

DEVELOPMENT AND MODEL ACCEPTANCE TESTS

	Power plant	Country	Type	Year	Producer	Flow (m ³ /s)	Head (m)	Power (MW)
1	Mratinje	Montenegro	FT	1970	Litostroj	80,0	162,0	118,0
2	Potpeć	Serbia	FT	1970	Litostroj	55,0	37,6	18,3
3	Jablanica	Bosnia Hercegovina	FT	1971	Litostroj	30,0	93,0	22,8
4	Kamburu	Kenya	FT	1971	Litostroj	46,0	74,0	30,0
5	Rama	Bosnia Hercegovina	FT	1971	Litostroj	32,0	285,0	81,8
6	Zakučac	Croatia	FT	1971	Litostroj	60,0	250,0	138,0
7	Kidatu	Tanzania	FT	1972	Litostroj	35,0	165,0	52,3
8	Cabra Corall	Argentina	FT	1973	Litostroj	45,5	83,0	34,2
9	Ramu	New Guinea	FT	1973	Litostroj	8,4	209,0	15,5
10	Crystal	USA (Colorado)	FT	1975	Litostroj	52,0	63,1	29,1
11	Ohau	New Zealand	FT	1975	Litostroj	135,0	57,6	70,0
12	Hemren Dam	Iraq	KT	1978	Litostroj	95,0	30,8	25,0
13	Duffers	N. Zealand	FT	1979	Litostroj	2,9	13,2	0,3
14	Obrovac	Croatia	RT	1979	Voith	31,6	541,0	151,0
15	Grabovica	Bosnia Hercegovina	KT	1980	Litostroj	190,0	34,0	58,5
16	Globočica	Macedonia	FT	1981	Litostroj	25,0	102,0	22,0
17	Haditha	Iraq	KT	1982	Litostroj/ČKD	330,0	36,0	110,0
18	Iron Gate	Serbia	KT	1982	LMZ	800,0	26,5	194,0
19	Penitas	Mexico	KT	1982	ČKD	371,0	32,3	107,0
20	Banieya	Guinea	KT	1985	Litostroj	152,0	19,5	2,6
21	Mostar	Bosnia Hercegovina	KT	1985	Litostroj	134,0	21,5	25,9
22	Vernayaz	Switzerland	PT	1985	Noell	6,7	640,0	38,5
23	Crystal	USA (Colorado)	FT	1986	Litostroj	55,6	67,7	31,4
24	Dubrava	Croatia	BT	1986	Litostroj	250,0	17,5	41,7
25	Menzelet	Turkey	FT	1986	Litostroj	131,0	104,0	31,0
26	Stratos	Greece	FT	1986	Litostroj	251,0	37,5	83,8
27	Vinodol	Croatia	PT	1986	Litostroj	18,0	592,0	81,2
28	Wald	Austria	FT	1986	Noell	12,6	178,0	21,0
29	Catalan	Turkey	FT	1987	Noell	120,0	51,5	56,0
30	Kniepass	Italy	BT	1987	Noell	28,8	12,3	3,1
31	Arturwerk	Austria	PT	1988	Noell	2,9	263,0	6,0
32	Birris	Costa Rica	PT	1988	ČKD	2,6	428,0	9,6
33	Fala 9, 10	Slovenia	KT	1988	Litostroj	175,0	14,4	21,4
34	Laudat	Dominica	PT	1989	Noell	0,7	211,0	1,3
35	New Trafalgar	Dominica	PT	1989	Noell	0,7	281,0	1,8
36	Vrhovo	Slovenia	BT	1989	Litostroj	167,0	7,3	11,0
37	Gorge	USA (Washington)	FT	1990	Noell	48,0	107,0	44,7
38	Hemfurth	Germany	FT	1991	Noell	27,8	41,0	10,2
39	Ozalj	Croatia	FT	1991	Litostroj	17,0	9,2	1,4
40	Diablo	USA (Washington)	FT	1992	Noell	99,1	97,5	88,0
41	Špilje	Macedonia	FT	1993	Litostroj	36,0	85,2	27,0
42	Kreuzbergmaut	Austria	BT	1993	Noell	110,0	11,0	11,0
43	Fala 8	Slovenia	KT	1993	Litostroj	175,0	13,5	20,3
44	Toro II	Costa Rica	FT	1994	Litostroj	10,0	376,0	34,0
45	Plave	Slovenia	KT	1994	Litostroj	40,0	24,0	8,6
46	Mariborski otok	Slovenia	KT	1994	Litostroj	183,3	12,9	20,4
47	Dravograd	Slovenia	KT	1995	Litostroj	135,0	7,4	8,5
48	Vuzenica	Slovenia	KT	1995	Litostroj	183,3	11,8	18,9
49	Doblar	Slovenia	FT	1995	Litostroj	34,0	46,5	13,7
50	Vinodol	Croatia	PT	1995	ČKD	3,0	605,0	15,9

Type: **PT**-Pelton turbine, **FT**-Francis turbine, **KT**-Kaplan turbine, **RT**-Reversible pump turbine, **BT**-Bulb turbine

DEVELOPMENT AND MODEL ACCEPTANCE TESTS

	Power plant	Country	Type	Year	Producer	Flow (m ³ /s)	Head (m)	Power (MW)
51	Peruća	Croatia	FT	1995	*	60,0	47,0	24,9
52	Batman	Turkey	FT	1996	Noell	118,0	58,8	62,5
53	Achensee	Austria	PT	1996	Noell	3,6	375,0	11,8
54	Medvode	Slovenia	KT	1997	*	60,0	21,0	11,1
55	Plavinas	Latvia	FT	1998	Neyrpic	275,0	39,3	104,0
56	Plave II	Slovenia	KT	1998	Litostroj	105,0	19,5	18,6
57	Doblar II	Slovenia	KT	1999	Litostroj	105,0	40,5	39,2
58	Ruetz	Austria	PT	1999	EFG	4,4	169,0	6,5
59	Obervellach	Austria	PT	2000	EFG	3,5	315,0	8,6
60	Vuhred	Slovenia	KT	2000	Litostroj	183,3	15,0	24,6
61	Ožbalt	Slovenia	KT	2000	Litostroj	183,3	15,2	24,8
62	Kozjak	Macedonia	FT	2000	Alstom P. Hydro	50,0	92,0	42,0
63	Sainte Marguerite 1a	Canada	FT	2001	Litostroj	60,0	16,4	8,6
64	Sainte Marguerite 1b	Canada	KT	2001	Litostroj	65,0	18,2	11,0
65	Zakučac	Croatia	FT	2001	*	55,0	268,0	122,6
66	Bhavani Kattalai	India	BT	2001	Litostroj	261,8	6,5	15,6
67	Gojak - old	Croatia	FT	2001	*	16,7	118,0	16,0
68	Gojak - new	Croatia	FT	2002	*	19,0	106,7	18,6
69	Tikveš	Macedonia	FT	2002	Litostroj	36,0	93,0	29,9
70	Kamburu	Kenya	FT	2002	Litostroj	51,5	72,0	31,0
71	Raven	Macedonia	FT	2002	Litostroj	12,6	71,0	8,0
72	Peč Mlini	Bosnia Herzegovina	FT	2002	Litostroj	15,0	111,0	15,5
73	Vrutok	Macedonia	PT	2002	IMPISA	10,0	525,0	46,0
74	Peruća	Croatia	FT	2002	Litostroj	60,0	47,0	24,9
75	Medvode	Slovenia	KT	2003	Litostroj	75,0	19,7	13,3
76	Varaždin - old	Croatia	KT	2003	Litostroj	250,0	22,2	49,4
77	Dubrava - old	Croatia	BT	2003	Litostroj	235,0	18,8	40,4
78	Dubrovnik - old	Croatia	FT	2003	*	47,5	270,0	119,0
79	Dubrava - new	Croatia	BT	2003	*	230,0	18,8	40,4
80	Varaždin - new	Croatia	KT	2004	*	275,0	22,0	54,9
81	Guri	Venezuela	FT	2004	Alstom P. Hydro	360,0	136,0	400,0
82	Boštanj	Slovenia	BT	2004	Litostroj	167,0	10,0	14,6
83	Dubrovnik -new	Croatia	FT	2004	*	55,0	284,2	145,0
84	Cariblanco	Costarica	FT	2005		409,0	11,4	41,9
85	Dubrava – new II	Croatia	BT	2005	*	250,0	18,8	43,5
86	Zlatoličje	Slovenia	FT	2005	Litostroj	265,0	28,1	68,6
87	Lagarfoss	Iceland	KT	2005	Litostroj	125,0	16,3	18,8
88	Chute Allard	Canada	ST	2005	Litostroj	66,0	17,8	10,6
89	Rapides des Cœurs	Canada	ST	2005	Litostroj	66,0	22,7	13,6
90	Magpie	Canada	ST	2005	Litostroj	70,0	20,5	12,9
91	Limmern	Switzerland	PT	2006	Fravit	11,0	1050,0	94,0
92	Dalešice	Czech Republic	RT	2006	ČKD	151,3	88,7	121,3
93	Blanca	Slovenia	KT	2006	Litostroj	166,7	11,4	17,3
94	Krško	Slovenia	KT	2006	Litostroj	166,7	11,1	16,8
95	Zakučac A, B	Croatia	FT	2006	Voith Siemens	60,0	270,0	151,0
96	Zakučac A, B	Croatia	FT	2006	Alstom	60,0	270,0	150,0
97	Mostarsko Blato	Bosnia Herzegovina	FT	2007	Litostroj E.I.	18,0	170,0	28,7
98	Sveta Petka	Macedonia	FT	2007	Litostroj E.I.	50,0	40,0	18,3
99	Lešće	Croatia	FT	2007	Litostroj E.I.	60,0	38,2	21,2
100	Bhavani Kattalai 2 & 3	India	BT	2007	Litostroj	289,4	6,5	17,0

Type: **PT**-Pelton turbine, **FT**-Francis turbine, **KT**-Kaplan turbine, **RT**-Reversible pump turbine, **BT**-Bulb turbine, **ST**-Saxo turbine

* Model test performed for the owner of HPP

DEVELOPMENT AND MODEL ACCEPTANCE TESTS

	Power plant	Country	Type	Year	Producer	Flow (m ³ /s)	Head (m)	Power (MW)
101	Djerdap I	Serbia	KT	2007	LMZ, Russia	800,0	31,6	240,0
102	Zakučac C, D	Croatia	FT	2007	Voith Siemens	60,0	270,0	150,0
103	Zarnowiec	Poland	RT	2007	ČKD Strojirny	173,0	120,0	187,0
104	Wells Dam	USA	KT	2008	Toshiba	510,0	18,9	85,3
105	Moste	Slovenia	FT	2008	Litostroj E.I.	13,0	58,1	6,7
106	Merila	Kenya	FT	2008	Resita	16,5	52,4	7,9
107	Maragua	Kenya	FT	2008	Resita	8,5	67,6	5,2
108	Dumitra	Romania	FT	2009	Resita	12,0	97,6	10,7

Type: **PT**-Pelton turbine, **FT**-Francis turbine, **KT**-Kaplan turbine, **RT**-Reversible pump turbine, **BT**-Bulb turbine, **ST**-Saxo turbine
 * Model test performed for the owner of HPP

SITE MEASUREMENTS

	Power plant	Country	Type	No.	Year	Flow (m ³ /s)	Head (m)	Power (MW)	Type	Method
1	Ožbalt	Slovenia	KT	3	1970	137,0	17,3	20,4	e	i
2	Mahabad	Iran	KT	2	1971	10,0	35,5	3,1	e	i
3	Savica	Slovenia	PT	4	1972	0,6	227,0	1,0	e	i
4	Špilje 2	Macedonia	FT	1	1974	30,0	91,3	24,2	e	i
5	Špilje 1	Macedonia	FT	1	1975	30,0	91,3	24,2	e	i
6	Senj	Croatia	FT	1	1976	20,0	410,0	72,5	e	i
7	Orlovac	Croatia	FT	2	1979	23,3	380,0	80,0	e	i
8	Formin	Slovenia	KT	2	1980	230,0	28,5	60,0	e	i
9	Špilje 3	Macedonia	FT	1	1980	30,0	91,3	24,2	e	i
10	Zakučac 2	Croatia	FT	1	1981	60,0	250,0	138,0	e	p
11	Bajina bašta	Serbia	FT	1	1982	150,0	69,0	98,0	v	i
12	Golubić	Croatia	FT	2	1982	7,0	59,0	3,3	e	i
13	Doblar	Slovenia	FT	3	1986	38,0	46,0	13,5	r	i
14	Vinodol	Croatia	PT	3	1986	18,0	592,0	27,0	e	i,t,p
15	Fužine	Croatia	RT	1	1987	10,0	35,0	3,4	e,v	i,p
16	Log	Slovenia	PT	2	1988	0,2	431,0	0,7	e,l	i
17	Manojlovac	Croatia	FT	4	1988	8,5	102,0	6,7	e,r,v	c,i,p
18	Bogatići	Bosnia Herzeg.	FT	2	1989	3,6	160,0	4,4	e,l	c,i
19	Djale	Croatia	KT	2	1989	110,0	21,0	20,4	e,r,v,l	c,i
20	Peruća	Croatia	FT	2	1989	60,0	41,0	20,8	e,r,v,l	c,i,p
21	Wald	Austria	FT	1	1989	12,6	178,0	21,0	v	i
22	Buško blato	Bosnia Herzeg.	RT	2	1990	24,0	14,0	3,5	v	i
23	Dubrava	Croatia	BT	2	1990	250,0	19,5	42,0	e	c,i
24	Fala	Slovenia	KT	2	1990	175,0	14,4	21,4	e,r,v	c,i
25	Jajce	Bosnia Herzeg.	FT	2	1990	45,0	94,0	33,6	v	i
26	Kraljevac	Croatia	FT	1	1990	2,7	105,0	2,3	v	i
27	Stratos	Greece	FT	1	1990	251,0	37,5	83,8	e,v,r	c,i
28	Kokra	Slovenia	FT	1	1991	4,7	8,8	0,3	e	i
29	Plave	Slovenia	KT	2	1992	68,0	24,9	15,0	e,v,l	c,i
30	Zakučac 1	Croatia	FT	2	1992	50,0	250,4	110,5	e,v,r,l	c,i
31	Moste 1	Slovenia	FT	3	1993	11,0	66,0	6,0	e,l	c,i
32	Moste 2	Slovenia	RT	1	1993	5,8	173,0	9,0	e,l	c,i
33	Špilje	Macedonia	FT	3	1993	30,0	91,3	24,2	e,v,l	c,i
34	Hemfurth 1	Germany	FT	1	1994	25,0	30,0	6,3	e,v,l	c,i
35	Senj	Croatia	FT	3	1994	20,0	410,0	72,5	e,v,l	c,i
36	Savica	Slovenia	PT	2	1994	2,2	200	3,4	e,l	n
37	Soccoridos	Portugal	PT	1	1995	1,8	454,0	8,0	e	c
38	Hemfurth 1	Germany	FT	1	1995	29,0	40,0	9,8	e,l	c,i
39	Medvode	Slovenia	KT	1	1995	70,0	21,2	13,0	e,v,l	c,i
40	Hubelj	Slovenia	FT	2	1995	2,2	110,0	1,8	e,l	i
41	Tržič	Slovenia	FT	1	1996	2,0	105,0	1,5	e,l	c,i
42	Formin 2	Slovenia	KT	2	1996	230,0	29,0	60,0	e,v	c,i
43	Zlatoličje 2	Slovenia	KT	2	1996	250,0	32,0	72,0	e,v	c,i
44	Fala 8	Slovenia	KT	1	1996	150,0	12,8	16,0	e,v,r	c,i
45	Vrhovo 1,2,3	Slovenia	BT	3	1996	167,0	8,2	11,0	e,v,r,l	c,i
46	Vuhred 3	Slovenia	KT	1	1996	137,0	16,0	18,8	e,v,r,l	c,i
47	Vuhred 1	Slovenia	KT	1	1997	137,0	16,0	18,8	e,v,r,l	c,i
48	Ožbalt 1, 2, 3	Slovenia	KT	3	1997	137,0	17,0	20,0	e,v,r,l	c,i
49	Formin 1	Slovenia	KT	1	1997	230,0	29,0	60,0	e,v	c,i
50	Zlatoličje 1	Slovenia	KT	2	1998	250,0	32,0	72,0	e,v	c,i

Type: **PT**-Pelton turbine, **FT**-Francis turbine, **KT**-Kaplan turbine, **RT**-reversible pump turbine, **BT**-bulb turbine

Type of measurements: **e**-efficiency, **v**-vibration, **r**-regulation, **l**-loss

Method of measurements: **c**-currentmeter, **i**-index test, **p**-pressure-time, **t**-thermodynamic, **n**-nozzle opening

SITE MEASUREMENTS

	Power plant	Country	Type	No.	Year	Flow (m ³ /s)	Head (m)	Power (MW)	Type	Method
51	Mariborski otok 3	Slovenia	KT	1	1998	183,0	12,9	20,0	e,v	c,i
52	Dravograd 3	Slovenia	KT	1	1998	135,0	7,3	8,5	e,v	c,i
53	Vuzenica 3	Slovenia	KT	1	1998	183,0	11,8	18,6	e,v	c,i
54	Vuhred 2	Slovenia	KT	1	1998	137,0	16,0	18,8	e,v,r,l	c,i
55	Plave I 2	Slovenia	KT	1	2000	40,0	24,0	8,8	e,v	c
56	Plave I 1	Slovenia	KT	1	2001	40,0	24,0	8,8	e,v	c
57	Lepenica	Croatia	RT	1	2001	6,2	18,0	1,2	e,l	u
58	Rama	Bosnia Herzeg.	FT	2	2001	32,0	285,0	90,0	e,v,l	c,i
59	Plave II	Slovenia	KT	1	2001	105,0	18,2	17,4	e,v,l	c,i
60	Doblar 1A	Slovenia	FT	1	2001	34,0	46,5	13,6	e,v,l	i
61	Vuhred 2 - ref	Slovenia	KT	1	2002	183,3	15,1	23,9	e,v,l	i
62	Doblar II	Slovenia	KT	1	2002	105,0	40,5	39,0	e,v,l	c,i
63	Ožbalt 3 - ref	Slovenia	KT	1	2003	183,3	15,2	24,7	e,v,r,l	c,i
64	Fužine	Croatia	FT/pump	1	2003	10,0/7,6	40/48,5	3,9/4,8	e,v,l	c,i
65	Jaruga	Croatia	FT	2	2004	9,0	24,5	3,5	e	c,i
66	Dubrovnik	Croatia	FT	1	2004	55,0	284,2	136,6	e,v,l	i
67	Vigevano	Italy	FT	2	2004	11,0	19,0	1,5	e,l	u,i
68	Tikveš	Macedonia	FT	1	2004	36,0	100,0	32,6	e,v	c
69	Vrutok	Macedonia	PT	1	2004	9,5	550,0	46,6	e	c
70	Kenyir	Malaysia	FT	4	2004	97,0	130,0	112,0	e,v,l	i
71	Raven	Macedonia	FT	1	2004	12,6	71,0	8,0	u	u
72	Medvode	Slovenia	KT	1	2005	75	18,6	12,4	e,v	c,i
73	Kozjak	Macedonia	FT	1	2006	50,0	92,0	41,0	e,v	c,i
74	Bratsk	Russia	FT	1	2007	280,0	100,0	255,0	e	c
75	Jajce	BiH	FT	2	2008	50,0	92,0	41,0	e,v	c, i
76	Zlatoličje	Slovenija	FT	1	2009	270,0	32,5	79,5	e,v	c
77	Piva	Montenegro	FT	1	2009	90,0	175	140	e,v,r,l	c,i

Type: **PT**-Pelton turbine, **FT**-Francis turbine, **KT**-Kaplan turbine, **RT**-reversible pump turbine, **BT**-bulb turbine

Type of measurements: **e**-efficiency, **v**-vibration, **r**-regulation, **l**-loss

Method of measurements: **c**-currentmeter, **i**-index test, **u**-ultrasonic, **p**-pressure-time, **t**-thermodynamic, **n**-nozzle opening

RETESTING, INDEPENDENT TESTS AND CONSULTING

	Power plant	Country	Type	Year	Producer	Flow (m ³ /s)	Head (m)	Power (MW)
1	Obrovac	Croatia	RT	1979	Voith	31,6	541,0	151,0
2	Hadiha	Iraq	KT	1982	Litostroj/ČKD	330,0	36,0	110,0
3	Iron Gate	Serbia	KT	1982	LMZ	800,0	26,5	194,0
4	Penitas	Mexico	KT	1982	ČKD	371,0	32,3	107,0
5	Birris	Costa Rica	PT	1988	ČKD	2,6	428,0	9,6
6	Vinodol	Croatia	PT	1995	ČKD	3,0	605,0	15,9
7	Karun III	Iran	FT	1997	HEC China	172,0	161,0	255,0
8	Mosad e Soleymani	Iran	FT	1997	HEC China	189,8	139,6	242,0
9	Plavinas	Latvia	FT	1998	Neyrpic	275,0	39,3	104,0
10	Jablanica	Bosnia Herzegovina	FT	1998	Hydro Vevey	33,5	99,0	29,5
11	Kozjak	Macedonia	FT	2000	Alstom Power Hydro	50,0	92,0	42,1
12	Vrutok	Macedonia	PT	2002	IMPISA	10,0	525,0	46,0
13	Guri	Venezuela	FT	2004	Alstom Power Hydro	360,0	136,0	400,0
14	Zakućac A, B	Croatia	FT	2006	Voith Siemens	60,0	270,0	151,0
15	Zakućac A, B	Croatia	FT	2006	Alstom	60,0	270,0	150,0
16	Zakućac C, D	Croatia	FT	2007	Voith Siemens	60,0	270,0	150,0
17	Djerdap I	Serbia	KT	2007	LMZ, Russia	800,0	31,6	240,0
18	Wells Dam	USA	KT	2008	Fuji, Voith Siemens	510,0	18,9	85,3

Type: **PT**-Pelton turbine, **FT**-Francis turbine, **KT**-Kaplan turbine, **RT**-Reversible pump turbine, **BT**-Bulb turbine