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:

$$\eta_{tu} = \frac{N_e}{Q_T} = 36\ \%, \quad (2)$$

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

$$\eta_{pipe} = \frac{Q_T}{Q_{SG}} = 0.990, \quad (3)$$

NPP efficiency:

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

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

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

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

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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 at the heart of that effort, with the need for clean, abundant and affordable electricity widely recognised.

The use of nuclear energy provides an affordable fast track to a high-powered and clean energy system, which delivers a healthier environment whilst strengthening a country's energy security. [1]

Large-scale nuclear reactors are the only proven low carbon technology that can be deployed at the scale and timings required to meet the Paris Agreement goals. These reactors run quietly in the background, delivering immense amounts of power around the clock, regardless of weather or season. At a global level, the nuclear energy has an excellent operational performance record, with an average capacity factor above 80% – with many reactors achieving above 90%.

The nuclear power plants operating across the world at present are based on proven technology, which has evolved and matured over the past 40 years. These reactors, available in capacities from about 600MWe to 1700MWe, provide secure and stable electricity supply for their national grids.

Development a nuclear power unit with 900 MW and determining an optimal combination between efficiency and economic issues was the aim of this project-which is required in the Middle Eastern [2] and South Asian countries- in addition to upgrade the blowdown system for the steam generator.

Upgrading the blowdown system was based on the commissioning the AES-2006 (V-392M) steam generator blowdown system a modified flowchart has been proposed for the steam generator blowdown and drainage using multi-pass valves with an electric single-turn (EST) actuator drive in the system. The flowchart modification makes it possible to reduce the specific content of metal in the system and to provide an extra space for the maintenance of the system's regenerative heat exchanger in a pressurized shell, to use eight multi-pass valves for the steam generators instead of 36 electromagnetic valves, and to cut the operating and repair costs.

Implementation of the SG blowdown system at Novovoronezh NPP (AES-2006 design, WWER-1200)

The closed high-pressure SG blowdown system is a new system with no analogues in the NPPs in operation in Russia .

The fluid flow rate in the new SG blowdown system is higher than in traditional systems due to the blowdown flow rate increased to 140 t/h (not more than 50 t/h in a traditional system).

No need for a traditional SG blowdown system to be used outside the containment is explained by the blowdown flow rate increase to 140 t/h, as required by the equipment developer and with regard for the long-term experience of operating SGs in current NPPs.

Austenitic stainless steel is used as the base material for the system's components, pipelines and valves. No copper-containing alloys are used.

The SG design, as far as blowdown is concerned, has not changed greatly as compared to the latest WWER-1000 units. There have been changes in the blowdown flowchart and in the equipment composition, design and layout. In a classical flowchart, the blowdown water from each SG is removed to beyond the containment over two pipelines, with the flows merging in a pair of headers (for continuous and periodic blowdown) and entering the blowdown expansion tank in which a pressure of 0.8 MPa is maintained. Shutoff control valves (SCV) are used for the pressure reduction and the flow rate regulation. Downstream of reactor water treatment system 5 (RWT-5), the deaerator steam and the purified water are discharged into the turbine hall deaerator .

There is no blowdown expansion tank in the AES-2006 design (V-392M reactor plant).

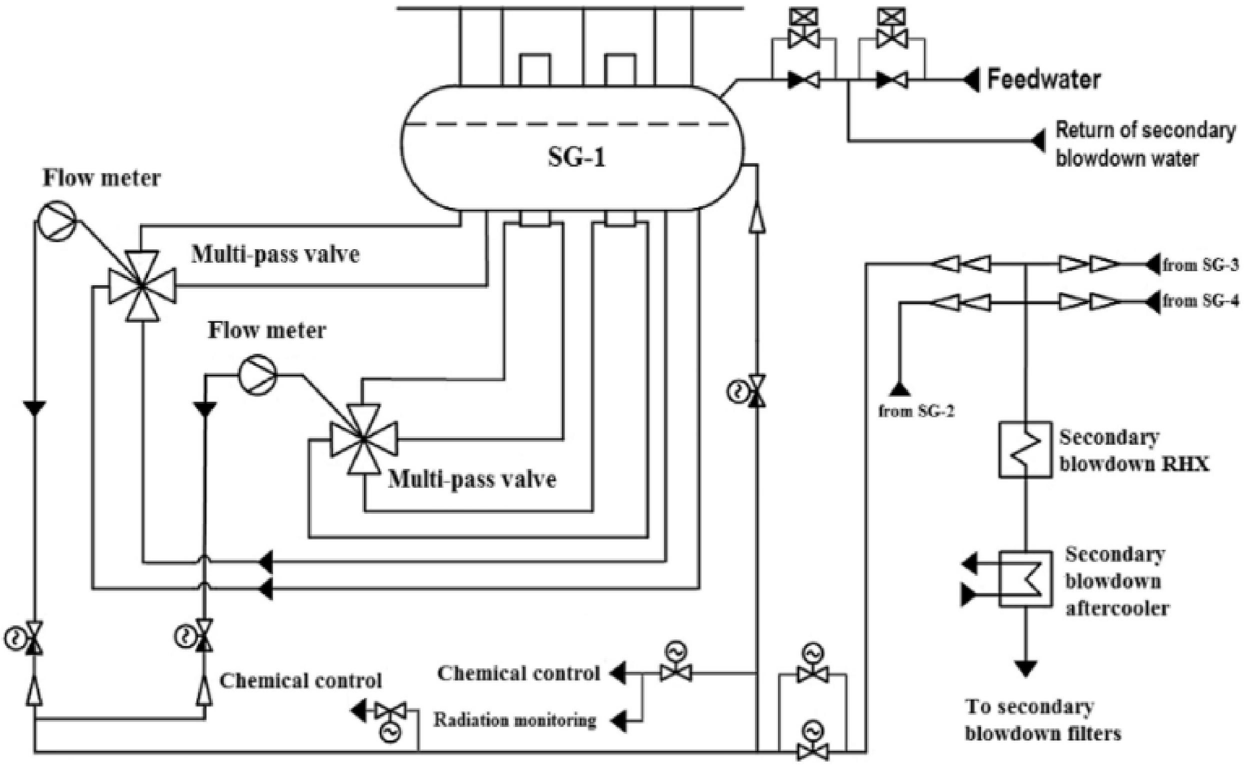

Fig. 1. Flowchart of the SG blowdown and drainage system used in WWER-1200 [3]

Choice of the parameters for a 900 MW NPP

- Choice of $P_0 = 7\ MPa$ which gives us a higher feed water temperature and a higher efficiency. Increasing the initial temperature causes increase in η_t and η_{oi}. since: - the specific volume of steam at the beginning of expansion grows, hence, the height of the first stage turbine blades increases. - the final degree of moisture decreases, hence, moisture-related losses in the last stages of the turbine are reduced.
- Choice of Pc at 4 kPa to:

1. Decrease of the final pressure causes thermal efficiency to increase because heat losses in the cycle decrease.
2. At decreased pressure at the outlet of the turbine, the steam humidity increases at the end of the expansion process, which leads to increase of losses in the turbine.
3. Capital costs increase when trying to approximate the temperature of steam in a condenser to the temperature of cooling water (expansion of heat-exchange surface).

- Choice of $P_d = 0.75\ MPa$ to fulfil the target of getting the highest efficiency.

- Choice of the feed water temperature t_{fw} as 234.8 °C in order to reduce the number of HPH which is affects positively to the economics calculations for the NPP.

Conclusion

Development a 900 MW NPP unit to obtain the optimal parameters for the thermal efficiency taking into account the economical issues was the aim of this work, in addition to updating the blowdown system of SG, improving the performance and operating reliability of the blowdown system as far as its design functions are concerned, this leading to such secondary circuit water chemistry as will minimize the amount of deposits on the heat-exchange surfaces.

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ПРОБЛЕМА ЭФФЕКТИВНОСТИ ОБУЧЕНИЯ ИСКУССТВЕННОЙ НЕЙРОННОЙ СЕТИ, РЕАЛИЗУЮЩЕЙ АЛГОРИТМ ФУНКЦИОНИРОВАНИЯ РЕЛЕЙНОЙ ЗАЩИТЫ, И РАЗРАБОТКА СООТВЕТСТВУЮЩИХ КРИТЕРИЕВ ОБУЧЕНИЯ И ПУТИ ЕЁ РЕШЕНИЯ

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Искусственные нейронные сети (НС) и принципы машинного обучения являются одной из наиболее обсуждаемых тем в настоящее время. Данная концепция нашла применение практически во всех значимых для человечества сферах деятельности. Электроэнергетика не является исключением.

В последние годы появилось множество проектов, посвященных разработке алгоритмов автоматического управления электроэнергетическими