Programme of construction of new heat generation facilities in the Far East

The development of the Far East is one of the highest priorities of the state. Thus, the Federal Target Programme for the Development of the Region has been developed, and the Ministry for the Development of the Far East has been created. [103-2], [103-3]

RusHydro Group contributes to the development of the region. The Company's most important investment project is the construction of four facilities on the territory of the Far East within the framework of the execution of the Presidential Decree dated November 22, 2012 No. 1564 "On the Further Development of the Open Joint-Stock Company Federal Hydro-Generating Company-RusHydro".

Financing of projects for the construction of new facilities is carried out mainly from budget funds intended for the development of power in the Far East. For these purposes, the state, under Presidential Decree No. 1564 of November 22, 2012, allocated 50 billion rubles in the framework of the additional capitalization of PJSC RusHydro. [201-4]

The implementation of these projects is the first stage of the Far Eastern Energy Development Programme aimed at replacing the outgoing power capacities and developing the infrastructure of the decentralised energy supply sector. The programme will achieve the following effects for the regions of the IPS of the East by 2025:

- total increase in the gross regional product of the Far Eastern Federal District;
- additional tax revenues for energy companies of the Far Eastern Federal District and related industries (mechanical engineering);
- development of the construction industry: additional housing can be connected to heating service;
- employment growth through the creation of new jobs in industries such as construction, operation of energy facilities and mechanical engineering. [203-2]

PROGRAMME OF MODERNIZATION, TECHNICAL REHABILITATION AND REPAIRS

Comprehensive modernization programme

A significant number of powerful hydroelectric power plants were comissioned in the 1950s and 1960s, and by the early 2000s, there was a need to upgrade and replace existing equipment. Due to the economic difficulties of those years, it was not possible to replace obsolete and worned-down equipment; hence, PJSC RusHydro had to resort to periodic repairs and the replacement of separate units.

Since the middle of the 2000s, a number of stations of PJSC RusHydro had their equipment replaced, but the pace of asset renewal did not allow breaking the trend of aging HPP equipment as a whole.

In December 2011, the Board of Directors of the Company approved the Programme for the comprehensive modernization of generating facilities of PJSC RusHydro (PCM), designed for the period through 2025.

PCM is a unique project for the upgrade of generating facilities in the energy sector.

As part of the RusHydro Programme, it is planned to replace more than half of the main equipment at HPPs:

- 154 turbines (55% of the total number of turbines),
- 119 generators (42% of the total number of generators);
- 176 transformers (61% of the total number of transformers);
- 396 high voltage switches;
- ~ 8 thousand units of secondary switching equipment;
- more than 4,000 units of auxiliary equipment;
- in addition, it is planned to perform the reconstruction of hydraulic structures.

The key requirement of the Comprehensive Modernization Programme is the lack of units of basic generating equipment with an expiry safe operation period before 2025.

Main results of PCM PJSC RusHydro

	2017	2018 (forecast)
Equipment, units		
Turbines	18	7
Generators	10	5
Transformers	2	11
High voltage switches	23	21
Hydraulic structures	11	38
Secondary switching equipment	608	481
Auxiliary equipment	578	265
Increase of installed capacity, MW		
Zhigulevskaya HPP	21.0	10.5
Volzhskaya HPP	10.5	10.0
Saratovskaya HPP	6.0	6.0
Novosibirskaya HPP	5.0	5.0
Votkinskaya HPP	0.0	15.0
Cascade of Verkhnevolzhskiye HPPs	0.0	10.0
Total	**42.5**	**46.5**

Index of the status of groups of main equipment, %

Turbine	76.50
Generators	77.25
Transformers	67.92

Technical Rehabilitation and Modernization Programme

The Technical Rehabilitation and Modernization Programme (further – TR&M programme) is based on a comprehensive modernization programme. It aims to maintain the proper operating condition of the equipment and to introduce new capacities into production, but, unlike PCM, it implies a replacement of the equipment with analogues with improved performance at RusHydro's facilities. TR&M also suggests the extension of the standard operating life of the main generating equipment, reduction of production costs, and the increase of the efficiency of stations.

The programme of technical rehabilitation and modernisation of RAO ES East Subgroup is part of the investment programme of the Subgroup and is connected with the need to maintain the reliability of all technological facilities in the long term. Development and implementation of the programme takes place within the framework set by the technical policy of RusHydro Group.

As a result of RAO ES East Subgroup TR&M programme:

- 1.3 MW of new capacity commissioning;
- 17.2 km of heat lines commissioning;
- 189.82 km of overhead power lines.

Main types of work on TR&M programme RAO ES East Subgroup

Company Name	Events
JSC DGK	Transition of boiler No. 8 to gas
PJSC Magadanenergo	Reconstruction of substations 220 kV "Orotukan", "Palatka", "Centralnaya"
PJSC Sahalinenergo	Development of Sports Complex "Mountain Air" (reconstruction)
JSC Chukotenergo	Transition of Anadyr CHP to gas

Main types of work on Technical rehabilitation and modernization

Branch	Results of 2017 year
Volzskaya HPP	■ Replacement of hydroturbines and hydrogenerators No. 1, 2 ■ Work was done on the construction of the building of the remote control room at 220 kV outdoor switchgear
Votkinskaya HPP	■ Replacement of the hydroturbine and hydrogenerator hydroelectric units No. 4
Zhigulevskaya HPP	■ The project on the reconstruction of hydroelectric power units with the replacement of hydro-turbines and the modernization of hydrogenerators was completed. In 2017, the plant was put into operation No. 8, 11, 20
Kamskaya HPP	■ Construction of laboratory building of Kamskaya HPP was completed
Verhnevolzhskiye HPPs Cascade	■ Reconstruction of hydraulic unit No. 1
Nizhegorodskaya HPP	■ Works on the manufacturing and the supply of hydro turbines, hydrogenerators and automatic control systems of hydroelectric unit No. 1
Saratovskaya HPP	■ Replacement of hydroturbine No. 13
Cheboksarskaya HPP	■ Modernization of hydroturbines No. 5, 17 - transition from a propeller mode to a normal mode (adjustable runner blades mode)
Sayano-Shushenskaya HPP	■ Replacement of excitation systems of hydro generators No. 1-3 ■ Reconstruction and replacement of lifting equipment, the replacement of cranes
Bureyskaya HPP	■ Modernization of turbine No. 5 by mounting the stabilizing device
Zeiskaya HPP	■ Reconstruction of the 500/220 kV switchyard
Novosibirskaya HPP	■ Replacement of hydroturbine No. 3 ■ Reconstruction of the HPP Dam was completed
Cascade Kubanskiye HPPs	■ Development of working documentation for the modernization of PSP, HPP-2 of Sengileevskaja HPP
Dagestan Branch	■ Modernization of hydro turbine equipment hydroelectric unit No. 1 Miatlinskaja HPP – it was replaced and its replacement led toan increase in rated power of 10 MW and a working wheel camera
Karachayevo-Cherckesia Branch	■ Creation of a duplicate communication channel with the main control Panel of Cascade of Kuban HPP ■ Server upgrade
Kabardino-Balkaria Branch	■ Modernization of the station system of the top level of automated control system for the technological process of electricity generation
North Ossetia Branch	■ The construction of the Yezminskaya HPP canal was completed, bypassing the main structures with the additional sump
Zagorskaya PSP	■ Replacement of arching cameras gas-insulated switches FKG2S ■ Modernization of an automated measurement system of commercial electricity accounting

Implementation of the TR&M programme by RAO ES East Subgroup, thousand rubles, without VAT

Company Name	2016	2017
JSC DGK	4,636.07	2,638.06
PJSC Kamchatskenergo	759.78	394.64
JSC SENK	372.30	59.75
PJSC Magadanenergo	1,050.41	763.56
JSC Chukotenergo	313.70	139.93
PJSC Sahalinenergo	1,333.60	849.61
JSC DRSK	726.80	2,243.95
PJSC Peredvizhnaya Energetika	56.05	56.43
PJSC Yakutskenergo	1,746.30	439.38
JSC Sahaenergo	328.40	62.06
JSC Teploenergoservis	129.90	82.27

Expenses for repair works, TR&M programme, RUB mn

	2015	2016	2017	2018 (Plan)
PJSC RusHydro and PJSC RusHydro's controlled companies except RAO ES East Subgroup				
Repair works	3,081	2,748	2,737	2,898
Technical rehabilitation and modernisation	28,560	27,258	27,622	23,008
RAO ES East Subgroup				
Repair works	11,227	11,568	12,693	12,993
Technical rehabilitation and modernisation	6,218	7,142	7,729	12,523

In 2018, Rushydro Group planned the increase of installed capacity of PJSC RusHydro by 46.5 MW with help of technical rehabilitation of hydropower facilities:

- Changing hydroturbines - 7 pcs;
- Changing hydrogenerators - 5 pcs;
- Constructing gas-insulated 500 kV switchgear.

ENERGY EFFICIENCY AND ENERGY SAVING

The main shareholder PJSC RusHydro, Russian Federation, challenges energy companies to increase energy security and reduce power consumption. In accordance with the state programme "Energy efficiency and power development", approved by the Decree of the Government of the Russian Federation of April 15, 2014 No. 321, there are three main directions for improving energy efficiency in the use of all types of energy resources:

- energy efficiency;
- development and modernization of electrical power;
- development of the use of renewable energy sources.

Energy efficiency of hydropower

Hydropower is one of the main branches of the electrical power industry, providing a significant contribution to energy production. At the same time, hydropower is the most economically efficient and environmentally safe industry. Hydropower plants have their own peculiar features that require a special approach to the assessment of energy efficiency and finding ways increase of energy efficiency. Hydropower plants, in addition to power generation, carry out a number of functions, which are critically necessary both for the energy industry and for the life of large groups of the population. These include the hydrotechnical problems of river flow regulation, flood prevention, irrigation of agricultural lands, automobile and railroad transportation across rivers as well as shipping.

In this connection, the hydroelectric power plants may be subject to requirements, sometimes diametrically opposed, which significantly complicates the analysis of their functioning. For example, a discharge of water reduces the overall energy efficiency of the HPP, but it provides a vital drainage of the river, and the operation of the hydrogenerator in the synchronous compensator mode reduces the overall efficiency of the HPP, but ensures the stability of the energy system as a whole.

Due to the lack of consumption of any fuel for the production of electricity, the analysis of energy efficiency of hydropower plants excluded this main cost item, inherent in other types of power plants, with the exception of renewable energy sources. Therefore, the main subject of analysis is its own consumption of power plants.