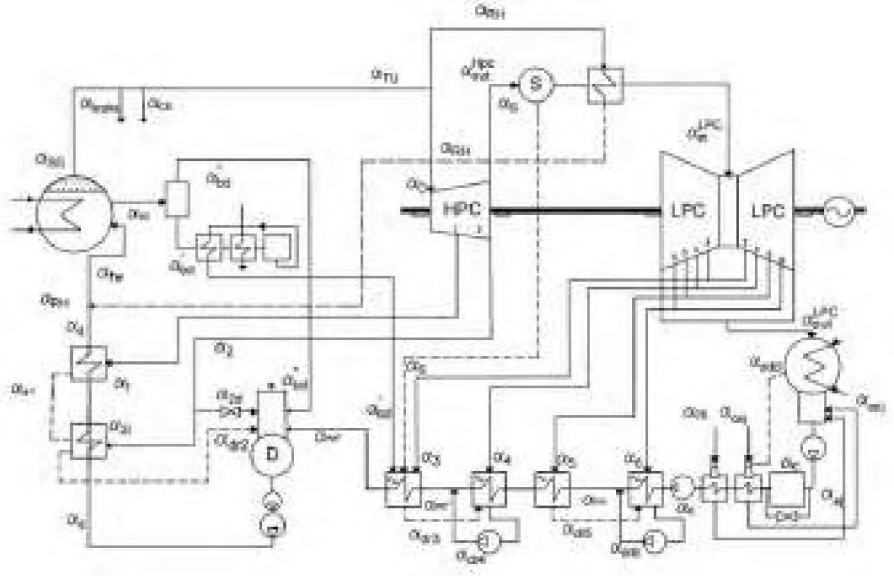

Fig. 1. NPP Scheme