Challenge for the Engineering Cup

IMPROVING FUEL UTILIZATION EFFICIENCY

Focus Area

Solutions in the field of energy, energy efficiency improvement, and thermal process optimization.

Objective

To create an engineering solution enabling the effective use of low-grade waste heat from a steam turbine unit in order to improve the enterprise's overall energy efficiency, reduce fuel consumption, and enhance environmental performance.

Company Background

The Siberian Generating Company (SGC) is one of the largest producers of thermal and electrical energy in Russia.
The company supplies energy to millions of consumers and develops advanced engineering solutions aimed at improving the energy efficiency, reliability, and environmental sustainability of power generation facilities.

Site Background

At thermal power plants, a substantial amount of low-grade waste heat is generated during electricity production in steam turbines. This heat is not utilized in the technological cycle and is released into the environment.

This energy resource can be used as an additional heat source for industrial processes, utility systems, or other needs of the enterprise or the city.

Context and Relevance

The energy sector faces the need to reduce operating costs, increase fuel-use efficiency, and optimize thermal schemes.
One of the key reserves for improving energy efficiency is the utilization of low-grade waste heat traditionally discharged to cooling towers or water bodies.

With rising fuel prices and stronger environmental requirements, waste-heat recovery has become one of the strategic development areas for modern CHP and TPP facilities.

Additionally, using this heat reduces thermal impact on the environment and strengthens the overall ecological sustainability of the energy complex.

Problem Statement

A significant portion of waste heat at power plants remains unused, leading to:

• loss of energy potential;
• increased fuel consumption;
• higher operating costs;
• increased load on cooling towers and cooling systems.

A technological solution is required to enable the effective utilization of low-grade waste heat in industrial or utility applications.

Task for Participants

Develop an engineering or e digital ngineering solution that enables the utilization of low-grade heat generated during the operation of a steam turbine.

Teams should:

• propose technological, infrastructural, or cross-sectoral methods for low-grade heat recovery;
• describe the operating principle and integration into the station's existing thermal scheme;
• calculate potential energy and economic effects;
• assess ecological and operational advantages;
• propose implementation phases.

Input Data

• Electrical capacity of the steam turbine: N_e = 200 MW
• Circulating water flow rate: 12000 t/h
• Circulating water temperature: 25 °C

Teams may introduce additional assumptions required for thermal calculations.

Constraints

• The solution must be feasible at an operating CHP/TPP without long equipment shutdowns.
• All works must comply with industrial safety and thermal engineering regulations.
• The proposed technology must include an economic justification.
• The cooling system load must not be increased.

Expected Deliverables

1. Technological concept or process diagram for low-grade heat utilization.
2. Thermal analysis: amount of recoverable heat, heat balance.
3. Economic justification (fuel savings, cost reduction, payback period).
4. Environmental benefits and reduced thermal impact on the environment.

Additional Materials

Appendix 1. Information about SGC.

Information about SGC

1. Name
LLC Siberian Generating Company (SGC).

2. Main Areas of Activity
Production of thermal and electrical energy; transmission and supply of heat and hot water to consumers.

3. Number of Employees in the SGC Group
37.4 thousand employees.

4. Brief Description of the Company's Activities
SGC is an energy holding company and part of the SUEK Group. It has been operating since 2009. The company carries out its activities in the Altai Territory, Kemerovo Region, Krasnoyarsk Territory, Novosibirsk Region, Sverdlovsk Region, Primorsky Territory, the Republic of Khakassia, and the Republic of Tuva.

The Group includes six state district power plants (GRES), one gas turbine power plant (GTES), and twenty combined heat and power plants (CHP) with a total installed electrical capacity of 17.5 GW and a thermal capacity of 26.4 thousand Gcal per hour, as well as heat networks totalling 11 thousand km in length, and repair and service companies.
SGC's power plants account for approximately 23–25% of heat and electricity generation in the Siberian energy system.