“AVAILABILITY” is a key theme for Alstom Hydro Services teams, and ensures that:
• Plants achieve a high level of availability
• Customers’ needs are addressed
  – anytime, any place
• Alstom is recognised as an “easy-to-do-business-with” partner
• The latest hydropower technologies are always available to customers
Hydro power plant operators are likely to face various service challenges in order to maintain plant availability, to ensure hydro equipment is running at optimum efficiency and to increase its performance. Assessing, maintaining, upgrading and replacing equipment may all be necessary from the very first operating years as well as during the plant’s operational lifecycle.

Alstom has been a world-leading hydro supplier for over a century and has provided its cutting-edge technology and services to more than 25% of the world’s installed base. Over this time, Alstom has built on its expertise to position itself to meet the needs of all hydropower plant services and retrofit requirements.

**Alstom, your long-term partner**
With the broadest range of hydro solutions and services on the market, Alstom operates in more than 70 countries. This truly global presence means Alstom Hydro Services experts are well positioned to provide your plant, wherever it is, with the highest level of service and support, bearing in mind cultural practices and requirements.

To ensure plant operators, owners and investors can achieve and maintain optimum performance, the Alstom Hydro PlantLife® programme – a comprehensive asset management programme, offers customised and off-the-shelf service and retrofit solutions, suitable for fleets, plants and components, covering all technologies for:
- Turbines
- Generators
- Control systems
- Hydro-mechanicals
- Balance of Plant

To reduce total cost of ownership and to optimise hydro power equipment over the entire plant lifecycle, Alstom offers proven tailor-made or turnkey solutions based on state-of-the-art technology while respecting the latest environmental regulations. Our solutions are compatible with Alstom and Other Original Equipment Manufacturer (OEM and OOEM) equipment, regardless of size of hydro power equipment, ensuring the highest global water-to-wire performance is achieved.
How Alstom is helping you

CLEAN POWER CLEAR SOLUTIONS™

Our Power generation offering is based on a deep understanding of power markets and our customers’ needs. It is organised around three levers to maximise the return of assets over their entire lifecycle.

REDUCING COST OF ELECTRICITY

It takes competitive assets to keep electricity affordable. We enable power companies to compete successfully in the marketplace and provide affordable electricity to consumers. We help you reduce the cost of electricity through:

• Efficiency improvements
• CAPEX reduction/scaling up
• Capacity Factor increase (renewable)
• Lead time reduction
• Competitive O&M
• Competitive financing

LOWERING ENVIRONMENTAL FOOTPRINT

Clean generation is one way of demonstrating environmental responsibility. Another is lowering resource usage, visual impact and noise pollution. In both cases, we can help you meet or exceed regulations and environmental standards. That is why Alstom innovates in the following areas:

• Renewable portfolio
• Natural resource optimisation
• CO₂ emission reduction
• Land use, visual impact and noise
• Water intensity reduction & recyclability

INCREASING FLEXIBILITY & RELIABILITY

Intermittent power generation is a growing challenge for energy security, as is maintaining an ageing installed base and adapting it to changing market conditions. We help you tackle both issues so that you can enjoy dependable operations with:

• Maintainability and outage time reduction
• Operational and fuel flexibility
• Designs and service for improved availability and reliability
• Energy storage
Clear Solutions
meet the challenges of energy sustainability

ENERGY SUSTAINABILITY: A GLOBAL CHALLENGE

1 in 5 people globally lack electricity.

A 20% rise in global energy-related carbon dioxide emissions could happen by 2035.

Only 20% of renewable energies in global electricity generation.
Proximity is the key to providing the level of service excellence that you expect. Alstom operates in more than 70 countries, ensuring optimal support through its local presence. Dedicated to providing a quick response, regardless of your geographical location, our teams and local Service Centres are on hand to support you to address your own unique requirements.

**CANADA**
- Global Technology Centre
  — Service & Retrofit
  Hydro Customer Service Centre
  Also supporting: Mexico
  Sorel-Tracy, Qc – Canada
  hydroNAMservice@alstom.com
  Tel: +1 (450) 746 6562 (Western Canada)
  Tel: +1 (450) 746 6557 (Eastern Canada)
- Hydro Customer Service Centre
  — Small hydro
  Granby, Qc – Canada
  service.canada.smallhydro@alstom.com
  Tel: +1 (855) 522 0755

**USA**
- Hydro Customer Service Centre
  Denver (Littleton), CO – USA
  hydroNAMservice@alstom.com
  Tel: +1 (303) 730-4036
- Hydro Customer Service Centre
  — Controls & Governors
  Monroe, WA – USA
  hydroNAMservice@alstom.com
  Tel: +1 (715) 359-0209 ext.15
- Hydro Customer Service Centre
  — Controls & Governors
  Schofield, WI – USA
  hydroNAMservice@alstom.com
  Tel: +1 (715) 359-0209 ext.16

**BRAZIL & LATIN AMERICA**
- Global Technology Centre—Kaplan
  Hydro Customer Service Centre
  Also supporting: Argentina, Bolivia, Chile, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay, Venezuela
  Taubaté, São Paulo – Brazil
  hydroserviceLAM@alstom.com
  Tel: +55 12 3608 3777

**COLOMBIA**
- Hydro Customer Service Centre
  Bogotá – Colombia
  hydroserviceLAM@alstom.com
  Tel: +57 1 63512227

**AUSTRIA**
- Hydro Customer Service Centre
  Vienna – Austria
  Office.AT@alstom.com
  Tel: +43 1608882210

**FRANCE**
- Hydro Customer Service Centre
  — Small hydro
  Belfort – France
  HydroServiceSouthEurope@alstom.com
  Tel: +33 (0)4 76 39 36 92
of local Service Centres
Supporting you anytime, anywhere

FRANCE
- Global Technology Centre (GTC)
  — GTC lead Centre and Turbines
Hydro Customer Service Centre
Also supporting: Benelux, Greece, Turkey
Grenoble – France
HydroServiceSouthEurope@alstom.com
Tel: +33 0(4) 76 39 36 92

ITALY
- Hydro Customer Service Centre
  Milan – Italy
HydroServiceSouthEurope@alstom.com
Tel: +39 02243483285

NORWAY
- Hydro Customer Service Centre
  Also supporting: Denmark, Greenland, Iceland
Oslo – Norway
HydroServiceNorthEurope@alstom.com
Tel: +47 22127322

PORTUGAL
- Hydro Customer Service Centre
  Lisbon – Portugal
HydroServiceSouthEurope@alstom.com
Tel: +351 218457233

SPAIN
- Hydro Customer Service Centre
  Barcelona, Catalonia – Spain
HydroServiceSouthEurope@alstom.com
Tel: +34944728540
- Hydro Customer Service Centre
  Bilbao, (Galindo), Biscay – Spain
HydroServiceSouthEurope@alstom.com
Tel: +34944728540

SWEDEN
- Hydro Customer Service Centre
  Also supporting: Baltics, Finland, Ireland, United Kingdom
Västerås – Sweden
HydroServiceNorthEurope@alstom.com
Tel: +46 21326266

SWITZERLAND
- Hydro Customer Service Centre
  — Generators
Also supporting: Germany, Poland
Birr – Switzerland
HydroServiceNorthEurope@alstom.com
Tel: +41 585066886
- Hydro Customer Service Centre
  Vevey – Switzerland
HydroServiceNorthEurope@alstom.com
Tel: +41 216017625

TURKEY
- Hydro Customer Service Centre
  Ankara – Turkey
HydroServiceSouthEurope@alstom.com
Tel: +903124440457

RUSSIA and CIS
- Hydro Customer Service Centre
  Moscow – Russia
HydroRussiaAndCisService@alstom.com
Tel: +7 495 989 99 09
- Hydro Customer Service Centre
  Alstom-RusHydroEnergy JV
Ufa*, Republic of Bashkortostan – Russia
HydroRussiaAndCisService@alstom.com
Tel: +7 347 246 2600

CHINA & SOUTH-EAST ASIA
- Global Technology Centre
  Hydro Customer Service Centre
Also supporting: Cambodia, Indonesia, Laos, Malaysia**, Myanmar, Philippines, South-Korea**, Thailand, Vietnam
Tianjin – China
HydroAsiaService@alstom.com
Tel: +86 139 2025 2310

INDIA & ASIA
- Global Technology Centre
  — Pelton technology & Silt Abrasion
Hydro Customer Service Centre
Also supporting: Bangladesh, Buthan, Nepal, Sri Lanka
Vadodara, Gurajat – India
hydroINDIAservice@alstom.com
Tel: +91 (0) 2656613437

AUSTRALIA & OCEANIA
- Hydro Customer Service Centre
  Grenoble – France
HydroServiceSouthEurope@alstom.com
Tel: +33 (0)4 76 39 36 23

AFRICA & MIDDLE EAST
- Hydro Customer Service Centre—GTC lead
  Grenoble – France
HydroServiceSouthEurope@alstom.com
Tel: +33 (0)4 76 39 31 86

*To be opened in 2014 - **Hydro Customer Service Centre to be opened in Kuala Lumpur and in Seoul in 2015
A comprehensive hydro plant management programme

PlantLife® is built on three pillars:

- **Assess**: Schedule the diagnosis and supervision of your hydropower plant performance
- **Secure & Extend**: Maintain plant availability and increase its lifetime
- **Reset & Upgrade**: Provide your plant with a second lease of life and optimise its performance and efficiency

Each module has been designed to meet customers’ priorities of speed of deployment in a fully integrated approach, by ensuring:

- Quick and accurate diagnosis
- Minimal downtime during assessments, repair or retrofit
- Operational equipment unaffected during repair or retrofit
- Respect for environmental and health & safety considerations
- Maximised return on investment

(1) - Replacement or reconditioning of major components
- Plant rehabilitation or renovation to reset performances
Alstom Hydro PlantLife® is fully dedicated to helping customers manage, protect and maximise their investment throughout the lifetime of their equipment, regardless of manufacturer, age or condition. Devised with proven yet flexible solutions, it comprises standardised and tailor-made modules for fleets, plants or components.

Standardised and customised solutions covering all types of hydro equipment

1. Generator and excitation system
2. Turbine and governor
3. Control system
4. Hydro-mechanical equipment
5. Balance of Plant

A 250 MW Kaplan turnkey power plant powered by Alstom in Bujagali (Uganda)
Comprehensive assessments show that the availability and reliability of equipment largely depend on the condition and behaviour of several key components. Alstom’s unique monitoring and diagnosis methods provide you with an informative and well-proven aid to better operate and maintain your plant.

The Assess programme provides continuous supervision and control of plant performance, simplifying and improving the scheduling for future investments. Three modules allow you to get a clear assessment of components, plants or the entire fleet:

**Diagnosis**
Alstom’s diagnosis technologies are designed to accurately determine the status of key components within turbines, generators as well as the balance-of-plant, with a short outage approach. We are able to detect abnormal behaviour, to test absolute or relative efficiency of equipment, to carry out fatigue analysis, to recommend regulation adjustments and provide reverse engineering.

- **WIDIPRO®,** our dedicated generator’s winding diagnosis programme, assesses the current state of the stator and rotor winding insulation system, including the winding support and fastening elements, to determine whether the winding is reliable for a further operating period.
- **Innovative Diris® solution** to check the slot wedges of the stator without dismantling the rotor. The purpose of this inspection is to ensure that the slot wedges are secured in place, to assess the slot filling and to make sure that the winding components are adequately fastened within the slots.

**Lifetime Forecast Analysis**
Alstom offers comprehensive analysis to estimate the remaining lifetime of generators. It comprises two phases:

- **Accurate condition assessment** – Alstom’s team of experts establish a complete fingerprint of the generator.
- **Remaining lifetime analysis** – Alstom provides analysis through its PlantLife® simulators on the generator to deliver a five year “green light”.

Alstom has successfully carried out more than 6,000 assessments to date. An effective lifetime forecast analysis is based on prior condition assessments data, and ensures both an efficient maintenance programme and investment plan to reduce the risk of equipment failure.

**Condition Assessment & Audit**
This tool is designed to accurately assess the state of the whole plant or of one of its components (turbine, generator, control system, hydro-mechanics and balance-of-plant) while minimising outage time and related costs.

Condition Assessment & Audit provides full in-depth knowledge of the complete power plant performance and a clear scope, including technical specifications of future interventions, in order to facilitate maintenance and investment decisions.
The Secure & Extend programme ensures that plant equipment is always available for electricity production, while increasing its lifetime.

Training
Plants can operate at optimal levels when staff are well trained, reactive and highly efficient. Alstom can impart knowledge and refine the skills of plant staff through a combination of theoretical and practical training. Alstom offers plant owners access to its library of worldwide best practices, based on 100+ years’ experience, and gives the opportunity to learn about latest technologies. Customers can tap into a large variety of courses to suit their teams’ needs and can request customised courses to address specific issues or scenarios. Training can be conducted at your power plant, in an Alstom Training Centre, or through e-learning programmes, taking into account the workload of your staff. Courses are conducted by senior engineers, and as experts in their specific field, they will share their real life experiences. At the end of each training session, a final exam assesses the transfer of knowledge.

Spare Parts
A spare parts stock in the power plant is not always the most effective solution for procuring common replacement parts. As standardised sub-components are common to a wide range of hydro plants, Alstom manages readily available and genuine high quality spare parts for Alstom and Other OEM equipment, covering turbines, generator, control system, balance-of-plant and hydromechanics. The Alstom spare parts system means reduced demands on a plant’s spare parts store and helps to lower losses that can occur as a result of unplanned outages due to inadequate parts. This means:
- reduced storage or inventory area and related costs
- reduced parts orders and delivery cycle

Emergency Field Services
In an emergency, local Alstom Hydro Services teams can provide reactive and accurate assistance to get plants back online in the fastest possible time, thanks to our extensive state-of-the-art equipment and plant expertise. This service includes analysis of inherent failure mechanisms and causes, repairs and final tests. Plant owners can reduce the need for specialised in-house staff and reduce downtime and breakdown costs.

Maintenance, Repair & Overhaul (MRO)
Alstom provides regular Maintenance, Repair & Overhaul (MRO) services for your equipment with the aim of retaining or restoring it to optimum performance levels. When carrying out regular inspection, scheduled or preventive maintenance and cleaning works, Alstom identifies and recommends pro-active small repair jobs that are key to reducing the impact of unexpected events and to eliminate the risk of serious damage. Such interventions increase machine availability and lengthen the operating life of components.

Operation & Maintenance
Alstom can design Operation & Maintenance (O&M) programmes for a whole fleet, a plant or any other type of equipment. Our programme is built on optional modules according to your business requirement: from scheduled and unscheduled maintenance (troubleshooting, performance supervision) and operation support, up to full operation and maintenance contracts, including complete administration of the hydro power plant. Outsourced O&M ensures: guaranteed availability, competitive, controlled and predictable maintenance costs as well as highly skilled staff for each piece of equipment.
Reset & Upgrade

The Reset & Upgrade module is designed for ageing equipment that requires refurbishment or upgrading. Alstom proposes three tailor-made solutions that can be adapted to each plant owner’s specific needs.

**Refurbishment**
Replacement or reconditioning of major components prevents forced outage and can restore initial performance levels. Plant rehabilitation or renovation can reset global performance. In a wider perspective, such interventions can extend plant life and provide an opportunity to optimise plant availability and maintainability.

This module is designed for replacing equipment, regardless of manufacturer (Alstom and Other OEM) and integrates the latest developments in project management to ensure a short downtime. Loss of production and overall costs of refurbishment can be reduced, thanks to our “Pit Stop” approach.

**Upgrade Kit for Planned Outage**
Designed to reduce production loss, Alstom offers you an exclusive set of services to upgrade components during a planned overhaul. The Upgrade Kit for Planned Outage is devised to optimise an offline period during which complementary maintenance, repairs or upgrades are carried out. Such shadow interventions are fully tied in with the schedule of the main overhaul. They aim to enhance the global performance of a plant by bringing more efficiency to its components.

---

The Alstom “Pit Stop” option for generators:

Based on Formula One® best practice, our refurbishment module can include a speedy “Pit Stop” option for generators aiming to reduce downtime to an absolute minimum. Compared to a traditional process, the “Pit Stop” approach can significantly reduce downtime, with an average lead time reduction of up to 75%.

<table>
<thead>
<tr>
<th>Total costs of refurbishment</th>
</tr>
</thead>
</table>

**Standard approach**

- Loss of production

**Pit Stop approach**

- Pit Stop savings

- Refurbishment costs

1Days of outage x daily production
Field Services, combining global expertise with local resources

Alstom can respond with unmatched confidence and speed, to reduce outage times. Our Field Service network provides you with skilled and experienced experts to keep your plant operations in line with your strategy and needs.

Our local presence allows us to deliver consistent results taking into account specific local regulations and constraints.

- Installation, construction, supervision and commissioning
- Inspections and performance tests
- Operations
- Maintenance

Environmentally friendly solutions

While Alstom supports plant owners to maximise plant performance and return on investment, our extensive range of products are devised to make hydropower plants more environmentally friendly.

Alstom environmentally friendly products can form part of a Refurbishment and Upgrade programme:

**Water-lubricated solutions**
For nearly 30 years, hydrostatic guide bearings have forced filtered water from the penstock between the shaft and bearing components to create a lubricating film of water. This eliminates the risk of oil pollution from the turbine discharge and saves costs.

**Oil-free solutions**
By supplying power plants with eco-friendly oil-free turbine components (such as Kaplan oil free hub, self-lubricated bushings, biodegradable and low toxicity oil), Alstom prevents any oil leakage and contributes to the protection of aquatic life.

**Fish-friendly turbine solutions**
Designed to protect migrating fish from harm, our fish-friendly turbines increase survival rate of fish entering turbines.

**Dissolved oxygen enhancement**
Thanks to air admission systems, Alstom solutions bring back dissolved oxygen levels and total dissolved gas levels to acceptable values to preserve the balance of natural ecosystems.

**Upgrade**
A power plant modernisation programme can involve more than just refurbishment. Overall performance levels can be improved by upgrading equipment through technology evolution.

To ensure increased output or to meet peak demands, the Upgrade module offers you a range of upgraded & refurbished components, or can be implemented as a turnkey solution. This module combines study with analysis to provide affordable solutions for plant owners wishing to improve plant operation, performance and efficiency.

The Upgrade programme:
- Increases efficiency of old units
- Increases output with additional discharge
- Improves peaking capability
- Enables addition of new units
- Complies with new environmental regulations
- Ensures safety standards upgrades
- Ensures obsolete equipment upgrades
- Can operate one or several plants remotely
Why choose Alstom?

Your everyday partner for long-term performance

With unsurpassed experience based on the largest worldwide hydro installed base, Alstom supports you to achieve the highest global water-to-wire performance during the whole plant lifecycle.

Alstom ensures:

**Increased plant availability and reliability**
Plant availability and reliability are increased through minimisation of asset downtime and outage required for equipment maintenance, repair or retrofit.

**Maximised return on investment**
Alstom helps to ensure customers’ plants stay up and running with best performance during peak performance times, ensuring optimal return on investment.

**Improved environmental performance**
Alstom has a complete portfolio of products dedicated to addressing environmental requirements and concerns while increasing plant’s performance.

**Secured and extended plant lifetime**
With Alstom’s on-site inspections and condition monitoring systems, plant operators can easily plan and execute operation & maintenance strategies and decide whether to change operating conditions or whether to extend plant life.

Over 100 years’ experience in offering proven tailor-made or turnkey solutions based on Alstom and Other OEM heritage.

**Alstom offers:**

**Comprehensive services for fleets, plants and all equipment**
With the largest portfolio of Services & Retrofit solutions on the market, Alstom Hydro Services is your partner for improving, modernising and making your plant greener.

**Latest technologies and state-of the-art solutions**
Alstom customers benefit from our global one-of-a-kind Research & Development capabilities network. Choosing Alstom ensures that the latest technological developments are available.

**Emergency response**
Alstom Hydro Services local teams, backed up by the entire Alstom Thermal Services network, are able to restore plants back to service in the shortest possible time.

**Genuine spare parts**
Alstom offers genuine spare parts support for customers, ensuring availability of components in the shortest possible lead time. Customers no longer need worry about interchangeability, compatibility and/or quality of spare parts.
Alstom

Alstom is a global leader in the world of power generation, power transmission and rail infrastructure and sets the benchmark for innovative and environmentally friendly technologies.

Alstom builds the fastest trains and the highest capacity automated metro in the world, provides turnkey integrated power plant solutions and associated services for a wide variety of energy sources, including hydro, nuclear, gas, coal, wind, solar thermal, geothermal and ocean energies. Alstom offers a wide range of solutions for power transmission, with a focus on smart grids.

Power generation

Alstom Power offers solutions which allow their customers to generate reliable, competitive and eco-friendly power.

Alstom has the industry’s most comprehensive portfolio of thermal technologies – coal, gas, oil and nuclear – and holds leading positions in turnkey power plants, power generation services and air quality control systems. It is also a pioneer in carbon capture technologies.

Alstom offers the most comprehensive range of renewable power generation solutions today: hydro power, wind power, geothermal, biomass and solar. With ocean energies, we are developing solutions for tomorrow. Alstom is one of the world leaders in hydro power, the largest source of renewable energy on the planet.