2. Data Sheet

2. Kaplan S-turbine(s) with horizontal shaft

size 32,10 AR

Turbine No. 17883 + 17884

2.1 Design Data

2.1.1 Nominal data

Head	H	= 5,944 m	19.5 ft (jca)
Discharge	Q	= 58,49 m^3/s	2066 cfs (jca)
Output	P	= 3044 kW	
Speed	n	= 120 rpm	
Runaway speed	n_d	= 362 rpm	

2.1.2 Maximum values

Head	H	= 7,74 m	25.4 ft (jca)
Discharge	Q	= 58,80 m_3/s	2077 cfs (jca)
	at H	= 5,578 m	18.3 ft (jca)
Power	P	= 3111 kW	

Direction of rotation:
Clockwise when viewed from the intake to the draft tube

Axial thrust	F	= 492 kN
Counterthrust	F	= 700 kN
Critical bending speed	n_{Kr}	= 495,1 rpm

2.2 Altitude Levels

Elevation centreline runner	= 208,48 m a.s.l.
Headwater normal water level	= 214,18 m a.s.l.
Maximum tailwater level	= 209,28 m a.s.l.
Minimum tailwater level	= 207,36 m a.s.l.

2.3 Machine Data (Main Dimensions)

2.3.1 Guide Apparatus

	Wicket gate type		= RL 23
	Number of wicket gates	z_0	= 16
	Wicket gate height	b_o	= 1107,5 mm
	Wicket gate opening angle		= 68 °
	Response force of bending link	F	= 2580 N
	1 gate servomotor	D	= 140 mm
	Piston rod dia	d	= 90 mm
	Servomotor stroke	s	= 781 mm
	Servomotor volume OPEN side	V	= 12,02 l
	Servomotor volume CLOSED side	V	= 7,05 l
	Regulating work	A	= 39,74 kNm
	Operating gauge pressure (mathematical)	p	= 33,1 bar
*	Pressure tank gauge pressure	p	= 40/60 bar/
*	Response pressure overflow valve	p	= 62 bar/
	Control equipment guide apparatus ..... K 4000/25		

2.3.2 Runner

	Runner nominal dia	D	= 3210 mm
	Hub ratio		= 0.428
	Number of blades	z_2	= 4
	Blade adjusting angle	φ	= 0 ÷ 34 °
	Type of blade		K 844/4
	Radial blade end clearance		= 1,6 mm
	Servomotor dia	D	= 320 mm
	Piston carrier dia	d	= 160 mm
	Servomotor stroke	s	= 184,2 mm
	Radius of blade lever and link	R_k	= 315 mm

Servomotor volume CLOSED side	V	= 14,81	l
OPEN side	V	= 11,11	l
Regulating work	A	= 58,49	kNm
Operating gauge pressure (mathematical)	p	= 39,5	bar
*Response pressure overflow valve	p	= 62	bar/

Control equipment runner K4000/25...

Closing direction: in the directon of water flow

2.3.3 Shafts

Bearing shaft	D_w	= 280	mm
Driving shaft	d_w	= 400	mm

2.3.4 Bearing

2.3.4.1 Output-side guide bearing

Bearing shell bore	D_L	= 355	mm
Max. bearing clearance, diametrical		= 0,422	mm
Min. bearing clearance, diametrical		= 0,329	mm
Bearing load	F	= 76,89	kN
Mean load per unit of contact area	p	= 0,85	N/mm^2
Shaft velocity	v	= 2,2	m/s
Friction loss	P_R	= 0,38	kW
Mathematical operating temperature	T	= 47	°C

2.3.4.2 Combined Thrust Bearing,
Bearing Shell

Bearing shell bore	d_F	= 280	mm
Max. bearing clearance, diametrical		= 0,294	mm
Min. bearing clearance, diametrical		= 0,190	mm
Bearing load	F	= 122,95	kN
Mean load per unit of contact area	pl	= 2,74	N/mm^2
Shaft velocity	v	= 1,759	m/s
Friction loss	P_R	= 0,386	kW
Mathematical oil quantity	Q	= 3,51	l/min
Preset oil quantity	Q	= 4	l/min

2.3.4.3 Combined Thrust Bearing, Thrust

Segment size	NM	= 160	mm
Number of segments	Z	= 8	
Segment inside dia	di_s	= 315	mm
Amount of crown	b	= 0,030	mm
Axial thrust	F	= 492	kN
Mean velocity	v_m	= 2,98	m/s
Specific segment pressure	P	= 2,70	N/mm^2
Friction loss	P_r	= 1,93	kW
Mathematical oil quantity	Q	= 6,96	l/min
Preset oil quantity	Q	= 8,5	l/min

2.3.4.4 Combined Thrust Bearing,
Counterthrust
NM, Z, d_{is}, b and v_m same as 2.3.4.3

Counterthrust (short-time)	F	= 700	kN
Specific segment pressure	p	= 3,84	N/mm^2
Friction loss	P_R	= 0,21	kW
Mathematical oil quantity	Q	= 0,8	l/min
Preset oil quantity	Q	= 1	l/min

2.3.4.5 Generator bearing
oil quantity adjusted to Q = 23 l/min

2.3.5 Shaft Seals
Bore bearing side D_d = 340 mm
Bore input side D_d = 460 mm

2.3.6 Main Dimensions
clear height inlet H = 8153 m
clear width inlet B = 6096 m
clear height draft tube outlet H = 3914 m
clear width draft tube outlet B = 6096 m
Plate liner draft elbow
up to cross section No. 6.
*Machine distance = 7925 m/
Clearance between bars = 80 mm

2.3.7 Regulation Guarantees
On sudden load rejection n = 120 rpm
from a turbine output P = 3148 kW
corresponding to a flowrate Q = 66,5 m^3/s
at a net head H = 5,58 m
the following speed
variation results:
- 100 % load variation
+ 60 % speed rise
at a moment of inertia of J_{Geno} = 1309 kgm^2
J_{Flywh} = 642,5 "

2.4 Other Data
Capacity of crane = 200 kN
Maximum crane hook
position elevation = 217,74 m a.s.l.
Control voltage U = 125 Volts DC
Frequency f = 60 Hz
Oil grade used for
turbine and governor: *~~ISO VG 100~~/
*ISO VG 68/