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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.

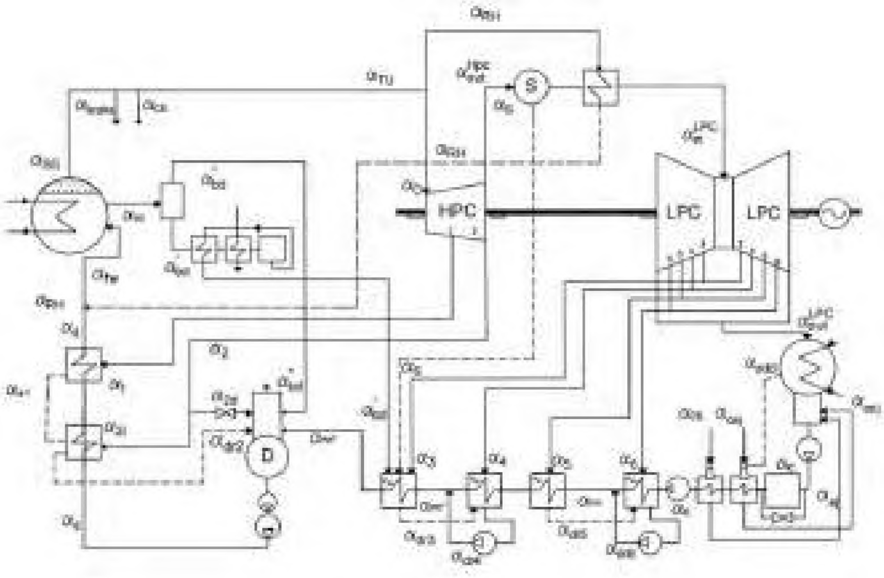

Fig. 1. NPP Scheme

Table 1. Final results

Name	Symbol	Value
Electrical power	N_e MW	1000
Initial pressure	p_0, MPa	6,27
Initial temperature	t_0, °C	t_{sat0}
Feed water temperature	t_{fw}, °C	220
Thermal power of SG	Q_{sg}, MW	754,9
Coolant temperature at the inlet to the SG	t_1', °C	321,0
Coolant temperature at the outlet of the SG	t_1'', °C	291,0
Coolant flow	G_1, kg/s	4455
Number stages of Superheater	-	1
Steam temperature at the outlet of the SG	t_{st}°C	281,7
Final pressure	p_c, kPa	3,5
Deaerator pressure	p_d, Mpa	0,62
n HPH	2	Number of high-pressure heaters
n MLPH	4	Number of low pressure heater
Steam flow rate for a turbine	$G_0, \frac{kg}{s}$	1507
Thermal loading of turbine	Q_{TS}, Mpa	2974

Efficiency of heat transport

$$\eta_{pipe}{}^{II} = \frac{Q_{TS}}{Q_{SG}} = \frac{2974}{3006} = 989 = 98{,}9\% .$$

NPP Efficiency:

$$\eta_{NPP} = \eta_{rs} \cdot \eta_{pipe}{}^{II} \cdot \eta_{pipe}{}^{I} \cdot \eta_{SG} \cdot \eta_{e}.$$

The calculation is acceptable according to conditions. NPP efficiency is 32,28% and it's in the range.

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DESIGN OF A POWER UNIT WITH VVER FOR A NPP WITH ELECTRIC CAPACITY OF 870 MW

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Introduction

The most widely used kind of reactor in the world is VVER, the VVER uses water as both a coolant and a moderator. Water-based energy reactor VVER.

Heat from the reactor core is transferred to the secondary circuit via the primary coolant [1].

A well-regulated chain reaction powers nuclear reactor, while the majority of reactors produce electricity. Fission heat is used in power reactors to create steam, which powers turbines to provide electricity [1].

The fuel assembly, control rods, coolant, pressure vessel, containment structure, and an external cooling facility are all common parts of nuclear reactors.