ДОДАТОК А

Публікація за темою досліджень

EUROPEAN OPEN SCIENCE SPACE

Proceedings of the 3rd International Scientific and Practical Conference

"Evolving Science: Theories, Discoveries and Practical Outcomes"

February 3-5, 2025

Zurich, Switzerland

Collection of Scientific Papers

Switzerland, 2025

Журавльова Л., Домалевський А.
ОСОБЛИВОСТІ ЕМПАТІЇ ТА ПРИХИЛЬНОСТІ В ЮНАЦЬКОМУ ВІЦІ..... 204

Кондратюк С., Навроцька Н.
ПСИХОЛОГІЧНА СЕПАРАЦІЯ В ЮНАЦЬКОМУ ВІЦІ..... 207

Решитун Ю.В.
ЦІЛІСНІСТЬ І ЗАХИЩЕНІСТЬ ЯК ОСНОВНІ КРИТЕРІЇ ПСИХОЛОГІЧНОЇ БЕЗПЕКИ ОСОБИСТОСТІ..... 210

Section: Technical Sciences

Бойдуник Р.
РОЛЬ ТЕХНІЧНИХ ЗАСОБІВ У ЗАБЕЗПЕЧЕННІ БЕЗПЕКИ ТА ПРИСКОРЕННІ МИТНИХ ПРОЦЕДУР..... 213

Гальчук Т.
ДОСЛІДЖЕННЯ ПРОЦЕСІВ КІНЕТИЧНОГО ПОДРІБНЕННЯ СТРУЖКОВИХ ВІДХОДІВ..... 215

Polishchuk A., Polishchuk O., Harbar Ye., Bonek M.
COMPOSITE FILAMENT REINFORCED WITH CARBON FIBERS FOR 3D PRINTING..... 221

Polishchuk O., Polishchuk A., Polishchuk O.P., Bonek M.
3D PRINTING EQUIPMENT WITH SCREW EXTRUDER FOR MANUFACTURING PARTS FROM COMPOSITE MIXTURES CONTAINING NATURAL FIBERS..... 233

Tverdokhlib K.
ANALYSIS OF THE STEAM GENERATOR CONTROL SYSTEM..... 237

Shevchenko V., Lazurenko K., Karpenko M.
DIRECTIONS FOR IMPROVING THERMAL POWER PLANTS TURBOGENERATOR IN THE CONDITIONS OF THE MODERN ENERGY TRANSITION..... 240

Section: Tourism and Hotel and Restaurant Business

Ковалевська І.М., Тарасова В.В.
ОСНОВИ СТАТИСТИЧНОЇ МЕТОДОЛОГІЇ В МІЖНАРОДНОМУ ТУРИЗМІ..... 246

Proceedings of the 3rd International Scientific and Practical Conference
"Evolving Science: Theories, Discoveries and Practical Outcomes"
February 3-5, 2025
Zurich, Switzerland

ANALYSIS OF THE STEAM GENERATOR CONTROL SYSTEM

Tverdokhlib Kirill
Master Student
Kharkiv National University of Radio Electronics

The ПГВ-1000 steam generator consists of several main parts: a casing, heat exchange tubes, a separator, collectors, pipes for supplying and discharging coolant and steam, and control and measuring devices. The steam generator vessel is a cylindrical high-pressure vessel made of special alloys that can withstand high temperatures and pressures. Inside the vessel are heat exchange tubes that form a bundle through which the coolant circulates [1, 2].

The control system of the ПГВ-1000 steam generator is a key element to ensure safe and efficient operation of this equipment. It consists of several subsystems and components that monitor and control the main parameters of the steam generator. These parameters include water level, pressure, temperature, steam quality, and the condition of structural materials [1, 2].

One of the most important aspects of the control system is monitoring the water level in the steam drum. These sensors provide continuous monitoring of the water level and transmit signals to the central control unit. If the water level deviates from the set limits, the system automatically adjusts the feed water supply or drains the excess. This is critical, as too low a water level can lead to overheating of the heat exchanger tubes, and too high a water level can lead to a deterioration in steam quality [2].

The steam generator pressure control system consists of several components, including pressure gauges, pressure sensors, and automatic control systems. The pressure sensors, in turn, transmit data to a central control unit, where they analyze and make decisions on pressure control. In case of exceeding the permissible pressure, the emergency protection system is automatically triggered to reduce the pressure by opening the steam or water relief valves.

The data from these sensors are also transmitted to the central control unit, where they are analyzed to maintain optimal thermal conditions [2, 3].

The steam quality control system includes humidity and steam composition sensors. Wet steam can lead to erosion of turbine blades, so it is important to ensure its high quality. Humidity sensors determine the level of steam saturation and transmit data to the central control unit, which adjusts the operation of separation systems to ensure dry steam.

The condition of the materials of the steam generator structure is monitored using a non-destructive testing (NDT) system. This system includes ultrasonic, X-ray, and magnetic methods that allow detecting defects and microcracks in materials [2]. Regular inspections allow for timely detection and elimination of potential problems, ensuring the durability and safety of the steam generator.

Proceedings of the 3rd International Scientific and Practical Conference
"Evolving Science: Theories, Discoveries and Practical Outcomes"
February 3-5, 2025
Zurich, Switzerland

The central control unit is the brain of the control system. It collects data from all sensors and analyzes it in real time, using this data to make decisions about adjusting various parameters of the steam generator. It also provides an interface for the operator, who can monitor and manually control the system as needed. In the event of anomalies or emergencies, the central control unit automatically activates the appropriate protection measures.

The steam generator control system also includes backup and emergency systems that provide an additional level of safety [2]. For example, emergency pressure valves automatically open in the event of a critical pressure increase, which prevents equipment destruction. Backup power systems ensure continuous operation of the control system even in the event of a power outage. Regular maintenance and inspection of all components is an integral part of the control system. This includes calibrating sensors, checking connections, testing emergency systems, and updating the central control unit software. Performing these activities ensures that the control system remains efficient and reliable throughout the life of the steam generator.

To better understand this, here is an example of a top-level video of the feedwater control system (Fig. 1), which is one of the key systems that ensure stable and safe operation of a nuclear power plant.

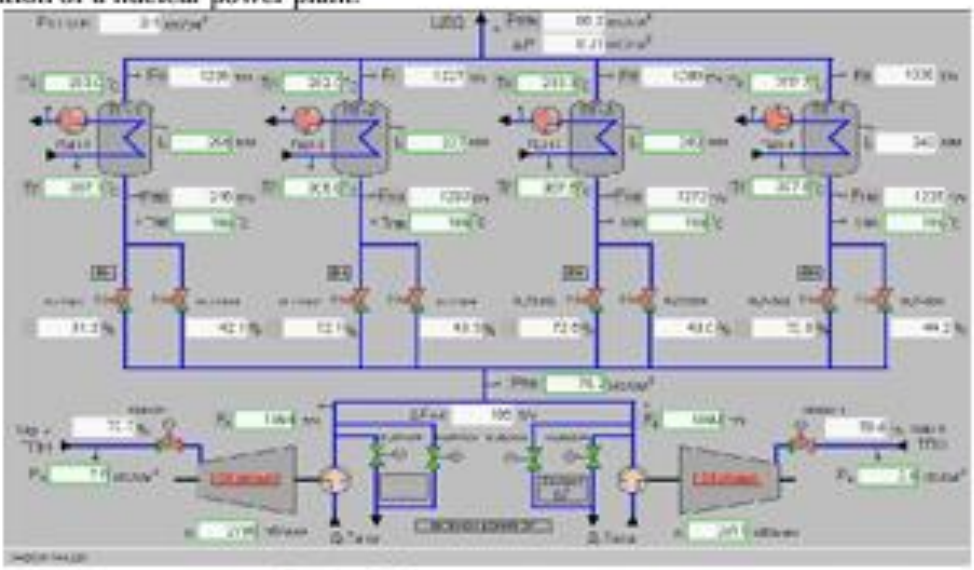

Fig. 1 – Feedwater management system

The main function of the feedwater control system is to automatically maintain the optimal water level in the steam generator, which avoids both pipe overheating and hydraulic shocks [2, 3]. This is achieved through a set of sensors, regulators and actuators that work in close cooperation.

For example, if we imagine a top-level video of a feedwater management system, we see a complex image that demonstrates the interaction of all system elements: from water level sensors to feedwater valve control. All these components work together to ensure a stable water level in the steam generator.

One of the main components of the feedwater management system is the water level sensors that are installed in various parts of the steam generator. These sensors constantly monitor the water level and transmit the data to a central controller. The central controller, in turn, analyzes the data received and decides whether it is necessary to correct the water level. This can be done by changing the position of the feed water valves, which are controlled by electronic or hydraulic actuators [2, 3].

The key element of the feedwater management system is the PID controller, which provides accurate and stable water level control. The PID controller adjusts the water supply based on three components: proportional, integral and differential. The proportional component is responsible for correcting the error between the actual setpoint and the water level. The integral component takes into account the accumulated error over a certain period of time, which reduces the constant system error. The differential component takes into account the rate of change of the error, which improves the dynamic response of the system [4].

Let's imagine that a video frame demonstrates the process of water level control in real time. We can see how water level sensors transmit data to the central controller, which, analyzing the information, adjusts the position of the water supply valves. For example, if the water level falls below a set point, the central controller opens the valves, increasing the water supply to bring the level back to the donor. If the water level is too high, the controller closes the valves, reducing the water supply.

In addition, the feedwater management system includes emergency shutdown mechanisms that ensure safety in the event of emergency situations [2, 3]. For example, if the sensors detect an excessive increase in the water level, which can lead to water hammer, the system automatically closes the water supply valves and notifies operators of the dangerous situation. Such mechanisms allow for quick response to emergencies and prevent possible damage to equipment.

The feedwater management system also includes monitoring and diagnostic tools that allow identifying potential problems in the system [2, 3]. This makes it possible to carry out preventive maintenance and timely troubleshooting, which significantly increases the reliability of the steam generator. Operators can use specialized software to monitor the operation of the feedwater management system, which allows them to obtain up-to-date data on the state of the system and quickly respond to any deviations from normal operation.

Another important aspect of the feedwater management system is its integration with other automatic control systems at a nuclear power plant. The feedwater management system interacts with the reactor control system, turbine control system, and other critical systems [2, 3]. This allows for an integrated approach to the management of all processes at a nuclear power plant, which increases its efficiency and safety.

In the overall context of a nuclear power plant, the feedwater management system plays a key role in ensuring stable and safe operation of the steam generator. It ensures optimal conditions for the production of steam, which is necessary for generating electricity. By automatically controlling the water level, the feedwater management system helps to avoid overheating of pipes and water hammer, which significantly increases the reliability and safety of the steam generator [2, 3].

Proceedings of the 3rd International Scientific and Practical Conference
"Evolving Science: Theories, Discoveries and Practical Outcomes"
February 3-5, 2025
Zurich, Switzerland

Thus, the feedwater management system is an integral part of modern nuclear power plants that ensures efficient and safe operation of the steam generator. Thanks to the use of modern technologies and automatic control methods, the feedwater management system allows maintaining optimal conditions for the steam generator and ensuring stable power generation. This makes it an important element in the overall control system of a nuclear power plant.

References

1. Бабічев В. П. Атомні електричні станції: основи проектування та експлуатації.– Київ: Енергоатом, 2015.– 360 с.
2. Єфімов В. М. Реактори і парогенератори енергоблоків АЕС. – Київ: Вид-во "Наукова думка", 2008. – 350 с.
3. The Feed Water Level Improved Automated Control for Steam Generators of Nuclear Power Plants // IEEE Trans action son Nuclear Science.–2022.–Vol.57,№.2.–P. 5-6.
4. Ковриго Ю. М. Сучасна теорія управління. Частина 2. Прикладні аспекти сучасної теорії управління [Електронний ресурс]: підручник для студ. спеціальності 151 «Автоматизація та комп'ютерно-інтегровані технології», спеціалізацій «Автоматизоване управління технологічними процесами», «Комп'ютерно-інтегровані технологічні процеси та виробництва» / Ю. М. Ковриго, О. В. Степанець, Т. Г. Баган, О. С. Бунке; – Київ: КПІ ім. Ігоря Сікорського, 2017. – 155 с.

DIRECTIONS FOR IMPROVING THERMAL POWER PLANTS TURBOGENERATOR IN THE CONDITIONS OF THE MODERN ENERGY TRANSITION

Shevchenko Valentyna
Doctor of Technical Sciences, Professor
Lazurenko Kostiantyn
postgraduate student
Karpenko Maksym
Master's student
Department of Electrical Machines
National Technical University
"Kharkiv Polytechnic Institute", Ukraine

The world is currently in the midst of a new energy transition in the global environment. It is moving towards the "5D" direction: Decarbonization, Decentralization of Resources, Digitalization, Democratization and Deregulation of energy markets with a focus on consumers. Determining the world's electric power industry future, which is in a dynamic environment of changes and challenges, is

ДОДАТОК Б

Демонстраційний матеріал

Формат	Позиція.	ПОЗНАЧЕННЯ	НАЙМЕНУВАННЯ	Кільк.	Примітки
			Текстові документи		
А4	1	ГЮІК 519.87.012 ПЗ	Пояснювальна записка	80	с.
			Інші документи		
А4	2		Публікація за темою	7	с.
			досліджень		
А4	3		Демонстраційний матеріал	22	с.

					ГЮІК 519.87.012 ВД
Змін.	Арк	Номер докум.	Підпис	Дата	
Розроб.		Твердохліб К.Б.			Розроблення ПІ – регуляторів для забезпечення заданих властивостей частотних характеристик рівня живильної води в корпусі парогенератора ПГВ-1000а Відомість кваліфікаційної роботи
Переві		Ромашов Ю.В.			
Н.конт		Стародубцев М.Г			
Затв.		Невлюдов І.Ш.			

Літера	Арку	Аркуш
Н	1	1

Кафедра КІТАР
ХНУРЕ