KHARKOVTURBOENGINEERING

Limited Liability Company

REFERENCE LIST

KHARKOVTURBOENGINEERING

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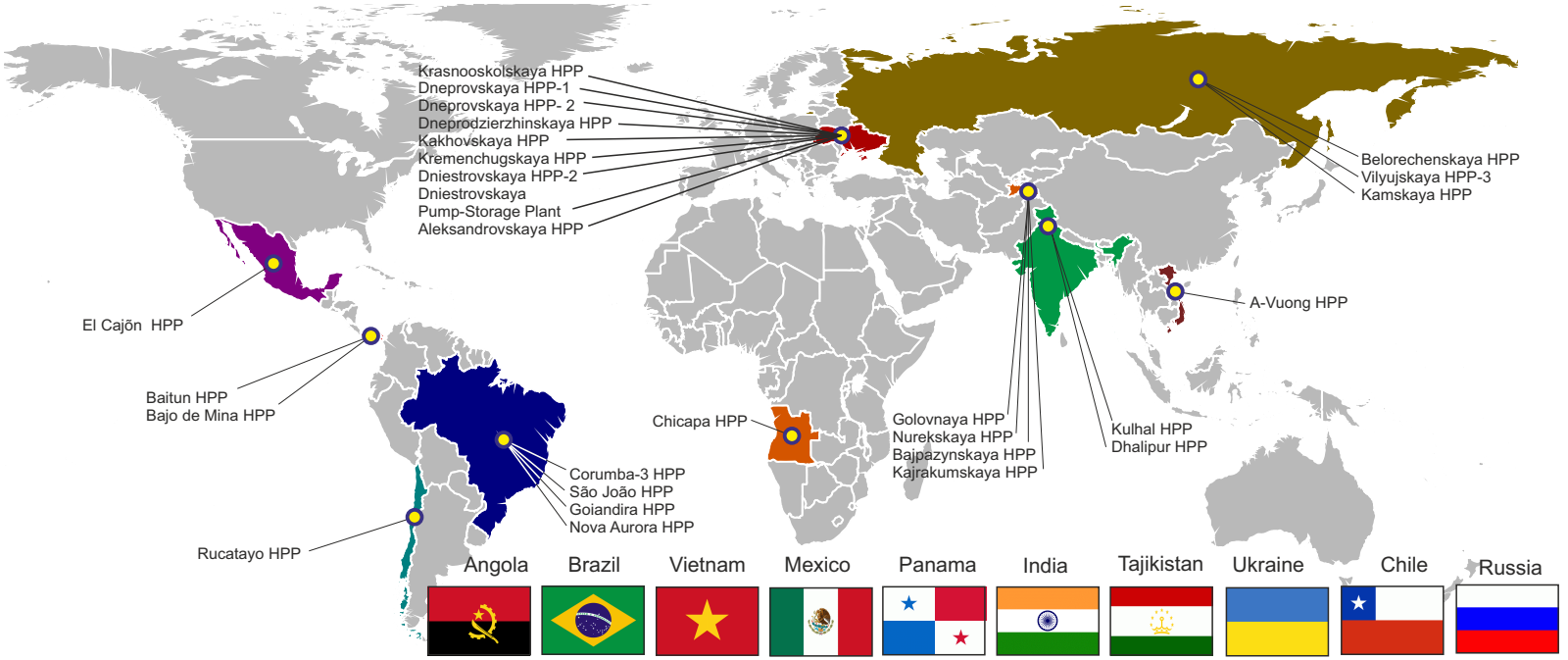
Within 2003 to 2020


Upgraded Kaplan-Type Hydraulic Unit Erection, Kamskaya HPP (Russia)


Francis-Type Hydro Turbine Runner, Nurekskaya HPP (Tajikistan)


Francis-Type Hydro Turbine Erection, Baitun HPP (Panama)

PARTICIPATION IN THE PROJECTS ON A NUMBER OF HYDROPOWER OBJECTS THAT HAVE BEEN COMMISSIONED, ARE UNDER CONSTRUCTION OR SUBJECT TO REHABILITATION



KhTE – drawing up of detail designs and maintenance documentation on hydraulic turbine equipment, placing of orders for manufacturing of the equipment at the enterprises of Ukraine, Russia and other foreign countries, designer's supervision and contract supervision (Nurekskaya HPP – 2nd stage of modernization of two (2) hydraulic units with runner replacement and output increasing from 310.0 MW to 345.0 MW; Chicapa HPP; Kamskaya HPP – 2nd stage of modernization of four (4) hydraulic units with output increasing from 25.0 MW to 26.0 MW; Baitun HPP; Bajo de Mina HPP; Corumba HPP; Rucatayo HPP, etc.), **complex full-scale tests** (Vilyujskaya HPP-3, Kamskaya HPP, Dneprovskaya HPP-1, Dneprovskaya HPP-2, Dneprodzierzhinskaya HPP, Kakhovskaya HPP, Kremenchugskaya HPP, Dniestrovskaya HPP-2, Bajpazinskaya HPP, Nurekskaya HPP, etc.); **pre-commissioning works** (Vilyujskaya HPP-3, Nurekskaya HPP, Chicapa HPP, Goiandira HPP, Bajo de Mina HPP, etc.), **model- and acceptance tests** (Dniestrovskaya Pump-Storage Plant, São João HPP, Rucatayo HPP); **full-scale acceptance tests with efficiency determination by an absolute method** (El Cajõn HPP).

Rucatayo HPP (Chile): Lowering of the Runner into the Turbine Pit

Draft Tube Elbows of Francis-Type Hydro Turbines, Chicapa HPP (Angola)

MAIN LINES OF ACTIVITIES

- According to Customer's specification requirements, performing of designing and development of reaction-type hydro turbines of all types and sizes, as well as reversible hydromachines and main inlet valves of different kinds (butterfly-, biplane-, spherical, built-in cylindrical ones) for the wide range of heads and capacities.
- Carrying out of retrofitting of hydro turbine equipment being in operation, which has exhausted its service life, using the state-of-the-art engineering solutions as for the reliability, efficiency and environmental safety indices.
- Execution of comprehensive studies and tests of power equipment of hydraulic power plants using universal measuring systems on the basis of microprocessor engineering, equipped with special software and hardware.
- Accomplishment of a package of pre-commissioning works while putting new and modernized hydro turbine equipment into operation.
- Conducting of model tests at special stands of all kinds of vertical jet water-wheels and reversible hydro machines, including acceptance tests according to requirements of IEC 60 193. Tests are conducted in the hydraulic laboratory belonging to the Institute of Mechanical Engineering Problems at Ukraine's National Academy of Sciences. (In 2003-2007, the laboratory was upgraded according to KHARKOVTURBOENGINEERING (KhTE) design that brought it to up-to-date level.)
- Mastering – by making use of scientific & production potential of the IPMach Concern “Institute of Mechanical Engineering Problems at Ukraine's National Academy of Sciences” (consisting of the Institute of Mechanical Engineering Problems at Ukraine's National Academy of Sciences, and KHARKOVTURBOENGINEERING Co.) – of modern scientific & technical developments and methods of mathematical and physical simulation of working processes in the turbine manufacture branch for increasing energy effectiveness, reliability and competitiveness of produced power-generating equipment.
- Carrying out of author's supervision of the process of production and erection of new and modernized equipment at the manufacturing works and hydraulic power plants, respectively.
- Complete after-sales servicing of hydro turbines and hydraulic valves installed at operating hydraulic power plants.
- Placing of orders for manufacturing of hydro turbine equipment at the enterprises of Ukraine and Russia, and in foreign countries.
- Technical maintenance of complete delivery of hydro turbine equipment with participation of relevant domestic & foreign profiled enterprises.
- The quality assurance system implemented at the company has been audited on the 1st of February, 2011 for compliance with requirements of International Standard ISO 9001:2008.

WORK EXPERIENCE IN THE FIELD OF HYDRO TURBINE MANUFACTURE

1. List of Projects Developed under the Leadership of the Chief Designer, Doctor of Eng. Scs. degree, Prof. Igor S. Veremeenko and under Participation of Key Specialists Employed at KhTE (KharkovTurboEngineering) since 2003, that have been realized at more than sixty (60) domestic and foreign hydraulic power plants (HPP).

1.1. Within 1975...2003 (Employment at Public J.-St. Co. „Turboatom“

Within 1975…1977: Linganamacky HPP (India), two (2) hydro turbines of Kaplan type with runner diameter of 3,600 mm, output of 28.5 MW (each), and heads being 34.76…10.36 m.

Within 1978…1980: Pournari-I HPP (Greece), three (3) hydro turbines of Francis type with runner diameter of 4,250 mm, output of 103 MW (each), and heads being 79…48.5 m.

Within 1978…1981: Salto Grande HPP (Argentina-Uruguay), fourteen (14) hydro turbines of Kaplan type with runner diameter of 8,500 mm, output of 142 MW (each), and heads being 32.5…10.6 m.

Within 1983...1985: Chirkeyskaya HPP (Russia). On said HPP, where four (4) hydro turbines of Francis type are installed with runner diameter of 4,500 mm, output of 256 MW (each), and heads being 207…156 m, modernization has been performed with unit turbine output increasing up to 270 MW.

Within 1983…1987: Nurekskaya HPP (Tajikistan). On said HPP, where in 1978…1983 nine (9) hydro turbines of Francis type were installed with runner diameter of 4,750 mm, output of 310 MW (each), and heads being 275…207 m, modernization has been performed with installation of anti-vortex facilities under the runner and with unit turbine output increasing up to 330 MW.

Within 1979…1981: Kurpsaiskaya HPP (Kirghizstan), four (4) hydro turbines of Francis type with runner diameter of 5,156 mm, output of 206 MW (each), and heads being 101…90.5 m.

Within 1980…1982: Andizhanskaya HPP (Uzbekistan), four (4) hydro turbines of Deriaz type with runner diameter of 2,500 mm, output of 36.5 MW (each), and heads being 99…45 m.

Within 1980…1983: Dniestrovskaya HPP (Ukraine), six (6) hydro turbines of Kaplan type with runner diameter of 6,000 mm, output of 119.5 MW (each), and heads being 54.5…28 m.

Within 1980...1984: Shamkhorskaya HPP (Azerbaijan), two (2) hydro turbines of Kaplan type with runner diameter of 7,350 mm, output of 195 MW (each), and heads being 55…37.8 m.

Within 1982…1984: Miatlinskaya HPP (Russia), two (2) hydro turbines of Kaplan type with runner diameter of 6,000 mm, output of 113 MW (each), and heads being 59…39 m.

Within 1982…1985: Baipazinskaya HPP (Tajikistan), four (4) hydro turbines of Francis type with runner diameter of 6,200 mm, output of 153 MW (each), and heads being 60…40 m.

Within 1982…1985: Shulbinskaya HPP (Kazakhstan), six (6) hydro turbines of Kaplan type with runner diameter of 8,500 mm, output of 230 MW (each), and heads being 48.3…33 m.

Within 1983...1985: Tashkumyrskaya HPP (Kirghizstan), three (3) hydro turbines of Francis type with runner diameter of 6,200 mm, output of 153 MW (each), and heads being 58.5…40 m.

Within 1985…1987: Zelenchukskaya HPP (Russia), four (4) hydro turbines of Francis type with runner diameter of 2,240 mm, output of 82 MW (each), and heads being 241.2…231 m (one hydraulic unit equipped with ring gate).

In 1986: Gabchikovo HPP (Czech Republic), eight (8) hydro turbines of Kaplan type with runner diameter of 9,300 mm, output of 91 MW (each), and heads being 23.4…11.81 m (engineering design, model acceptance tests and partial manufacture in co-operation with CKD Blansko (Czech Republic)).

Within 1985...1986: Kievskaya Pump-Storage Plant (Ukraine), where in 1968…1971 three (3) reversible hydromachines of radial-axial type were installed with runner diameter of 4,650 mm, capacity in turbine mode of 37.6 MW and 45.6 MW in pump mode and heads being 65...69.5 m, modernization has been performed in 1986...1987 with replacement of the runner and wicket gate, with capacity increasing in both modes by more than 10 % and efficiency increasing by 2...3 %.

Within 1986...1988: Vilyuiskaya-III HPP (Russia), three (3) hydro turbines of Kaplan type with runner diameter of 7,500 mm, output of 92.5 MW (each), and heads being 30…18.3 m.

Within 1987...1991: Rogunskaya HPP (Tajikistan), six (6) hydro turbines of Francis type (with ring gate) with runner diameter of 6,000 mm, output of 615/810 MW (each), and heads being 320…120 m (in 1990...1991, two (2) hydro turbines with temporary runners have been manufactured and supplied to HPP site).

Within 1988...1990: Piedra del Aguila HPP (Argentina), four (4) hydro turbines of Francis type with runner diameter of 6,000 mm, output of 375 MW (each), and heads being 114.2…83.1 m.

Within 1989...1990: Gergebilskaya HPP (Russia), three (3) hydro turbines of Francis type with runner diameter of 1,400 mm, output of 5.2 MW (each), and heads being 51.5…43.3 m.

Within 1990...2001: Irganaiskaya HPP (Russia), four (4) hydro turbines of Francis type (with ring gate) with runner diameter of 6,000 mm, output of 205 MW (each), and heads being 198.7…143.3 m (in 1990...1991, two (2) hydro turbines have been manufactured and commissioned).

Within 1990...1995: Pliavinskaya HPP (Latvia), where among ten (10) hydro turbines of Francis type installed at HPP site within 1964...1966 with runner diameter of 6,000 mm, output of 82.5 MW (each), and heads being 40...29 m, modernization has been performed on four (4) hydraulic units with capacity increasing from 85 MW to 92.5 MW and efficiency increasing by 2...3 %.

Within 1990...1992: Aleksandrovskaya HPP (Ukraine), two (2) hydro turbines of Kaplan type with runner diameter of 2,800 mm, output of 5.75 MW (each), and heads being 20.1…12.3 m.

Within 1990...1995: Svistukhinskaya-1 HPP (Russia), two (2) propeller-type hydro turbines with runner diameter of 1,600 mm, output of 3.05 MW (each), and heads being 22.8…19.2 m (modernization).

Within 1990…1993: Svistukhinskaya-2 HPP (Russia), two (2) propeller-type hydro turbines with runner diameter of 1,800 mm, output of 3.9 MW (each), and heads being 22.8…19.2 m (modernization).

Within 1990...1993: Dniestrovskaya HPP (buffer plant) (Ukraine), three (3) hydro turbines of Kaplan type (horizontal-shaft & bulb type) with runner diameter of 4,700 mm, output of 9 MW (each), and heads being 12.6…5.0 m.

Within 1991...1993: Aguamilpa HPP (Mexico), three (3) hydro turbines of Francis type with runner diameter of 5,200 mm, output of 368 MW (each), and heads being 157.3…119.7 m.

Within 1992...1995: Thac Mo HPP (Vietnam), two (2) hydro turbines of Francis type with runner diameter of 3,250 mm, output of 77.5 MW (each), and heads being 104.9…83 m.

Within 1992...1993: Sengeleyevskaya HPP (Russia), one (1) propeller-type hydro turbine with runner diameter of 1,600 mm, output of 5.7 MW, and heads being 45.2…43.6 m (modernization).

Within 1993...1997: Pournari-II HPP (Greece), two (2) Kaplan hydro turbines (of horizontal-shaft & bulb type) with runner diameter of 4,500 mm, output of 15.15 MW (each), and heads being 12.9…5.6 m.

Within 1994...1995: Sengeleyevskaya HPP (Russia), two (2) hydro turbines of Francis type with runner diameter of 1,400 mm, output of 5.2 MW (each), and heads being 45.2…43.6 m.

Within 1994...1996: Baksan Malka HPP (Russia), three (3) hydro turbines of Francis type with runner diameter of 1,400 mm, output of 3.75 MW (each), and heads being 38.2…32.8 m.

Within 1995..1997: Gunibskaya HPP (Russia), three (3) hydro turbines of Francis type with runner diameter of 1,400 mm, output of 5.2 MW (each), and heads being 51.5…43.3 m.

Within 1995...1996: Nihuil-IV HPP (Argentina), one (1) hydro turbine of Kaplan type with runner diameter of 2,500 mm, output of 30.45 MW, and heads being 71…38.5 m.

Within 1996 …1997: Yegorlykskaya HPP (Russia), one (1) propeller-type hydro turbine with runner diameter of 3,300 mm, output of 15.75 MW, and heads being 30.91…27.4 m (modernization).

Within 1997…2003: Kamskaya HPP (Russia). Among twenty-three (23) installed hydro turbines of Kaplan type with runner diameter of 5,000 mm, output of 21.8 MW (each) and heads being 21...11 m, modernization has been performed on fourteen (14) hydro turbines with usage of ecologically clean runners and capacity increasing up to 25 MW.

Within 1997...2001: Dneprovskaya HPP-1 (Ukraine). Among nine (9) hydro turbines of Francis type installed in 1947…1950 with runner diameter of 5,450 mm, output of 66...67 MW (each) and heads being 38.3...27.4 m, modernization has been performed on six (6) hydro turbines (manufacturer – LMZ Plant) with capacity increasing up to 73.6 MW.

Within 1997...2011: At Kievskaya HPP (Ukraine) with twenty (20) Kaplan hydro turbines (of horizontal-shaft & bulb type) installed in 1964…1967 with runner diameter of 6,000 mm, output of 19.2 MW (each) and heads being 11.8...5.6 m, modernization has been performed on hydro turbines with capacity increasing up to 21 MW.

Within 1997…2005: Dniestrovskaya Pump-Storage Plant (Ukraine). Acc. to the project, provision shall be made for installation of seven (7) (reversible) hydro turbines of Francis type with runner diameter of 7,300 mm, capacity in turbine mode of 330 MW (each), and capacity in pump mode of 410.6 MW (each) and heads being 165.3…133 m. This pump-storage plant is under construction; the first hydraulic unit was commissioned in 2010 and the second - in 2013.

Within 1998...2002: Tehri HPP (India), four (4) hydro turbines of Francis type with runner diameter of 4,100 mm, output of 280 MW (each), and heads being 230…122.6 m.

Within 2001…2003: Gissarakskaya HPP (Uzbekistan), two (2) hydro turbines of Francis type with runner diameter of 1,510 mm, output of 23.5 MW (each), and heads being 132…80 m.

Within 2001...2011: At Kanevskaya HPP (Ukraine) with twenty-four (24) Kaplan hydro turbines (of horizontal-shaft & bulb type) installed in 1969…1975 with runner diameter of 6,000 mm, output of 18.1 MW (each) and heads being 13.2...4.5 m, modernization has been performed on twelve (12) hydro turbines with capacity increasing up to 20.5 MW.

Within 2002...2011: At Dneprodzerzhinskaya HPP (Ukraine) with eight (8) Kaplan hydro turbines installed at HPP site in 1961…1964 with runner diameter of 9,300 mm, output of 45.4 MW (each) and heads being 13...7.6 m, modernization has been performed on four (4) hydro turbines with capacity increasing up to 50 MW.

Within 2002...2003: Largi HPP (India), three (3) hydro turbines of Francis type with runner diameter of 3,450 mm, output of 43.5 MW (each), and heads being 68.25…53.8 m. Basic hydro turbine design and detailed runner design were developed for the Indian customer.

1.2 Within 2003...2020 (Employment at KhTE)

Within 2004…2005: Golovnaya HPP (Tajikistan) – detail design elaboration for modernization of six (6) Kaplan hydro turbines ПЛ40-В-550 installed at HPP site in 1962…1964 (with runner diameter of 5,500 mm and heads being 31.2...15.0 m) with turbine output increasing from 36.5 MW to 42 MW.

Within 2003...2004: Byelorechenskaya HPP (Russia) – detail design elaboration for modernization of Francis hydro turbine with runner diameter of 2,700 mm with turbine output increasing from 20 MW to 24.4 MW realized at the plant unit No. 1.

Within 2006...2007: Chicapa HPP (Angola), four (4) Francis hydro turbines PO45-B-145 with runner diameter of 1,450 mm, output of 4.25 MW (each), and heads being 33…25.9 m.

Within 2006...2007: A - Vuong HPP (Vietnam) development of detail design of disc valve.

Within 2009…2010: Nurekskaya HPP (Tajikistan) with Francis turbines PO310-B-475 – extended reconstruction of the first two (2) hydro turbines (plant unit Nos. 3 & 8) with replacement of the runner and some other assemblies, with nominal turbine output increase from 310 MW to 345 MW (maximum output – up to 355 MW); commissioning of the plant unit No. 3 - in 2009.

Within 2009…2010: Corumba-3 HPP (Brazil), two (2) hydro turbines PO75-B-405 of Francis type with runner diameter of 4,050 mm, output of 47.8 MW (each), and heads being 42.5…32.6 m.

Within 2008…2010: Goiandira HPP (Brazil), two (2) hydro turbines PO75-B-212 of Francis type with runner diameter of 2,120 mm, output of 13.92 MW (each), and heads being 46.3…38 m.

Within 2008...2010: Nova Aurora HPP (Brazil), two (2) hydro turbines PO75-B-235 of Francis type with runner diameter of 2,350 mm, output of 10.82 MW (each), and heads being 35.5…27 m.

Within 2008…2011: Bajo de Mina HPP (Panama), two (2) hydro turbines PO170-B-170 of Francis type with runner diameter of 1,700 mm, output of 28 MW (each) (maximum output – 29 MW), and heads being 114.87…109.2 m.

Within 2008…2011: Bajo de Mina HPP (Panama), 2 (two) hydraulic valves of biplane-type with diameter of 2,240 mm.

Within 2009…2012: Baitun HPP (Panama), (2) hydro turbines PO170-B-195 of Francis type with runner diameter of 1,950 mm, output of 44.36 MW (each) (maximum output – 48.6 MW), and heads being 135.7…125.75 m.

Within 2009…2012: Baitun HPP (Panama), 2 (two) hydraulic valves of biplane-type with diameter of 2,400 mm (the valves have been put into guaranteed operation).

Within 2010…2012: Rucatayo HPP (Chile), 1 (one) Kaplan hydro turbine ПЛ40-В-483 with runner diameter of 4,830 mm, output of 53 MW (maximum output – 58.3 MW), and heads being 36.5…34.46 m.

Within 2009…2012: Kamskaya HPP (Russia) modernization has been performed on four (4) Kaplan hydro turbines ПЛ20-В-500 with usage of ecologically clean runners, with improvement of its efficiency and cavitation characteristics and output increasing of 26 MW (each).

Within 2013...2014: Kulhal HPP (India) 3 (three) hydro turbines ПЛ20-В-320 of Kaplan type with runner diameter of 3,200 mm, output of 10.4 MW, and heads being 18.82…11.97 m.

Within 2014…2016: San Bartolo (Panama) two (2) hydro turbines ПЛ30-В-235 of Kaplan type with runner diameter of 2,350 mm, output of 10.48 MW (each), and heads being 29.14…25.32 m.

Within 2016… 2020: Dhalipur HPP (India) 3 (three) hydro turbines PO45-B-310 of Francis type with runner diameter of 3,100 mm, output of 17.91 MW (each), and heads being 30.69…29.0 m.

2. SUMMARY NOMENCLATURE OF WORKS EXECUTED BY KHARKOVTURBOENGINEERING WITH REGARD TO HYDRO TURBINES AND MAIN INLET VALVES WITHIN 2003 TO 2020

Sl. No.	Designation of Installation	Number of Units per HPP / Works Performed at Unit No. …	Type of the Turbine	Parameters of Hydraulic Turbine Equipment				Years of Implementation, Scope of Fulfilled Works
				Head range: H_{max} – H_{rated} – H_{min}, m	Runner Diameter, m	Speed of Rotation, r.p.m.	Output of the Turbine N_{rated} at H_{rated}, MW	
1	2	3	4	5	6	7	8	9
1	Byelorechenskaya HPP (Russia) – modernization	3/1	PO75 (Francis)	41.0 – 44.85 – 52.0	2.7	187.5	(prior to modernization) – 20.0 (after modernization) – 22.0	– Development of detail design for modernization in 2004; – First prototype unit launched in 2006.
2	Dniestrovskaya Pump-Storage Plant (Ukraine) with built-in ring gate	7	OPO170 (reversible, Francis)	133.0 – 135.2/153.5 –165.3	7.3	150.0	Turbine: 391.0 Pump: 410.0	– Model testing of hydraulic machine at lowered (start-up) heads in pumping and transition modes have been conducted in 2003.
3	Krasnooskolskaya HPP (Russia) – modernization	2/1	ПЛ15 (Kaplan)	7.0 – 11.6 – 12.5	2.0	214.3	(prior to modernization) – 2.0 (after modernization) – 2.4	– Development of detail design for modernization in 2004; – Designer's supervision of equipment manufacture in 2005; – Erection supervision, pre-commissioning works and full-scale tests of modernized unit in 2006; – Commissioning of hydraulic unit under plant No. 2 in 2006.

1	2	3	4	5	6	7	8	9
4	Golovnaya HPP (Tajikistan) – modernization	6/6	ПЛ40 (Kaplan)	15.0 – 23.3 – 31.2	5.5	107.1	(prior to modernization) – 36.5 (after modernization) – 42.0	– Detail design development for hydro turbine modernization in 2004; – Full-scale vibration testing of hydraulic units under plant unit Nos. 1, 2, 3, 4, 5, and 6 in 2008; – Tests with optimum angle setting determination of hydro turbine runner blades at plant unit No. 5 in 2008.
5	Chicapa HPP (Angola)	4/4	PO45 (Francis)	25.9 – 30 – 33.0	1.45	333.3	4.25	– Development of hydro turbine detail design in 2005; – Designer's supervision of manufacture; – Hydro turbine erection supervision, pre-commissioning works in 2006…2007; – Commissioning of four (4) plant units in 2006 … 2007.
6	Nurekskaya HPP (Tajikistan) * Hydro turbines modernized from 1983 to 1987, with anti-vortex facilities installed under the runner	9/9	PO310 (Francis)	207.0 – 230.0 – 275.0	4.75	200.0	310/330.0*	– Investigation of technical condition of hydro turbines at hydraulic units under plant unit Nos. 1, 2, 3, 4, 5, 6, 7, 8, and 9; – Dynamic balancing of the hydraulic units under plant unit Nos. 4 and 9; – Pulsation testing of hydraulic units under plant unit Nos. 2 and 4 and other works in 2005.
7	Nurekskaya HPP (Tajikistan) Extended modernization of hydro turbines with replacement of the runner and other assemblies	9/2	PO310 (Francis)	207.0 – 230.0 – 275.0	4.75	200.0	(prior to modernization) – 330.0 (after modernization) – 345.0	– Detail design development for hydro turbine modernization in 2005; – Designer's supervision of manufacture and modernization of hydro turbines under plant unit Nos. 3 and 8 in 2009…2010; – Pre-commissioning works – at hydraulic unit under plant unit No. 3 in 2009; – Commissioning of hydraulic unit under plant unit No. 3 in 2009; – Complex testing of hydraulic unit under plant unit No. 3 in 2009. – Pre – commissioning works of unit No 3 in 2009 – Commissioning of unit No 3 in 2009 – Complex tests unit No 3 in2009

1	2	3	4	5	6	7	8	9
8	Dneprovskaya HPP-1 (Ukraine) – modernized*	9/5	PO45 (Francis)	27.4 – 33.5 – 38.4	5.45	83.3	(prior to modernization) – 67.0/73.6*	– Vibration state determination of hydro turbines under plant unit Nos. 1, 2, and 3 prior to modernization, including transition modes; – Complex vibration tests on modernized hydraulic units under plant unit Nos. 5 and 9 in 2004.
9	Dneprovskaya HPP-2 (Ukraine)	8/8	6-ПР40 (propeller type) 2-ПЛ40 (Kaplan)	30.2 – 34.3 – 38.3	6.8	107.1	6 * 120.0 ПР (propeller type) 2 * 107.0 ПЛ (Kaplan)	– Vibration state evaluation of hydraulic units under plant unit Nos. 11, 12, 13, 14, 15, 16, 17, and 18, including in transition modes after prolonged operation – in 2004; – Vibration state evaluation of hydraulic units under plant unit No. 18 after major overhaul in 2005.
10	Dneprodzerzhinskaya HPP (Ukraine) – modernized	8/1	ПЛ20 (Kaplan)	8.4 – 9.85 – 12.5	9.3	51.7	45.4	– Vibration state evaluation of modernized plant unit No. 5 in 2004.
11	Kakhovskaya HPP (Ukraine) – modernized	6/6	ПЛ20 (Kaplan)	8.9 – 13.8/15.4 – 16.5	8.0	62.5	57.8	– Vibration state evaluation of hydraulic units under plant unit Nos. 1, 2, 4, and 5 prior to modernization in 2004; – Vibration tests of hydraulic units after modernization – in 2006; – Full-scale index tests with optimum on-cam relationship determination at hydraulic units under plant unit Nos. 5 and 6 in 2006; – Full-scale vibration testing and dynamic balancing of the hydraulic unit under plant unit No. 3 in 2007.

1	2	3	4	5	6	7	8	9
12	Kremenchugskaya HPP (Ukraine) – modernized	12/11	ПЛ20 (Kaplan)	9.55 – 14.2 – 16.9	8.0	62.5	58.0	– Vibration state evaluation of hydraulic units under plant unit Nos. 1, 3, 4, 7, 8, and 11 and dynamic balancing in 2003; – Vibration state evaluation of hydraulic units under plant unit Nos. 2, 5, 6, 9, 11, and 12 and dynamic balancing in 2005; – Optimum on-cam relationship determination and full-scale vibration tests of hydro turbines under plant unit Nos. 1, 3, 8, and 11 – in 2004; – Pulsation testing of hydro turbine under plant unit No. 11 – in 2006.
13	Dneprovskaya HPP-2 buffer plant (Ukraine) – modernized	3/1	ПЛ15-ГК (horizontal shaft & bulb type, Kaplan)	5.0 – 6.6 – 12.6	4.7	107.1	9.0	– Optimum on-cam relationship determination and vibration state evaluation at lowered heads of hydro turbine under plant No. 3 in 2003.
14	Kajrakumskaya HPP (Tajikistan)	6/5	ПЛ20 (Kaplan)	13.5 – 15.0 – 24.5	5.0	125.0	20.9	– Investigation of technical condition and full-scale vibration testing of hydro turbines under plant Nos. 1, 2, 3, 4, 5, and 6 in 2005.
15	Vilyuiskaya HPP-3 (Svetlinskaya) (Russia)	3/3	ПЛ30 (Kaplan)	18.3 – 22.7 – 30.0	7.5	88.2	92.5	– Pre-commissioning works and vibration testing of hydraulic units under plant unit Nos. 1, 2, and 3 – in 2004, 2006, and 2008.
16	El Cajõn HPP (Mexico)	2/2	PO170 (Francis)	121.8 – 156.54 – 168.94	5.3	150.0	380.33	– Full-scale acceptance tests with turbine efficiency determination by an absolute method – in 2007.

1	2	3	4	5	6	7	8	9
17	A-Vuong HPP (Vietnam)	"Biplane"-type butterfly valve of 3.8 m in dia.						– Development of detail design within 2006…2007.
18	Baipazy HPP (Tajikistan)	4	PO75 (Francis)	40.0 – 54.0 – 60.0	6.2	100.0	153.0	– Full-scale vibration testing and dynamic balancing of the hydraulic units under plant unit Nos. 1, 2, 3, and 4 – in 2007.
19	Corumba-3 HPP (Brazil)	2	PO45 (Francis)	36.4 – 39.5 – 42.5	4.05	128.57	47.8	– Development of detail design in 2007; – Equipment erection supervision and pre-commissioning works on hydraulic units under plant Nos. 1 and 2 in 2010; – Full-scale tests, including index tests of hydraulic unit under plant unit No. 2 – in 2009…2010; – Commissioning of hydraulic units in 2010.
20	Aleksandrovskaya HPP (Ukraine)	2/1	ПЛ20 (Kaplan)	12.3 – 14.0 – 20.1	2.8	214.3	5.75	– Vibration testing of hydraulic unit under plant unit No. 1 prior to and after repair – in 2009.
21	Sao Joao HPP (Brazil)	2	ПЛ30 (Kaplan)	14.4 – 28.7/26.0 – 30.2	4.83	138.48	39.5	– Model acceptance tests in 2008; – Development of detail design in 2008.
22	Nova Aurora HPP (Brazil)	2	PO45 (Francis)	27.0 – 29.7 – 35.5	2.35	200.0	10.82	– Development of hydro turbine detail design in 2008; – Equipment erection supervision in 2010.
23	Goiandira HPP (Brazil)	2	PO45 (Francis)	38.0 – 40.42 – 46.3	2.12	276.9	13.92	– Development of hydro turbine detail design in 2008; – Equipment erection supervision and pre-commissioning works in

1	2	3	4	5	6	7	8	9
24	Bajo de Mina HPP (Panama)	2	PO140 (Francis)	109.2 – 112.2 – 114.87	1.7	450.0	28.0	– Development of hydro turbine detail design in 2008; – Author's supervision of manufacture within 2008 – 2009; – Equipment erection supervision within 2009 – 2011; – Pre-commissioning works, including power-, vibration- and pulsation tests of hydraulic turbines under plant Nos. 1 and 2 in 2011; – Equipment has been put into guaranteed operation in 2011; – Tests for output increase over design output, including vibration and index tests of hydraulic units under plant unit Nos. 1 and 2 in 2012.
25	Bajo de Mina HPP (Panama)	2	"Biplane"-type butterfly valve of 2.24 m in dia.					– Development of detail design in 2008; – Author's supervision of manufacture within 2008 – 2009; – Equipment erection supervision within 2009 – 2011; – Pre-commissioning works in 2011; – Equipment has been put into guaranteed operation in 2011.
26	Baitun HPP (Panama)	2	PO140 (Francis)	125.75 – 128.7 – 135.7	1.95	400.0	44.36	– Development of hydro turbine detail design in 2010; – Author's supervision of manufacture within 2010 – 2011; – Equipment erection supervision, pre-commissioning works in 2012; – Equipment has been put into guaranteed operation in 2012.
27	Baitun HPP (Panama)	2	"Biplane"-type butterfly valve of 2.4 m in dia.					– Development of detail design in 2010; – Author's supervision of manufacture within 2010 – 2011; – Equipment erection supervision and putting into guaranteed operation in 2012.

1	2	3	4	5	6	7	8	9
28	Rucatayo HPP (Chile)	1	ПЛ40 (Kaplan)	34.0 – 34.5 – 36.0	4.83	150.0	52.9	– Development of hydro turbine detail design in 2011; – Check model tests of analogous turbine in 2010; – Random author's supervision of equipment manufacture in 2011; – Equipment erection supervision, pre-commissioning works and starting tests, commissioning in 2012.
29	Kamskaya HPP (Russia) – modernization	5	ПЛ25 (Kaplan)	11.0 – 16.5 – 21.0	5.0	125.0	26.0	– Participation in detail design (preparation of engineering documentation for ecologically-clean hydro turbine runner, oil header and diagnostic system of runner seal characteristics) in 2011; – Random author's supervision of equipment manufacture, contract supervision, pre-commissioning works and full-scale tests on hydraulic units under plant unit Nos. 17 and 23 – in 2010...2011; – Random author's supervision of equipment manufacture for hydraulic units under plant unit Nos. 22 and 10.
30	Kulhal HPP (India)	3	ПЛ20 (Kaplan)	11.97 – 18 –18.82	3.2	187.5	10.4	– Development of hydro turbine basic design in 2014;
31	San Bartolo HPP (Panama)	2	ПЛ30 (Kaplan)	28.32	2.35	300	10.48	– Development of hydro turbine detail design in 2015; – Author's supervision of manufacture in 2015
32	Dhalipur HPP (India)	3	РО45 (Francis)	29.0 – 29.99 – 30.69	3.1	150	17.91	– Development of hydro turbine detail design in 2018…2020; – CFD calculation performed in 2018; – Author's supervision of manufacture in 2019…2020

3. KHARKOVTURBOENGINEERING'S SCIENTIFIC-TECHNICAL COUNCIL MEMBERS (from other organizations)

Surname, Name & Patronymic	Post Title	Specialization
V. V. Kuzmin	Professor, doctor of engineering sciences Electroenergetics Subdepartment at Ukrainian Engineering-Pedagogical Academy (Kharkov)	Expert in the field of generator engineering for hydro power plants (HPP), thermal power stations (TPS) and nuclear power plants (NPP)
A. V. Rusanov	Doctor of engineering sciences, Director of the Institute of Mechanical Engineering Problems at Ukraine's National Academy of Sciences	Expert in the field of mathematical and physical simulation of work processes in the passageway of steam-, gas- and hydro turbines
V. N. Dedkov	Candidate of engineering sciences, senior staff scientist in the hydro- and aeromechanics department of power-generating machines at Institute of Mechanical Engineering Problems at Ukraine's National Academy of Sciences	Expert in the field of computational fluid dynamics and physical simulation of work processes in reversible hydromachines and reaction-type hydraulic turbines
O. V. Potetenko	Professor, candidate of engineering sciences Hydro Machines Subdepartment at National Technical University "Kharkov Polytechnic Institute"	Expert in the field of hydro engineering
V. I. Gnesin	Professor, doctor of engineering sciences, head of hydro- and aerodynamics department atInstitute of Mechanical Engineering Problems at Ukraine's National Academy of Sciences	Expert in the field of hydro- and aeromechanics
E. A. Strelnikova	Professor, doctor of engineering sciences, principal research assistant in the dynamics & strength department at Institute of Mechanical Engineering Problems at Ukraine's National Academy of Sciences	Expert in the field of dynamics & strength analysis of turbo-installations

FROM DRAWINGS TO REAL OBJECTS

Limited Liability Company
KHARKOVTURBOENGINEERING

Nurekskaya HPP (Tajikistan): Hydro Turbine under Plant Unit No 3 with Output after Modernization of 345 MW - Modernized Runner at Erection Site (2009)

Kamskaya HPP (Russia): Hydro Turbine under Plant Unit No. 17 with Output of 26 MW, with Ecologically-Clean Runner – Hydro Turbine Rotor Mounting. (2011)

Corumba-3 HPP (Brazil): Hydro Turbine with Output of 47.8 MW – Hydro Turbine Runner at Mounting Site. (2010)

Chicapa HPP (Angola): 4.25 MW Hydro Turbine – Coupling of Hydro Turbine Runner & Shaft at Workshop. (2006)

Rucatayo HPP (Chile): 52.9 MW Hydro Turbine – Hydro Turbine Runner at Mounting Site. (2012)

Chicapa HPP (Angola): 4.25 MW Hydro Turbine – Wicket Gate Assembling. (2007)

Corumba-3 HPP (Brazil): Hydro Turbine with Output of 47.8 MW – Hydro Turbine Mounting. (2010)

Chicapa HPP (Angola): Mounting of Draft Tubes at Site. (2006)