ZECO Kaplan turbine

Who is ZECO?

ZECO has more than half century of experience in turbine design and manufacturing and relies on a dense network of premium quality suppliers and partners. The final product combines years of experience with the best technology and materials.








This document acknowledges the “General Contract Conditions for ZECO di Zerbaro e Costa e C srl ”.

ZECO solution for the hydro-power plant

Based on our 50years know-how and experience, ZECO Kaplan is the best solution for your project.

CASTELLO D'ANNONE, Italy, 2014:

- Turbine: Double regulated Horizontal Kaplan Bulb
- Net Head: 3.9 m (12.0 fts)
- Flow rate: 32.0 m^3/s (1130.1 cfs)
- Nominal power: 1091 kW
- Nominal speed: 167 rpm
- Runner diameter: 2400 mm

SEYON AVAL, Switzerland, 2017:

- Turbine: Double regulated Vertical TAT kaplan
- Net Head: 18.8 m (61.7 fts)
- Flow rate: 1.4 m^3/s (49.4 cfs)
- Nominal power: 232 kW
- Nominal speed: 1000 rpm
- Runner diameter: 540 mm

VETRA, Italy, 2015:

- Turbine: Double regulated Vertical Kaplan Bulb
- Net Head: 6.4 m (21.0 fts)
- Flow rate: 11.0 m^3/s (388.5 cfs)
- Nominal power: 622 kW
- Nominal speed: 333 rpm
- Runner diameter: 1450 mm

SOMESUL MAR, Romania, 2016:

- Turbine: n° 2 Double regulated Vertical Radial Kaplan
- Net Head: 5.7 m (18.7 fts)
- Flow rate: 10 m^3/s (353.1 cfs)
- Nominal power: 997 kW
- Nominal speed: 238 rpm
- Runner diameter: 1500 mm

ZECO hydropower Kaplan turbines are engineered, fabricated, assembled and shop tested in ZECO own facilities using first quality components and raw materials.

Inlet valve

ZECO solution includes a Butterfly Valve connected to the flange of the turbine spiral casing and controlled by the turbine governor, with adjustable opening and closing time. The control is ensured by a single acting counterweight actuator.

BRUACHAIG, UK, 2016:

- Turbine: Double regulated Vertical TAT Kaplan
- Net Head: 13.4 m (44.0 fts)
- Flow rate: 4.4 m^3/s (155.4 cfs)
- DN:1400
- PN:10

SAINT CLAUDE, France, 2016:

- Turbine: Double regulated Horizontal Radial Kaplan
- Net Head: 16 m (52.5 fts)
- Flow rate: 2 m^3/s (70.6 cfs)
- DN:1000
- PN:10

The supply includes:

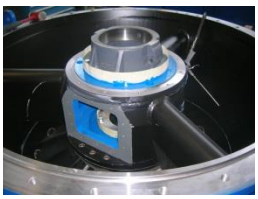
- Emergency shutdown device for the closure of the valve in a timing securing water hammer protection of the penstock
- By-pass tube with electrically operated valve for the opening of the main inlet valve.
- Connecting tube with dismantling flange between flange of turbine spiral casing and valve.
- Connection flange for the valve connection to the steel penstock by a welding nut.

Turbine

- **Fixed guide vanes:**
  - Made of steel S375JR, it connects the penstock/forebay to the wicket gate. Inside the bulb there is installed the guide bearing.

MULCHEN, Chile, 2015

- Turbine: Double Regulated Vertical TAT Kaplan
- Net Head: 19.2 m (63.0 fts)
- Flow rate: 18 m^3/s (635.7 cfs)
- Nominal power: 3098 kW
- Nominal speed: 500 rpm
- Runner diameter: 1200 mm



SAHAMBANO, Madagascar, 2014

- Turbine: n° 2 Double Regulated Vertical TAT Kaplan
- Net Head: 12.0 m (39.4 fts)
- Flow rate: 3.5 m^3/s (123.6 cfs)
- Nominal power: 741 kW
- Nominal speed: 600 rpm
- Runner diameter: 820 mm

SUSA, Italy, 2005

- Turbine: Double Regulated Horizontal S-Kaplan
- Net Head: 10.7 m (35.1 fts)
- Flow rate: 12 m^3/s (423.8 cfs)
- Nominal power: 1129kW
- Nominal speed: 333 rpm
- Runner diameter: 1450 mm

- **Wicket gate:**
  - Made in nodular cast iron GS500/7;
  - equipped with bushes; bars floating ring and servomechanism connected with the pre-distributor.

CASTELLARANO, Italy, 2013

- Turbine: Double regulated Vertical TAT Kaplan
- Net Head: 13.5 m (44.3 fts)
- Flow rate: 28 m^3/s (988.8 cfs)
- Nominal power: 3334 kW
- Nominal speed: 256 rpm
- Runner diameter: 2200 mm

LA CHIUSA, Italy, 2005

- Turbine: Double regulated Vertical TAT Kaplan
- Net Head: 9.0 m (29.5 fts)
- Flow rate: 9.0 m^3/s (317.8 cfs)
- Nominal power: 715 kW
- Nominal speed: 375 rpm
- Runner diameter: 1275 mm

FARA GERA D'ADDA, Italy, 2009

- Turbine: Double regulated Vertical Radial Kaplan
- Net Head: 7.5 m (29.5 fts)
- Flow rate: 25.0 m^3/s (317.8 cfs)
- Nominal power: 1655 kW
- Nominal speed: 191 rpm
- Runner diameter: 2400 mm

- **Runner:**
  - Runner with blades in stainless steel CrNi13-4
  - (CA6NM) totally N.C. machined and hand polished.
  - Hub hydraulically optimized. Static balancing according to UNI ISO 1940-2 G 6.3 standards.

FONTANE, Italy, 2003

- Turbine: Mono Regulated Vertical Radial Kaplan
- Net Head: 2.5 m (13.1 fts)
- Flow rate: 5.5 m^3/s (211.9 cfs)

CODRIGNANO, Italy, 2001

- Turbine: Double Regulated Vertical TAT Kaplan
- Net Head: 19.4 m (63.6 fts)

CROSARA, Italy, 1996

- Turbine: Mono Regulated Vertical Kaplan
- Net Head: 2.9 m (9.5 fts)
- Flow rate: 6.0 m^3/s (211.9 cfs)

▪ Nominal power: 121 kW ▪ Nominal speed: 178 rpm ▪ Runner diameter: 1275 mm	▪ Flow rate: 6.1 m^3/s (215.4 cfs) ▪ Nominal power: 1044 kW ▪ Nominal speed: 600 rpm ▪ Runner diameter: 950 mm	▪ Nominal power: 154 kW ▪ Nominal speed: 240 rpm ▪ Runner diameter: 1275 mm

- **Shaft:**

Made of ASTM A 105 carbon steel, totally N.C. machined and coated.
Centrally perforated for the passage of the regulation bar.

 VERDUNO, Italy, 2004 ▪ Turbine: Double Regulated Vertical Radial Kaplan ▪ Net Head: 6.7 m (22.0 fts) ▪ Flow rate: 20.0 m^3/s (706.3 cfs) ▪ Nominal power: 1183 kW ▪ Nominal speed: 208 rpm ▪ Runner diameter: 1950 mm	 TALAMONA 3, Italy, 2010 ▪ Turbine: Double Regulated Vertical Radial Kaplan ▪ Net Head: 5.9 m (19.4 fts) ▪ Flow rate: 10.0 m^3/s (353.1 cfs) ▪ Nominal power: 519 kW ▪ Nominal speed: 250 rpm ▪ Runner diameter: 1500 mm	 SANTA VITTORIA, Italy, 1999 ▪ Turbine: Mono Regulated Vertical Radial Kaplan ▪ Net Head: 12.8 m (42.0 fts) ▪ Flow rate: 4.2 m^3/s (148.3 cfs) ▪ Nominal power: 473 kW ▪ Nominal speed: 600 rpm ▪ Runner diameter: 900 mm

- **Draft tube, Runner shell, Spiral casing and other steel fabricated parts**

 CALCINATO, Italy, 2010 ▪ Turbine: Double regulated Vertical Axial Kaplan ▪ Net Head: 5.9 m (19.4 fts) ▪ Flow rate: 7 m^3/s (247.2 cfs) ▪ Nominal power: 364 kW ▪ Nominal speed: 333 rpm ▪ Runner diameter: 1150 mm	 FONTANETO, Italy, 2007 ▪ Turbine: Double Regulated Vertical TAT Kaplan ▪ Net Head: 13.3 m (43.6 fts) ▪ Flow rate: 3.2 m^3/s (113.0 cfs) ▪ Nominal power: 376 kW ▪ Nominal speed: 600 rpm ▪ Runner diameter: 800 mm	 SERNIO, Italy, 2007 ▪ Turbine: Double Regulated Vertical Radial Kaplan ▪ Net Head: 7.0 m (16.4 fts) ▪ Flow rate: 4.7 m^3/s (176.6 cfs) ▪ Nominal power: 290 kW ▪ Nominal speed:300 rpm ▪ Runner diameter: 1200 mm

Surface Treatments

All ZECO components are protected with the following coatings.

Surfaces in contact with air	▪ Sandblast till bare metal (degree Sa 2½); ▪ Application of an epoxy primer at least 50 micron thick dry thickness; ▪ Application of one or more acrylic/epoxy coats at least 250 micron dry thickness with primer.
Surfaces in contact with concrete	▪ Sandblast till bare metal (degree Sa 2½); ▪ Application of one or more zinc epoxy coats at least 100 micron thick dry thickness.

Surfaces in contact with water	▪ Sandblast till bare metal (degree Sa 2½); ▪ Application of an epoxy primer at least 50 micron dry thickness; ▪ Application of one or more epoxy tar coats at least 250 micron dry thickness with primer.

Generator unit

ZECO solution includes the generator unit to be coupled with the turbine. According to the project data ZECO supplies the best solution tailored to the designed parameters.

TAGLIUNO, Italy, 2015

- Turbine: Double regulated Vertical Kaplan Bulb
- Net Head: 8.9 m (29.2 fts)
- Flow rate: 13.0 m^3/s (459.1 cfs)
- Generator type: Permanent magnets with exciter
- Nominal power: 948kW
- Nominal speed: 230 rpm
- Number of Poles: 26
- Rated frequency: 50 Hz

DOSAL, Chile, 2014

- Turbine: Double regulated Vertical Kaplan Bulb
- Net Head: 5.8 m (19.0 fts)
- Flow rate: 5.0 m^3/s (176.6 cfs)
- Generator type: Asynchronous
- Nominal power: 270 kW
- Nominal speed: 375 rpm
- Number of Poles: 16
- Rated frequency: 50 Hz

Detailed quality control tests are performed by ZECO suppliers before being delivered at ZECO manufacturing plant. The quality control protocol includes the following tests:

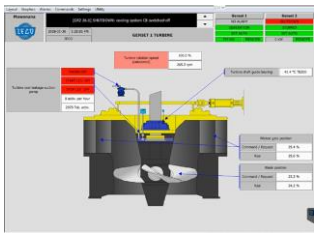
- No load characteristic;
- Short circuit characteristic;
- Heating test – resistance method;
- H.V. test;
- Centrifugal test;
- Insulation measuring;
- Voltage adjusting.

SAN GIOVANNI, Italy, 2015:

- Turbine: Double regulated Vertical Radial Kaplan
- Net Head: 16.0 m (52.5 fts)
- Flow rate: 3.50 m^3/s (123.6 cfs)
- Type: asynchronous
- Nominal power: 460 kW
- Nominal speed: 600 rpm
- Number of Poles: 10
- Rated frequency: 50 Hz

Automation Control System

All ZECO turbines are equipped with PLC digital governor with Industrial PC for HMI (Human Machine Interface) and SCADA system for remote monitoring.



MAWANANA, Sri Lanka, 2016

- Turbine: n° 2 Double regulated Vertical Radial Kaplan
- Net Head: 12.2 m (40.0 fts)
- Flow rate: 20.0 m^3/s (706.3 cfs)
- Nominal power: 4307 kW
- Nominal speed: 260 rpm
- Runner diameter: 1950 mm

Preassemble & Pre-shipping tests

All ZECO components are manufactured according to the highest quality standards (ISO quality standards).

In order to provide a turn-to key product ZECO always performs in-house pre-shipment functional test on preassembled machine with the possibility of client attendance.

The pre-shipment functional test usually includes the following activities:

PRESHIPMENT TEST ACTIVITIES:

- Visual verification of all components
- Connection and verification of electrical and control cables
- Verification of over pressure safety device
- Calibration of actuators on control system
- Calibration and verification of alarm setting of PT and other sensors
- Verification and calibration of transducers and other sensors
- Calibration of Main Valve opening and closing timing
- Calibration of shut off timing of Inlet Guide Vane (IGV)
- Verification of by-pass valve and sensors
- Functional test on Control system
- Electrical connection of all sensors included in our supply
- Functional test of synchronizer with calibration
- Functional test of AVR with calibration
- Functional test of protections and auxiliaries
- Verification of lighting and heaters

CAPO DI PONTE, Italy, 2017:

- Turbine: 1 Double Regulated Horizontal Kaplan Bulb
- Net Head: 2.2 m (7.2 fts)
- Flow rate: 17.0 m^3/s (600.3 cfs)
- Nominal power: 323 kW
- Nominal speed: 176 rpm
- Runner diameter: 1800 mm

The customer is far welcome to assist at the in-house pre-shipping tests. At this time ZECO usually starts also a training period with the customer personnel that will last also during the on site erection and commissioning.

Delivery

ZECO supply is packed and delivered CIF to indicated Port (as per Incoterms 2010) as a standard delivery **in 12 months** from the coming into force of the contract