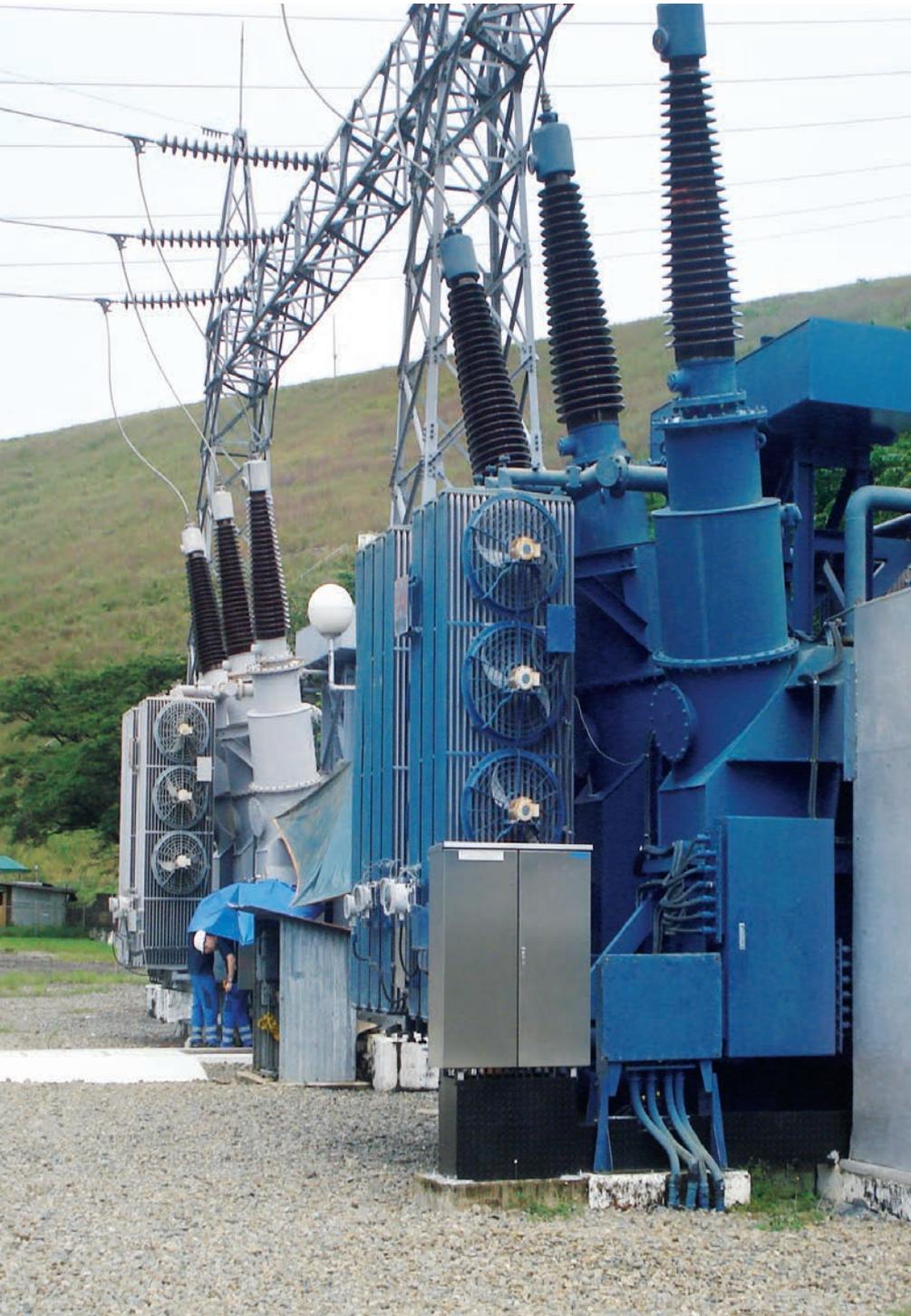


# Service and Rehabilitation Electrical Power Systems



From  
water  
to  
wire

# Modernization and rehabilitation



International technology group ANDRITZ is a globally leading supplier of plants, equipment, and services for hydropower stations, the pulp and paper industry, the metal-working and steel industries, and solid/liquid separation in the municipal and industrial sectors.

ANDRITZ HYDRO, part of the ANDRITZ GROUP, is one of the leading global suppliers of electro-mechanical equipment and services for hydropower plants. With over 175 years of experience and more than 31,600 turbines installed - totaling about 434,000 MW of capacity - ANDRITZ HYDRO offers the complete product portfolio, including turbines, generators, as well as mechanical and electrical systems of all types and sizes.

More than 120  
years of experi-  
ence in electrical  
engineering

As a leader in the global market for hydraulic power generation, ANDRITZ HYDRO develops tailor-made solutions to meet customer requirements and expectations, delivering products and services of the highest quality.

# Why rehabilitate existing systems?

## System integration

**ANDRITZ HYDRO offers a comprehensive service for the design, procurement, transport, installation, and commissioning of the complete product range of nominated suppliers - from low to high voltage equipment - and also provides full system integration.**

With its profound experience in the rehabilitation and modernization of hydropower plants, ANDRITZ HYDRO is well prepared to deliver prolonged operational lifetimes.

Aging equipment requires more maintenance and is more likely to cause unexpected failure or shutdown, leading to loss of production. Due to the lack of available spare parts, repair works can be complicated, lengthy, and sometimes even impossible. Hence, timely rehabilitation and modernization are critical to ensure the continued asset value of a hydropower plant.

## Environmental aspects

Equipment modernization supports the mitigation and prevention of environmental threats and contamination events, such as oil and acid leakages or emissions of sulfur hexafluoride (SF<sub>6</sub>) ensuring ANDRITZ HYDRO's environmental responsibilities.

## Availability and efficiency

New components provide higher availability and efficiency of the plant and lead to higher production output.

## Health and safety

Refurbishment and modernization of electrical equipment and components - such as removal of asbestos, use of oil-free transformers, or SF-free circuit breakers, reduction of noise emissions or implementation of adequate protection - increases the health and safety standards of the plant.

## Power output increase

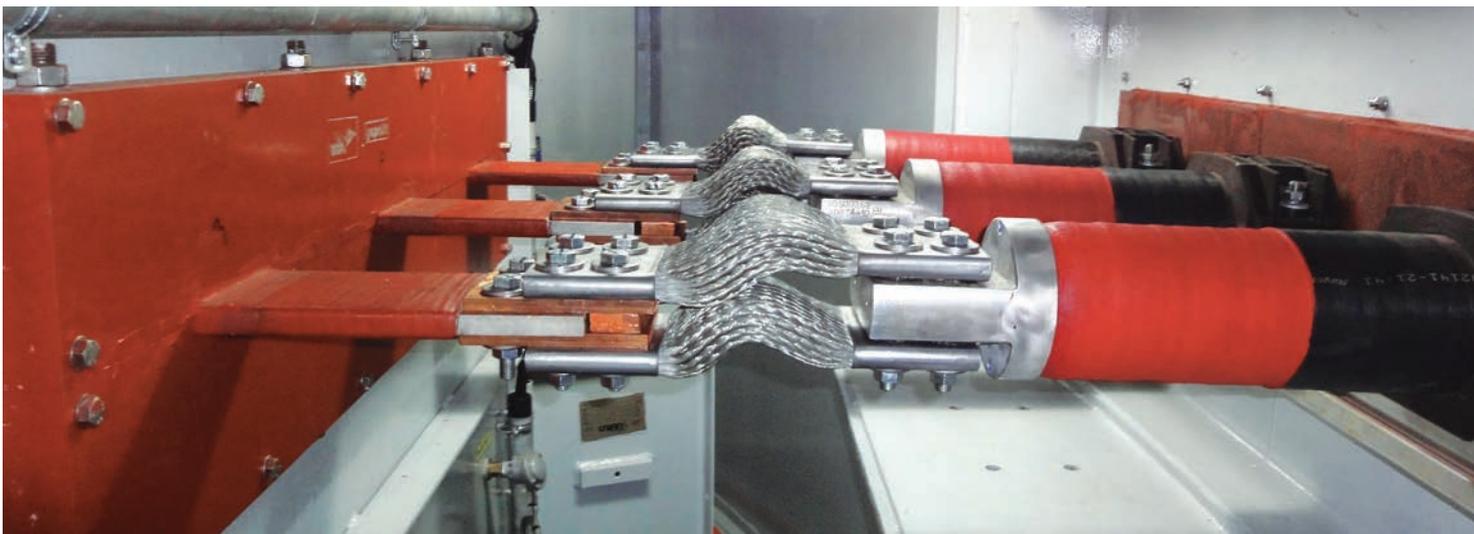
Increasing turbine and generator power output also requires a detailed analysis of the entire electrical system. Only specific adaptations of existing electrical equipment guarantee reliable operation with a higher output.

## Power train

The power train evacuating energy from the generator to the grid is the most important part of a hydropower plant's electrical system. After years of operation and thousands of grid synchronization events, modernization of the associated equipment - such as generator circuit breakers, MV switchgear, bus ducts, transformers and HV equipment - is necessary.

## Grid code compliance

With renewal of electrical power systems, adaption to the actual grid codes may be required. On-going grid code compliance of rehabilitated and/ or upgraded power plants can be assured by means of transient calculations and grid studies.





# Modernization process

## Turn-key solutions

ANDRITZ HYDRO provides turn-key rehabilitation from a single source, reducing the number of interfaces required between involved parties, and enabling optimized scheduling of all rehabilitation activities.

Depending on the plant condition, customized modernization of specific plant components can also be performed based on an exact condition assessment.

## Modernization process

Rehabilitation is a very complex issue and the aging of the various plant components and systems depends on environmental, operating and ambient conditions. In addition to various specific customer requirements, a combination of tailor-made solutions is key to meeting technical, economical and legal market needs.

## Three-phase approach

Based on long-term experience, ANDRITZ HYDRO has developed a structured process for the assessment and modernization of power plants. This process consists of three phases:

### Phase 1 - Diagnosis

Major elements of the diagnosis phase include:

- Registration of required plant data (single line diagrams, layout, drawings etc.)
- Registration of operation and maintenance records, and spare parts
- Visual inspection
- Selected on-site measurements, such as contact resistance tests, use of IR-cameras for hot spot detection, operating current, and earth current measurements, detection of unbalanced loads, fault circuit impedance measurements, insulation measurement, as well as oil analysis or oil leakage detection.

### Phase 2 - Analysis

Acquired data will be technically analyzed, assessed and further processed in order to establish possibilities for improvement in performance. Suitable modernization scenarios are evaluated based on economic, safety and lifetime expectations. Together with the customer the most feasible solution is selected and agreed upon.

### Phase 3 - Therapy

Implementation begins with basic and detailed design and ends with the commissioning of the modernized equipment. The focus is on the additional challenges compared with greenfield projects, such as management of the many interfaces between existing components and structures and any new elements.

#### Highlights:

- Condition assessment
- Tailor-made solutions
- "From water-to-wire" (W2W) competence and system integration
- Optimized scheduling and minimal outage period

# Rehabilitation competence

## Identified needs for each component

After many years of operations attention is increasingly focused on:

- Availability of spare parts
- Loss of knowledge of existing plant and maintenance
- Condition monitoring and diagnostic capability

Typical problems of electrical power plant equipment after years of operation are:

- Operational malfunctions
- Oil quality / leakage
- Heat problems, chemical reactions
- Problems in switching operations
- Capacity of battery system
- Insulation resistance
- Damage on cables

## Typical plant services

ANDRITZ HYDRO offers the following services:

- Recalculation of load flow and short circuit analysis
- Check and enhancement of redundancy and operational safety concept
- Analysis of protection systems
- Refurbishment / modernization of high-, medium- and low voltage systems
- Adaptation of the DC system, batteries, UPS, and emergency diesel to allow stand-by capability
- Control, protection, and SCADA system

## Plant safety enhancements

The main objective of hydropower plant operation is to guarantee safe, stable, and reliable electricity production under regular and fault conditions, taking into account external factors such as grid disturbances or system failures.

By modernizing essential components, the plant operation concept is enhanced, ensuring a future of safe and reliable operation.

## Reduced downtime and optimized process

In order to reduce the outage period during the modernization process, ANDRITZ HYDRO optimizes all rehabilitation activities from the design stage up to and including site installation.



# Selected references



**Kindaruma, Kenya**

Modernization of 2 x 28.2 MVA units and one new 28.2 MVA unit including:

- 132/11 kV switchyard
- Main transformers
- 415 V AC system
- 110 V DC systems
- Cabling
- Excitation
- Protection
- Unit control and SCADA

**2010 - 2013**



**Shardarinskaya, Kazakhstan**

Modernization of 4 x 35 MVA units including:

- 12 kV MV switchgear & duct
- LV AC and DC systems
- Emergency diesel genset
- Fire protection system
- Cable system and lighting
- Control, excitation, protection

**2013 - 2017**



**Bajina Basta, Serbia**

Modernization of 4 x 109.60 MVA units including:

- 220 kV HV switchgear
- Main transformer
- MV switchgear equipment
- LV and control cabling
- Control, excitation, and monitoring system

**2007 - 2013**



**Pantabangan, Philippines**

Modernization and upgrading of 2 x 71 MVA units including:

- MV switchgear
- AC distribution
- DC distribution
- Control, excitation, and protection system
- Monitoring

**2008 - 2011**



**5 de Noviembre, El Salvador**

Modernization of 5 x 20-24 MVA units including:

- 11kV unit switchgear
- AC distribution
- DC system
- Emergency diesel genset
- MV, LV and control cabling
- Control, excitation, protection

**1999 - 2003**



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