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The Safety of the Hydraulic Engineering Structures of PJSC RusHydro's HPPs

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General Information about PJSC RusHydro Group Facilities

Installed capacity of power plants – 38.5 GW

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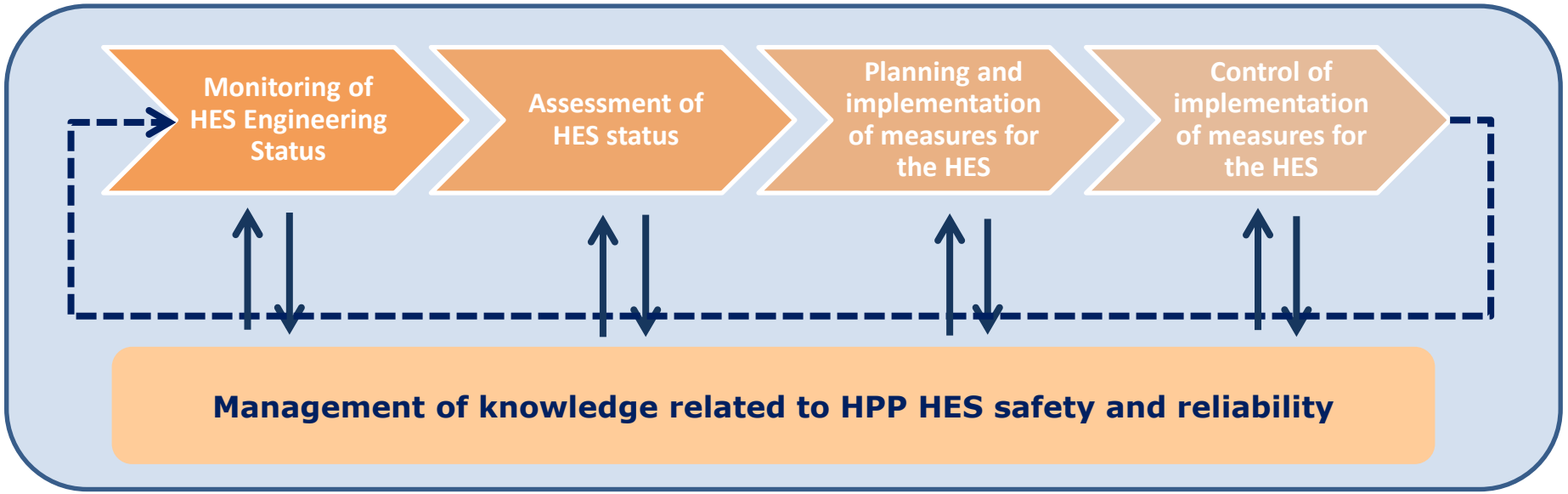
Key HPP Hydraulic Engineering Structure Safety and Reliability Management Processes



The HES status assessment process, which makes it possible to determine the conformity of an HES's status to the established standards and regulations of HES safety and reliability, consists of:

- **On-line HES status diagnostics** – comparison of diagnostic HES status indicators (both qualitative and quantitative) with HES safety criteria.
- **Comprehensive HES status assessment** – a comprehensive analysis of monitored HES status parameters (both qualitative and quantitative), acting loads, natural and man-made influences, and data on the operational level of the structures, as well as an assessment of the HES safety and reliability level, and a forecast of changes in it.
- **Declaring HES safety** – implementation of measures aimed at the development / revision of HES safety declarations, including development / revision of the safety criteria and evaluation of probable damage from HES accidents.

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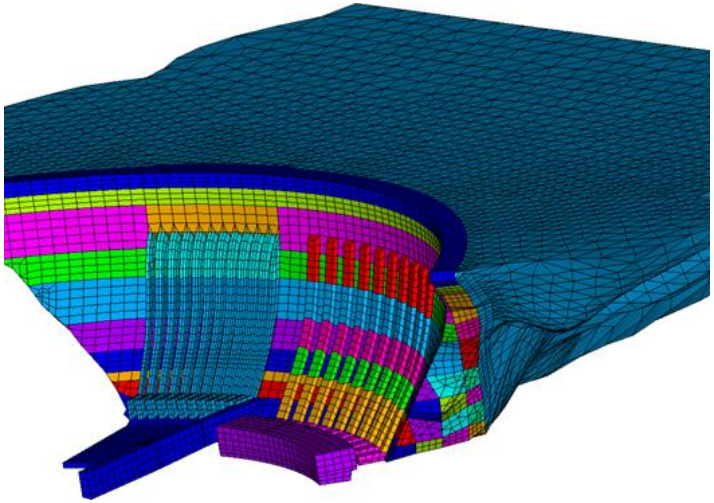
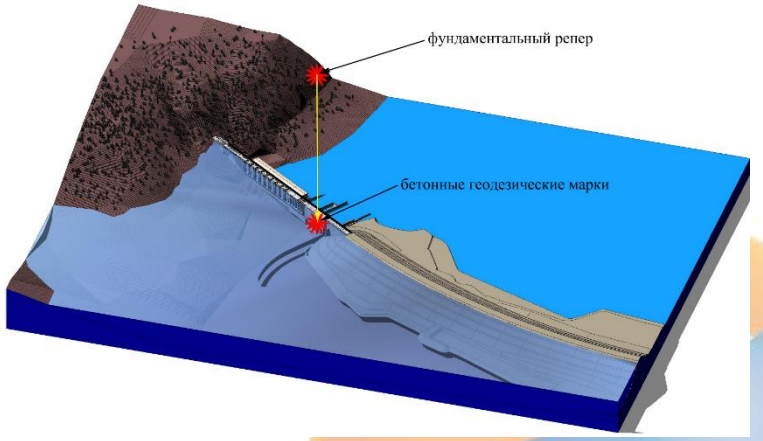
Monitoring of HES Engineering Status

The following tasks are carried out as part of the processes of HES status monitoring and assessment:

- Monitoring and assessment of HES status.
- Modernization and implementation of diagnostic information systems (DIS) for HES status monitoring.
- Revamping of current HES control and measurement instrumentation (CMI), installing new CMI.
- Improvement and revision of HES field study programs with the assistance of specialized research organizations.
- Development of finite-element mathematical models for assessment of the current HES status and subsequent forecasting.
- **Monitoring and assessment of the Company's HESs by RusHydro's Analytical Center.**





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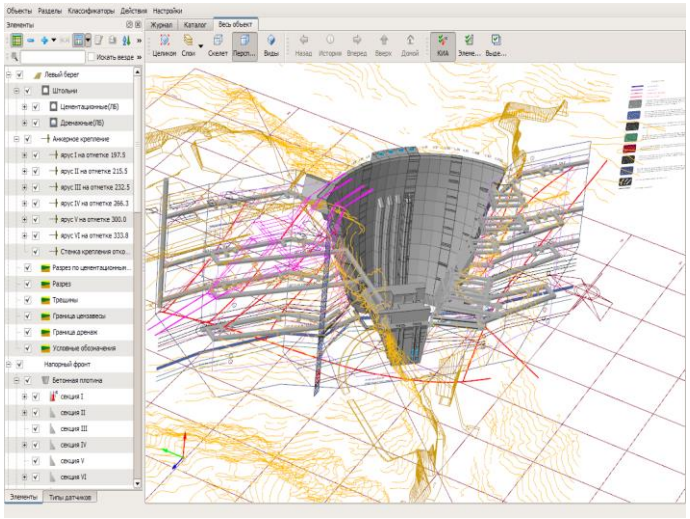
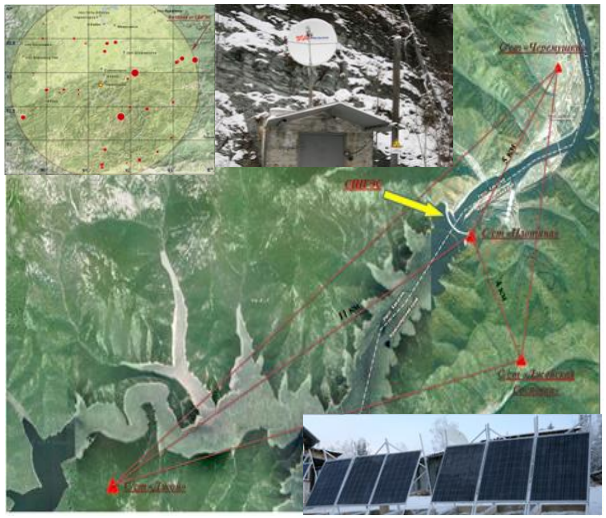
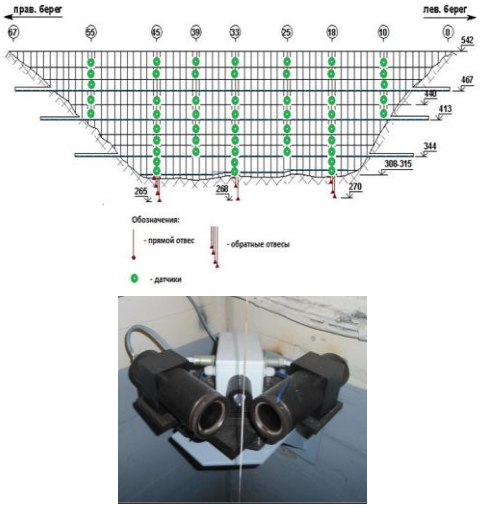
Monitoring of HES Engineering Status
Diagnostic Information Systems







- Diagnostic information systems are one of the tools for setting up HES monitoring based on data from instrumental measurements and visual observation.

The systems allow for the following:

- Entering visual observation data.
- Entering instrumental measurement data both manually and automatically.

Processing and graphical representation of the results obtained from instrumental and visual observation.

- Comparing observation results with the safety criteria (diagnostic indicators) specified by the HES Safety Declaration.
- Managing the schedules of instrumental observations and maintenance.

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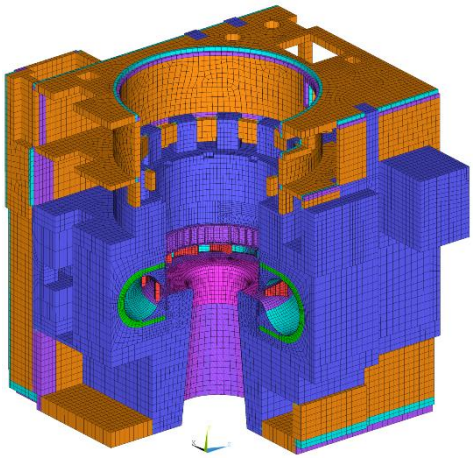
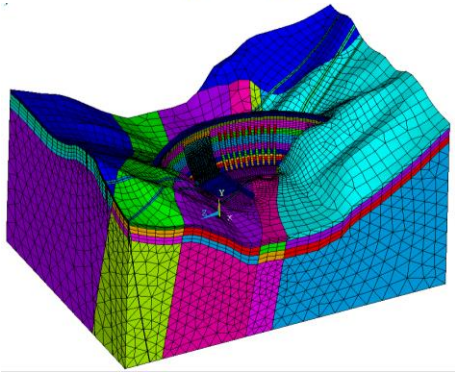
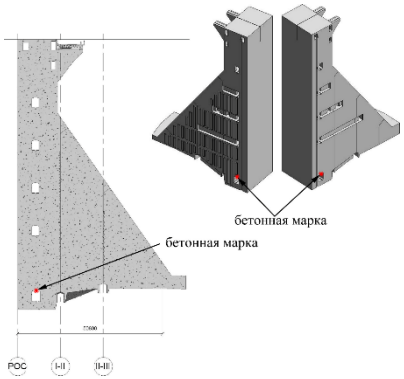
Analytical Center of PJSC RusHydro







The Analytical Center is the decision-making support system of the Chief Engineer's Office of PJSC RusHydro.

The Analytical Center includes subdivisions of the JSC NIIES and JSC B.E. Vedeneev VNIIG research institutes, the JSC Lenhydroproject, JSC Hydroproject and JSC Mosoblhydroproject design institutes, and personnel of the Chief Engineer's Office.

All these bodies belong to the RusHydro Group of Companies.

The main objective of the Analytical Center is to ensure the making of optimum decisions which determine the current and future reliability, safety, and efficiency of HPPs. This is accomplished through the development of draft decisions based on:

- the acquisition, arrangement, and consolidation of all existing information that defines the status and functioning of an HPP and of detected deviations;
- analytical processing, including diagnostics and forecasting;
- development and comparison of decision options.

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Integrated Modernization Program. Goals and Key Parameters

GOALS:

- Safety of hydraulic engineering structures and equipment
- Ensuring economic efficiency and HPP capacity growth
- Reliability of HPP operation and the electrical power system as a whole

Intended Outcomes

Replacement of 154 hydraulic turbines or 55 % of the total equipment stock

Replacement of 119 generators or 42 % of the total equipment stock

Replacement of 176 transformers or 61 % of the total equipment stock

Revamping of 252 hydraulic engineering structures, 57 % of the total number of Company's HESs

Financing (Inclusive of VAT), Bln Rubles, Money of the Day				
2012	2013-2015	2016-2020	2021-2025	TOTAL
44,700	**96,759**	**222,894**	**81,141**	**445,494**

The Integrated Modernization Program for Generating Facilities for 2012-2025 was approved by a Resolution of the PJSC RusHydro Board of Directors dated December 5, 2012.
The key IMP requirement for ensuring the absence of main generating equipment units with expired service life by IMP completion.

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Integrated Modernization Program. Change in the Design Complex Role



- The institution of the General Design Organization was restored in order to increase design documentation quality and provide support at all life-cycle stages of modernization projects.
- The following organizations have obtained General Design Organization status:

JSC Lenhydroproject

JSC Hydroproject Institute

JSC Mosoblhydroproject

JSC B.E. Videneev VNIIG

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Industry-Specific Surveillance and HES Status Monitoring System

Company Level

The following subdivisions of the RusHydro Company are responsible for monitoring the status of hydraulic engineering structures and adherence to operational safety standards and regulations:

Company divisions:

- RusHydro Analytical Center.
- Specialists of PJSC RusHydro when cunducting internal technical audits.

Third-party experts:

- Specialized research organizations.
- Independent companies when conducting surveys for the purpose of insuring PJSC RusHydro's facilities.

National Level

- According to the requirements of the Russian Federation Decree No. 455 "On the Continuous State Surveillance of Hazardous Production Facilities and Hydraulic Engineering Structures" dated May 5, 2012, continuous government surveillance has been established at PJSC RusHydro HPPs in hazard class 1 and 2 (35 HPPs). Surveillance is carried out by Rostekhnadzor inspectors.
- Rostekhnadzor is the authorized agency for implementation of state surveillance in the field of HES safety.
- In accordance with the legislation, PJSC RusHydro's facilities undergo an integrated audit of compliance with HES safety requirements at least once every 3 years.

Thank you for your attention!

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