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Reference list

Status: January 2025

Discharge, head and power are given per machine group

- **Thermodynamic efficiency measurements**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
55	HPP Rothenbrunnen EWZ	Switzerland	Francis	2024	25.0	177	40.0
54	HPP Robbia	Switzerland	Pelton	2024	2.2	604	11.9
53	HPP Yang-yang	S. Korea	Pumpturbine	2024	32.0	819	250.0
52	HPP Mörel	Switzerland	Pelton	2023	3.5	616	19.3
51	HPP Silz	Austria	Pelton	2023	25.0	1232	266.0
50	HPP Lostallo	Switzerland	Pelton	2023	2.0	700	12.5
49	HPP Ilanz Panix	Switzerland	Pelton	2023	4.4	722	28.0
48	HPP Pradella	Switzerland	Francis	2022 - 2024	17.1	440	69.3
47	HPP Rabiusa-Realta	Switzerland	Pelton	2022	3.0	498	13.0
46	HPP Mapragg	Switzerland	Pump	2020	12.0	455	53.0
45	HPP Mapragg	Switzerland	Francis	2020	24.7	444	93.3
44	HPP Tannuwald	Switzerland	Pelton	2020 / 2021	1.1	359	3.4
43	HPP Tiefencastel	Switzerland	Francis	2019	9.8	142	12.8
42	HPP Findelnbach	Switzerland	Pelton	2019	1.0	509	4.5
41	HPP Hapcheon 1	S. Korea	Francis	2018 / 2020	51.3	110	51.6
40	HPP Lötschen	Switzerland	Pelton	2018	11.6	645	66.2
39	HPP Stundhüs	Switzerland	Pelton	2018	0.6	450	2.4
38	HPP Chrizji	Switzerland	Pelton	2018	0.7	532	3.1
37	HPP Tavanasa	Switzerland	Pelton	2018	11.5	473	45.0
36	HPP Pradella	Switzerland	Francis	2018	17.1	440	69.3
35	HPP Martina	Switzerland	Francis	2017	44.0	89	36.1
34	HPP Tschar UST	Switzerland	Pelton	2017	2.7	419	10.1
33	HPP Tschar OST	Switzerland	Pelton	2017 / 2018	1.2	396	4.2
32	HPP Silz	Austria	Pelton	2017 / 2021	25.0	1232	266.0
31	HPP Grund	Switzerland	Pelton	2016	2.5	131	2.9
30	HPP Arni	Switzerland	Pelton	2016	1.1	314	2.8
29	HPP Ulrichen	Switzerland	Pelton	2015	1.1	270	2.4
28	HPP Göschenen	Switzerland	Pelton	2015	6.2	332	19.0
27	HPP Tasnan	Switzerland	Pelton	2015	2.5	298	6.6
26	HPP Göschenen	Switzerland	Pelton	2014	7.5	665	46.0
25	HPP Zermeiggern	Switzerland	Pump	2014	4.5	447	22.0
24	HPP Spina Valbella	Switzerland	Francis	2014	5.0	91	3.9
23	HPP Chur Sand	Switzerland	Francis	2013	3.4	159	4.9
22	HPP Siebnen	Switzerland	Francis	2012	7.9	197	12.9
21	HPP Obermatt	Switzerland	Pelton	2012	3.0	309	8.4
20	HPP Ilanz	Switzerland	Francis	2012	28.5	88	22.3
19	HPP Filisur	Switzerland	Francis	2012 / 2016	8.8	415	32.5

18	HPP Wilen	Switzerland	Pelton	2011	0.03	130	0.02
17	HPP Sassello	Switzerland	Pelton	2011 / 2012	3.0	395	10.4
16	HPP Feldsee	Austria	Pumpturbine	2011	14.7	521	65.8
15	HPP Turtmann	Switzerland	Pelton	2010	1.3	730	8.9
14	HPP Oberems	Switzerland	Pump	2010	0.5	1007	5.5
13	HPP Oberems	Switzerland	Pelton	2010	0.6	950	4.2
12	HPP Sarelli	Switzerland	Francis	2010	15.5	350	49.0
11	HPP Mapragg	Switzerland	Pump	2010	12.0	455	53.0
10	HPP Mapragg	Switzerland	Francis	2010	24.7	444	93.3
9	HPP Rothenbrunnen	Switzerland	Pelton	2009 (2x)	7.9	669	42.0
8	HPP Frisal	Switzerland	Pelton	2009 (2x)	3.1	470	12.8
7	HPP Solis	Switzerland	Pelton	2008	1.4	588	7.4
6	HPP Hopflauenen	Switzerland	Pelton	2008	2.2	320	6.0
5	HPP Linth-Limmern	Switzerland	Pelton	2007 / 2008	11.0	1050	87.0
4	HPP Rabiusa-Realta	Switzerland	Pelton	2007	3.0	498	13.0
3	HPP Soazza	Switzerland	Pelton	2007 / 2009	7.0	704	40.0
2	HPP Sedrun	Switzerland	Pelton	2006	10.1	588	51.6
1	HPP Wysserlen	Switzerland	Pelton	2003	0.2	520	1.0

- **Neutral expertise for thermodynamic and other efficiency measurements performed by third parties**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
26	HPP Daecheong	S. Korea	Francis	2022	132.0	39	45.0
25	HPP Nant de Drance	Switzerland	Pumpturbine	2020 - 2024	60.0	306	157.0
24	HPP Chungju 2	S. Korea	Bulp	2020 - 2022	75.3	9	6.3
23	HPP Häusling	Austria	Francis	2019	28.0	744	181.0
22	HPP Ackersand 2	Switzerland	Pelton	2018	7.2	525	33.4
21	HPP Limmern	Switzerland	Pumpturbine	2018 - 2024	45.0	640	255.0
20	HPP Wassen	Switzerland	Francis	2017	10.2	258	24.3
19	HPP Baner	India	Pelton	2016	1.4	341	4.2
18	HPP Binwa	India	Pelton	2016	1.6	225	3.2
17	HPP Chanrion	Switzerland	Pelton	2016	9.8	365	28.6
16	HPP Sils	Switzerland	Francis	2016	17.5	386	62.7
15	HPP Dörverden	Germany	Francis	2015	40.0	3.5	1.3
14	HPP Russein	Switzerland	Pelton	2015	7.0	393	24.2
13	HPP Sarelli	Switzerland	Francis	2014	15.5	350	49.0
12	HPP Mapragg	Switzerland	Francis	2014 / 2015	24.7	444	93.3
11	HPP Stalden	Switzerland	Pelton	2013 / 2014	10.3	1029	92.5
10	HPP Massaboden	Switzerland	Francis	2013	10.5	42	3.9
9	HPP Grono	Switzerland	Pelton	2013	2.0	608	11.0
8	HPP Zermeiggern	Switzerland	Francis	2011	9.5	410	37.0
7	HPP Rempen	Switzerland	Francis	2011	7.0	250	15.0
6	HPP Hugschwendi	Switzerland	Pelton	2010	1.2	819	8.8
5	HPP Sedrun	Switzerland	Pelton	2009	10.1	588	53.6
4	HPP Lötschen	Switzerland	Pelton	2008	10.8	645	55.0
3	HPP Küblis	Switzerland	Pelton	2007	8.6	337	25.6
2	HPP Riddes	Switzerland	Pelton	2006	6.2	1005	55.7
1	HPP Stalden	Switzerland	Pelton	2002	10.3	1029	92.5

- **Current meter and acoustic flow rate measurements (efficiency measurements)**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
17	HPP Hwa-cheon	S. Korea	Francis	2024	43.8	65	25.4
16	HPP Ova Spin	Switzerland	Pumpturbine	2023	17.5	165	25.0
15	HPP Kirchbichl	Austria	3x Kaplan 1x Bulp	2023	1x 65 / 2x 130 1x 200	9.4	1x 5 / 2x 10 1x 17

14	HPP Windisch	Switzerland	Kaplan	2022	25.0/15.3	4	0.8/0.6
13	HPP Nant de Drance	Switzerland	Pumpturbine	2022	60.0	306	157.0
12	HPP Hapcheon 2	S. Korea	Bulp	2019	12.4	9	1.0
11	HPP Wettingen	Switzerland	Kaplan	2019 / 2020	45.0	23	8.5
10	HPP Erlabrunn	Germany	Kaplan	2017	90.0	3.5	2.5
9	HPP Sedrun	Switzerland	Kaplan	2016	3.5	29	0.9
8	HPP Pradella	Switzerland	Kaplan	2015	5.0	11	0.5
7	HPP Wettingen	Switzerland	Kaplan	2013 / 2014	45.0	23	8.5
6	HPP La Rance	France	Bulp	2013	275.0	6	10.0
5	HPP Sedrun	Switzerland	Kaplan	2013	3.0	29	0.8
4	HPP Mühlau	Switzerland	Bulp	2011	15.5	5	0.7
3	HPP Ponte Brolla	Switzerland	Francis	2010	6.0	39	2.4
2	HPP Neuhausen	Switzerland	Francis	2009 / 2011	25.0	20	4.6
1	HPP Veveri	Italy	Bulp	2003	16.0	4	0.5

- **Pressure-time flow rate measurements (efficiency measurements)**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
1	HPP Vissoie	Switzerland	Pelton	2022	1.2	76	0.8

- **Index efficiency measurements (e.g. cam correlation measurements)**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
16	HPP Rüchlig	Switzerland	Bulp	2025	90.0	3	2.4
15	HPP Perlen Papier	Switzerland	Kaplan	2023 / 2024	15.0	2.7	0.4
14	HPP Rheinau	Switzerland	Kaplan	2023	219.0	12	21.5
13	HPP Wildegg-Brugg	Switzerland	Kaplan	2022	210.0	15.6	25.9
12	HPP Windisch	Switzerland	Kaplan	2022	25.0/15.3	4	0.8/0.6
11	HPP Rüchlig	Switzerland	Bulp	2021 / 2022	90.0	3	2.4
10	HPP Bortelalp	Switzerland	Pump	2020	0.2	493	1.3
9	HPP Tiefencastel	Switzerland	Francis	2019	9.8	142	12.8
8	HPP Martina	Switzerland	Francis	2018	44.0	89	36.1
7	HPP Cayalti 2	Turkey	Kaplan	2017	22.5/10.0	11	2.2/1.0
6	HPP Göschenen	Switzerland	Pelton	2015	7.5	665	46.0
5	HPP Fieschertal	Switzerland	Pelton	2010 / 2011	7.3	520	32.0
4	HPP Freienstein	Switzerland	Kaplan	2009	12.0	6	0.6
3	HPP Rothenbrunnen	Switzerland	Pelton	2008 (2x)	7.9	669	42.0
2	HPP Safien Platz	Switzerland	Francis	2007 / 2008	11.5	408	43.0
1	HPP Tavanasa	Switzerland	Pelton	2002 / 2003	6.2	478	25.0

- **Noise emission measurements**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
3	HPP Perlen Papier	Switzerland	Kaplan	2023 / 2024	15.0	2.7	0.4
2	HPP Rabiusa-Realta	Switzerland	Pelton	2021 / 2022	3.0	498	13.0
1	HPP Sedrun	Switzerland	Pelton	2010	10.1	588	53.6

- **Efficiency history (periodical efficiency measurements) and efficiency monitorings**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
6	HPP Mapragg	Switzerland	Pump	2021 - now	12.0	455	53.0
5	HPP Mapragg	Switzerland	Francis	2021 - now	24.7	444	93.3
4	HPP Tiefencastel	Switzerland	Francis	2018 - now	9.5	140	12.0
3	HPP Filisur	Switzerland	Francis	2016 - now	9.8	415	32.5
2	HPP Stalden	Switzerland	Pelton	2013 - 2017	10.3	1029	92.5

1	HPP Fieschertal	Switzerland	Pelton	2012 - 2020	7.3	520	32.0

- **Visualizations of Pelton jets**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
11	HPP Silz	Austria	Pelton	2021	25.0	1232	266.0
10	HPP Tannuwald	Switzerland	Pelton	2021	1.1	359	3.4
9	HPP Kaunertal	Austria	Pelton	2014	10.8	810	84.0
8	HPP Lünersee	Austria	Pelton	2013	5.5	974	46.2
7	HPP Sassello	Switzerland	Pelton	2012	3.0	395	10.4
6	HPP Rothenbrunnen	Switzerland	Pelton	2009	7.9	669	42.0
5	HPP Sedrun	Switzerland	Pelton	2008	10.1	588	51.6
4	HPP Rabiusa-Realta	Switzerland	Pelton	2007	3.0	498	13.0
3	HPP Soazza	Switzerland	Pelton	2007 / 2009	7.0	704	40.0
2	HPP Fionnay	Switzerland	Pelton	2004	7.5	874	48.3
1	HPP Moccasin	USA	Pelton	2001	16.5	380	50.0

- **Water hammer, pressure fluctuation and mechanical vibration (Fingerprint) measurements**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
12	HPP Perlen Papier	Switzerland	Kaplan	2023 / 2024	15.0	2.7	0.4
11	HPP Wassen	Switzerland	Francis	2023	11 / 14	258	24 / 30
10	ARA Lonza	Switzerland	Pump	2021	0.3	10	0.1
9	HPP Rabiusa-Realta	Switzerland	Pelton	2021 / 2022	3.0	498	13.0
8	HPP Limmern	Switzerland	Pumpturbine	2018	45.0	640	255.0
7	HPP Dörverden	Germany	Francis	2014	40.0	3.5	1.3
6	HPP Obermatt	Switzerland	Pelton	2012	3.0	309	8.4
5	HPP Ilanz	Switzerland	Francis	2012	28.5	88	22.3
4	HPP Gondo	Switzerland	Pelton	2012	5.1 / 2.1	450	18.5 / 8.0
3	HPP Oberems / Turtmann	Switzerland	Pump / Pelton	2012	0.5 / 1.3	1007 / 729	5.5 / 8.9
2	HPP Oberems	Switzerland	Pump	2010	0.5	1007	5.5
1	HPP Neuhausen	Switzerland	Francis	2009 / 2011	25.0	20	4.6

- **Water hammer, pressure fluctuation and system oscillation simulations**

	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
6	Public water supply Lucerne	Switzerland	Pump	2014 / 2023	-	-	-
5	HPP Bondo	Switzerland	Pelton	2014	1.9	277	4.0
4	HPP Tavanasa	Switzerland	Pelton	2012	11.5	479	45.0
3	HPP Oberems / Turtmann	Switzerland	Pump / Pelton	2012	0.5 / 1.3	1007 / 729	5.5 / 8.9
2	HPP Turtmann	Switzerland	Pelton	2011	1.3	729	8.9
1	HPP Oberems	Switzerland	Pump	2010	0.5	1007	5.5

- **Numerical flow simulations (CFD)**

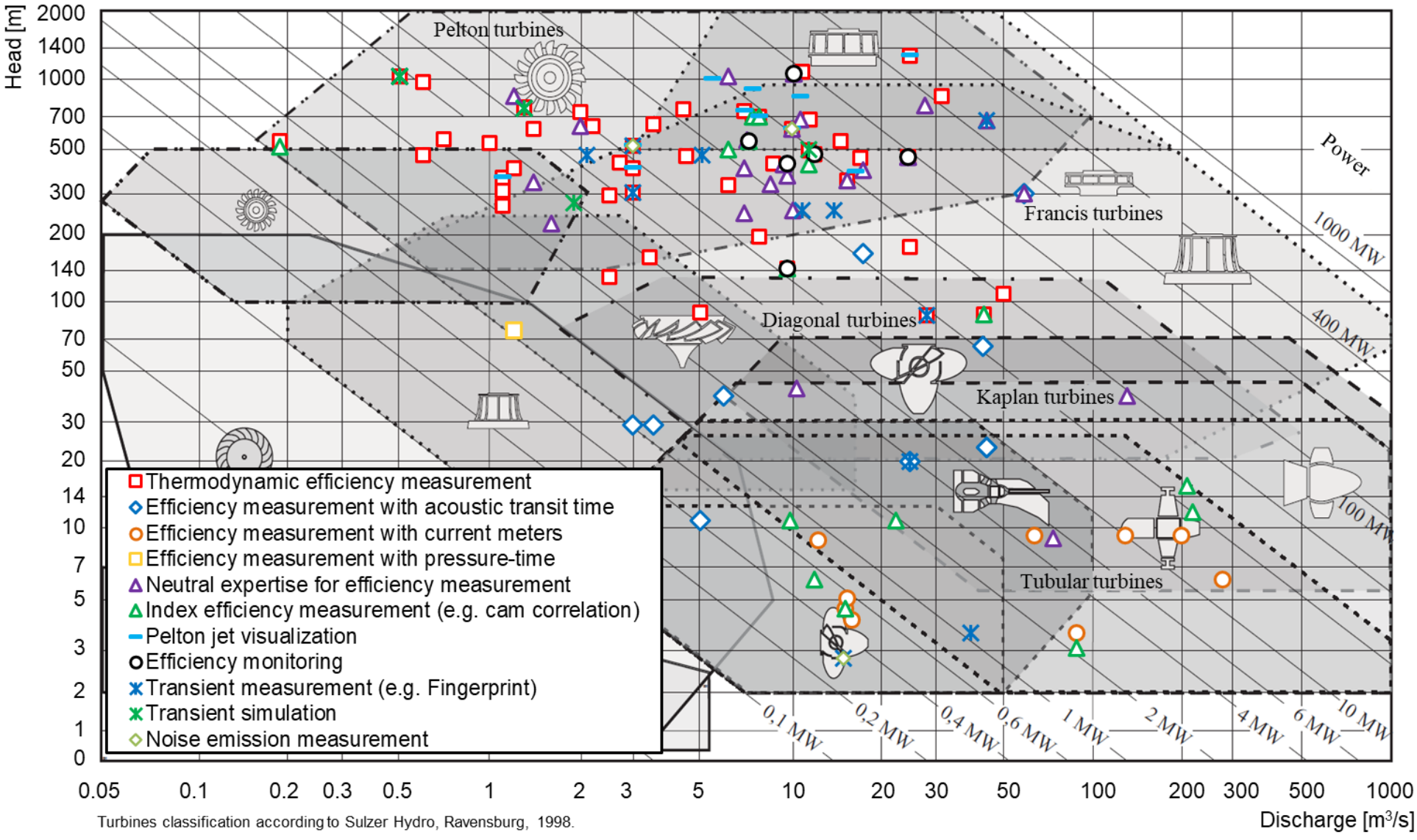
	Power plant	Country	Type	Year	Discharge (m^3/s)	Head (m)	Power (MW)
22	HPP Ova Spin	Switzerland	Pumpturbine	2023	17.5	165	25.0
21	Intake Pfaffensprung	Switzerland	Intake	2023	18.0	-	-
20	HPP Snowy 2.0	Australia	Pumpturbine	2022 / 2023	60.0	650	333.0
19	HPP Antuco	Chile	Francis	2022	100.0	190	160.0
18	HPP Sauzal	Chile	Francis	2021	26.0	118	26.0
17	HPP Aguasabon	Chile	Francis	2021	31.0	91	26.0
16	HPP Pehuenche	Chile	Francis	2020	150.0	206	285.0
15	HPP Ralco	Chile	Francis	2020	225.0	184	400.0
14	HPP Hermillon	France	Francis	2020	45.0	150	59.0

13	PP Genelba	Argentina	Pump	2019	9.2	-	-
12	HPP Marèges	France	Francis	2019	64.6	72	38.4
11	HPP Guavio	Colombia	Pelton	2018	22.4	1100	242.6
10	HPP Nant de Drance	Switzerland	Pumpturbine	2017 / 2022	60.0	308	157.0
9	HPP Silver Falls	Canada	Francis	2017	56.0	103	48.0
8	HPP John Hart	Canada	Francis	2016	41.0	112	46.0
7	HPP Borgnone	Switzerland	Kaplan	2016 / 2018	20.0	5	1.0
6	HPP Juncalito	Chile	Kaplan	2015	13.2	12	1.5
5	HPP Sauzalito	Chile	Kaplan	2015	49.8	25	11.1
4	HPP Grimsel 1E	Switzerland	Pumpturbine	2015	90.0	-	150.0
3	HPP Wettingen	Switzerland	Kaplan	2013	45.0	23	8.5
2	HPP Sarelli	Switzerland	Francis	2012	15.5	350	49.0
1	HPP Neuhausen	Switzerland	Francis	2009 / 2011	25.0	20	4.6

- **Efficiency measurements at hydrogen power plant**

	Power plant	**Country**	**Type**	**Year**	**Discharge (m^3/s)**	**Head (m)**	**Power (MW)**
1	HPP Reichenau	Switzerland	-	2024	-	-	2.5

Measurement, monitoring, simulation and neutral expertise from etaeval



Turbines classification according to Sulzer Hydro, Ravensburg, 1998.

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Clients

- **Turbine and pump manufacturer**

- **Operator and service companies / measurement equipment manufacturer**