VVER-1200 WITH VERTICAL STEAM GENERATOR

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Introduction

The object of the study is the power unit of a nuclear power plant with a VVER reactor with an electrical power of 1200 MW.

The purpose of the work is to design a power unit for a nuclear power plant with a VVER-1200 reactor with vertical steam generator

In the course of work, thermal, design, calibration, hydrodynamic calculations of the STU, steam generator and reactor plant were performed.

As a result of the research, a reactor was designed,

Vertical steam generator and thermal diagram of the power unit

Description of the research object

At my research object I designed Thermal schema of nuclear power plant and vertical steam generator with High- and Low-pressure part

With Turbine plant efficiency = 36 %, NPP efficiency = 34.5%.

My nuclear power plant VVER-1200 consisting intermediate Separator and double stage superheater with two cylinders of turbine High and Low part

With (7) 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

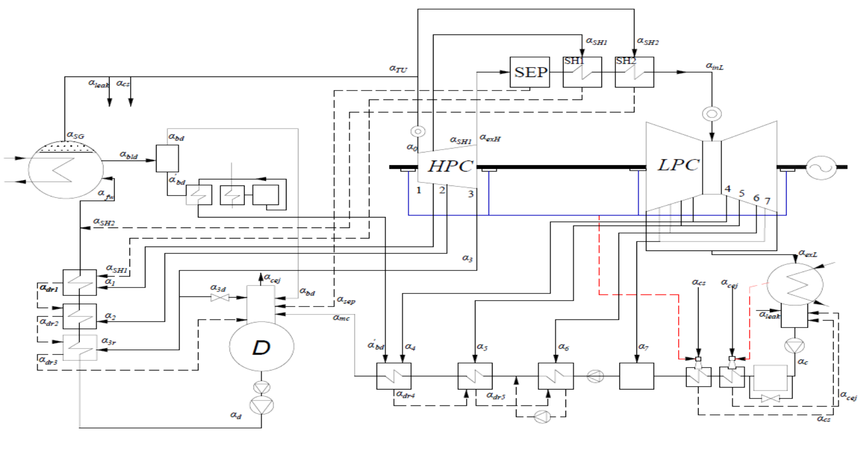

Fig. 1. Scheme of npp with flow rate directions

Functional dependencies

steam flow rate from the steam generator

$$D_2 = \frac{Q_{sg}}{\left[k_{hl}\cdot[(h_2''-h_2')+(h_2'-h_{fw})]+\left(\frac{\alpha_{bd}}{100}\right)\cdot(h_2'-h_{fw})\right]}, \quad (1)$$

Q_{sg} is thermal power of the steam generator, kW

D_2 is steam flow rate from the steam generator, kg/s;

k_{hl} , is coefficient that takes into account heat losses in the steam generator;

h_2'' is steam enthalpy at saturation temperature;

h_2' is steam enthalpy at saturation temperature;

h_{fw}, is enthalpy of feed water;

$D_{bd} = \left(\frac{\alpha_{bd}}{100}\right) \cdot D_2$ is flow rate of blowdown water, kg/s.

Calculation results

Turbine plant efficiency:

$$\eta_{tu} = \frac{N_e}{Q_T} = 36\ \%, \tag{2}$$

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

$$\eta_{pipe} = \frac{Q_T}{Q_{SG}} = 0.990, \tag{3}$$

NPP efficiency:

$$\eta_{npp} = \eta_{rs} \cdot \eta_{pip}^{I} \cdot \eta_{pip}^{II} \cdot \eta_{sg} \cdot \eta_{ts} = 34.5\%, \tag{4}$$

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

$$b_{ndf} = \frac{1000}{24 \cdot \bar{B} \cdot 10^3 \cdot \eta_{npp}} \cdot \frac{X_n - X_o}{X_e - X_o} = 27.05 \frac{ton}{year}, \tag{5}$$

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

LITERATURE:

1. Power plant engineering/by Black & Veatch; Lawrence F. Drbal, managing editor, Patricia Boston, associate editor, Kayla L. Westra, associate editor.
2. Nuclear Power Plants. Design and Safety Considerations / editor by J. P. Argyriou. — New York: Nova Science Publishers, Inc., 2012.

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DEVELOPMENT OF A 900 MW NPP POWER UNIT WITH AN UPGRADED STEAM GENERATOR BLOWDOWN SYSTEM

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Introduction

The world is at a turning point. Despite the considerable efforts to decarbonize the economy and the many billions spent, our world remains highly dependent on fossil fuels. Fossil fuels still supply over 80% of energy worldwide and the trend is clear – instead of reducing our dependence on fossil fuels, we are increasing it. A global effort towards establishing a sustainable energy system is underway. The electricity sector is