Operation and Maintenance Of Water Treatment Plant In Phnom Penh Water Supply Authority

MON Tito (モン ティト)
Chief of Niroth Water Treatment Plant
Production Office, Production and Distribution Department, PPWSA



GENERAL INFORMATION

Land: 181,035 km²
Population:
16 million

Phnom Penh:
678 km²
3.3 million
inhabitant

VISION & MISSIN of PPWSA

Our Vision

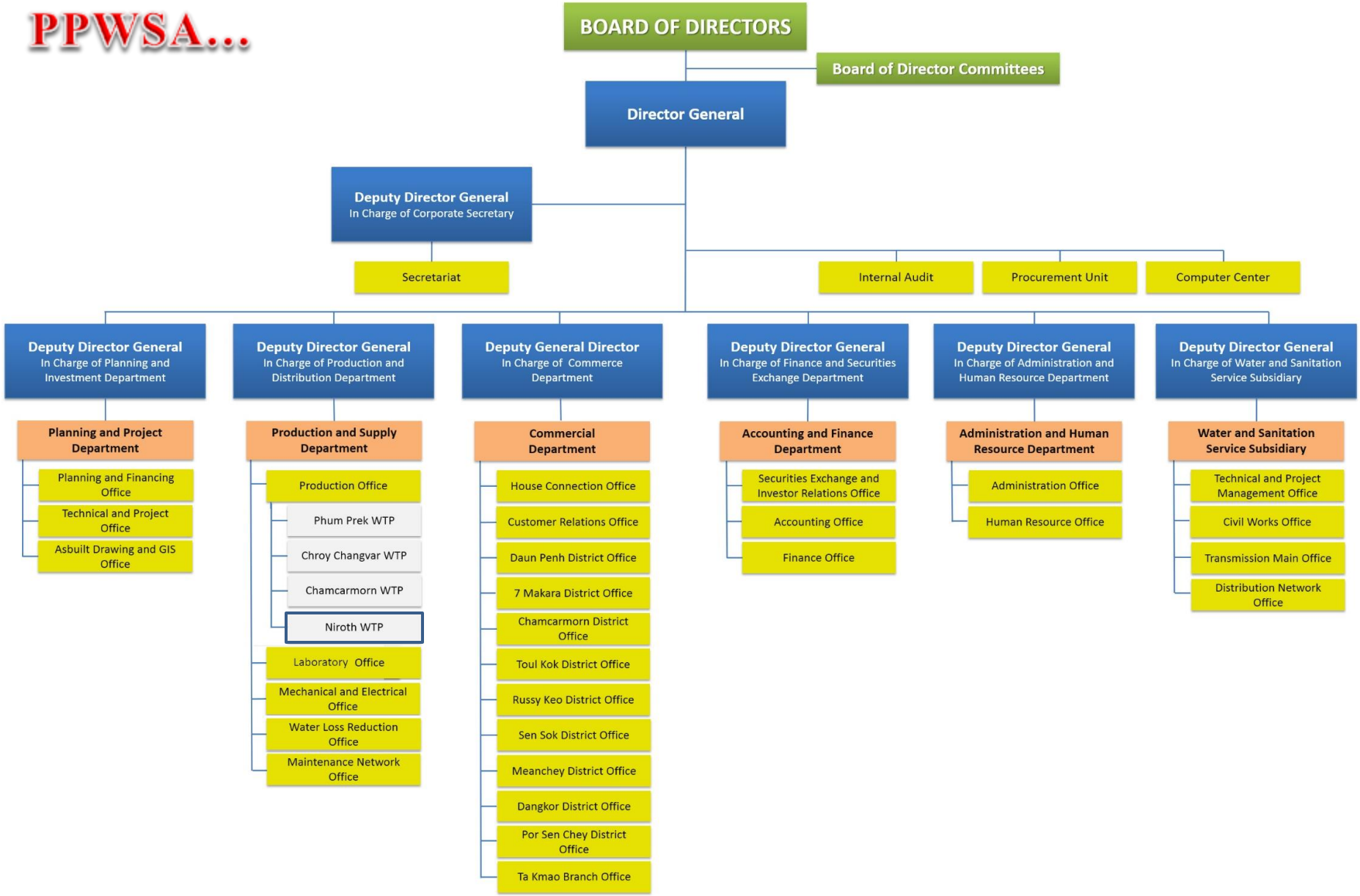
- Sustainable developing of our potable water supply services to cities and provinces of CAMBODIA.
- Assisting other developing countries to supply potable water to their people.

Our Missions

- To ensure the supply of clean potable water 24 hours/day, 7 days/week with adequate water pressure at a reasonable price whilst considering the needs of those people living in poverty.
- To share our experiences with some provincial waterworks in CAMBODIA as well as in the region and the rest of the world.

ORGANIZATION CHART

PPWSA...



GENERAL INFORMATION (Cont.)

Total Capacity now = 540,000 m³/day

Coverage area 85%

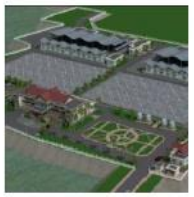
1 Phum Prek WTP

- Capacity: 150,000m³/day
- Year of Activation: 1966
- End of Rehabilitation: 1995

2 Chrouy Changva WTP

- Capacity: 130,000m³/day
- Year of Activation: 1895
- End of Rehabilitation: 2003

3 Niroth WTP



- Stage I 130,000m³/day Mid 2013
- Stage II 130,000m³/day 2017

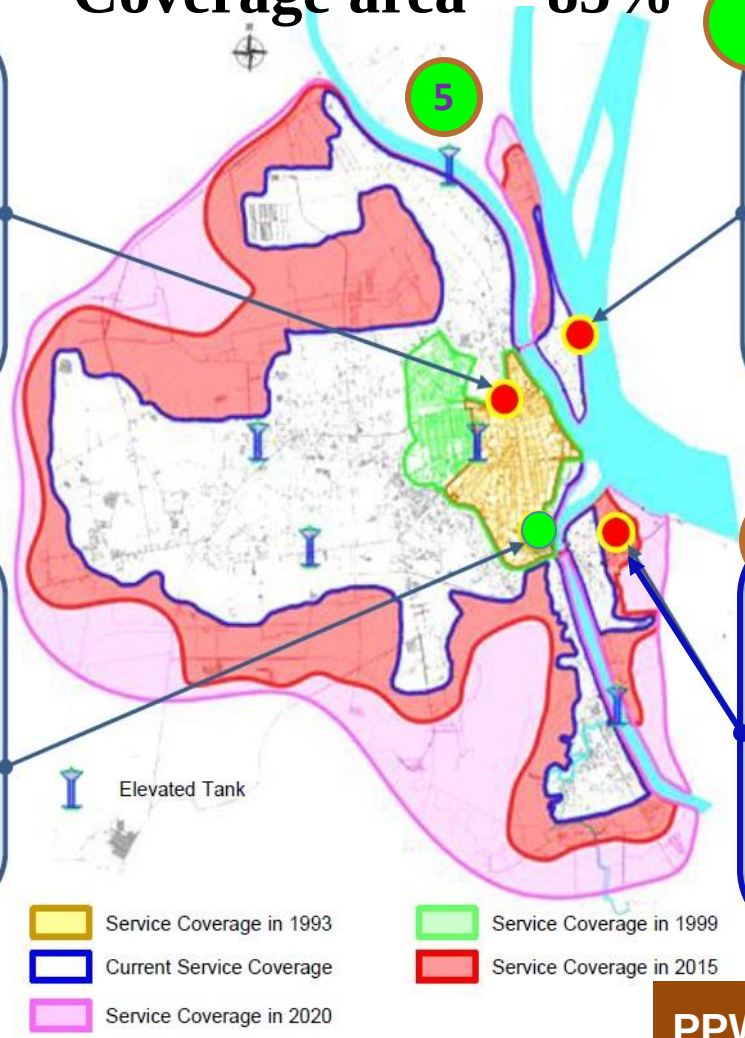
260,000m³/day

4 Chamkamorn WTP

- Capacity: 20,000m3/day
- Year of Activation: 1958
- End of Rehabilitation: 1995

Stop Build new WTP

52,000 m³/day
Under construction: 2018-2019



5 Bakkheng WTP Phase 1&2

2019-2023 195,000 m³/day
2023-2025 195,000 m³/day

390,000 m³/day

PPWSA Total Capacity:
2020: 592,000 m³/day
2026: 982,000 m³/day

NIROTH WATER TREATMENT PLANT

MISSION…

To ensure the supply of clean potable water 24 hours per day, 7 days per week, with adequate water pressure.

ORGANIZATION CHART

MON TITO
Chief

SEN KIMSONG
Vice Chief

Operator T1	Operator T2	Operator T3	Operator T4	Laboratory	Electrical	Mechanical
Hun Chantha *Team Leader*	**Ma Bora** *Team Leader*	**Bin Ratana** *Team Leader*	**Phan Ratanak** *Team Leader*	**Hul Soursdey** *Water Analyst*	**Yun Ratanak** *Electrician*	**Nou Bunna** *Mechanician*
Chhim Maksideth *SCADAControl room*	**Pum Vun** *SCADAControl room*	**Preap Seiha** *SCADAControl*	**Phim Sambath** *SCADAControl room*	**Kong Sopheak** *Water Analyst*	**Kong Lyphalkun** *Electrician*	**Sarun Chandana** *Mechanician*
San Vivith *Clarifier-Filter P1*	**Pheap Sinan** *Clarifier-Filter P1*	**Ouch Ratha** *Clarifier-Filter P1*	**Seang Chantha** *Clarifier-Filter P1*		**Lim Chaiypang** *Electrician*	
Bo Sophea *Chemical P1*	**Heab Seanghai** *Chemical P1*	**Phorn Daro** *Chemical P1*	**Phut Amnot** *Chemical P1*			
Bun Sovannsak *Clarifier-Filter P2*	**Ly Mony** *Clarifier-Filter P2*	**Nou Bunnapheakdey** *Clarifier-Filter P2*	**Heng Chamnab** *Clarifier-Filter P2*			
Tit Uksa *Chemical P2*	**Pom Veasna** *Chemical P2*	**Tep Soriyung** *Chemical P2*	**Ros Ratha** *Chemical P2*			
Meas Mardy *Intake*	**Yang Sokchum** *Intake*	**Yous Sophal** *Intake*	**Teum Sambo** *Intake*			

OPERATOR ROUTINE WORK TIME SCHEDULE...

Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Morning (06:00-12:00)	I	IV	III	II	I	IV	III
Afternoon (12:00-20:00)	II	I	IV	III	II	I	IV
Night (20:00-06:00)	III	II	I	IV	III	II	I
Stand-By	IV	III	II	I	IV	III	II

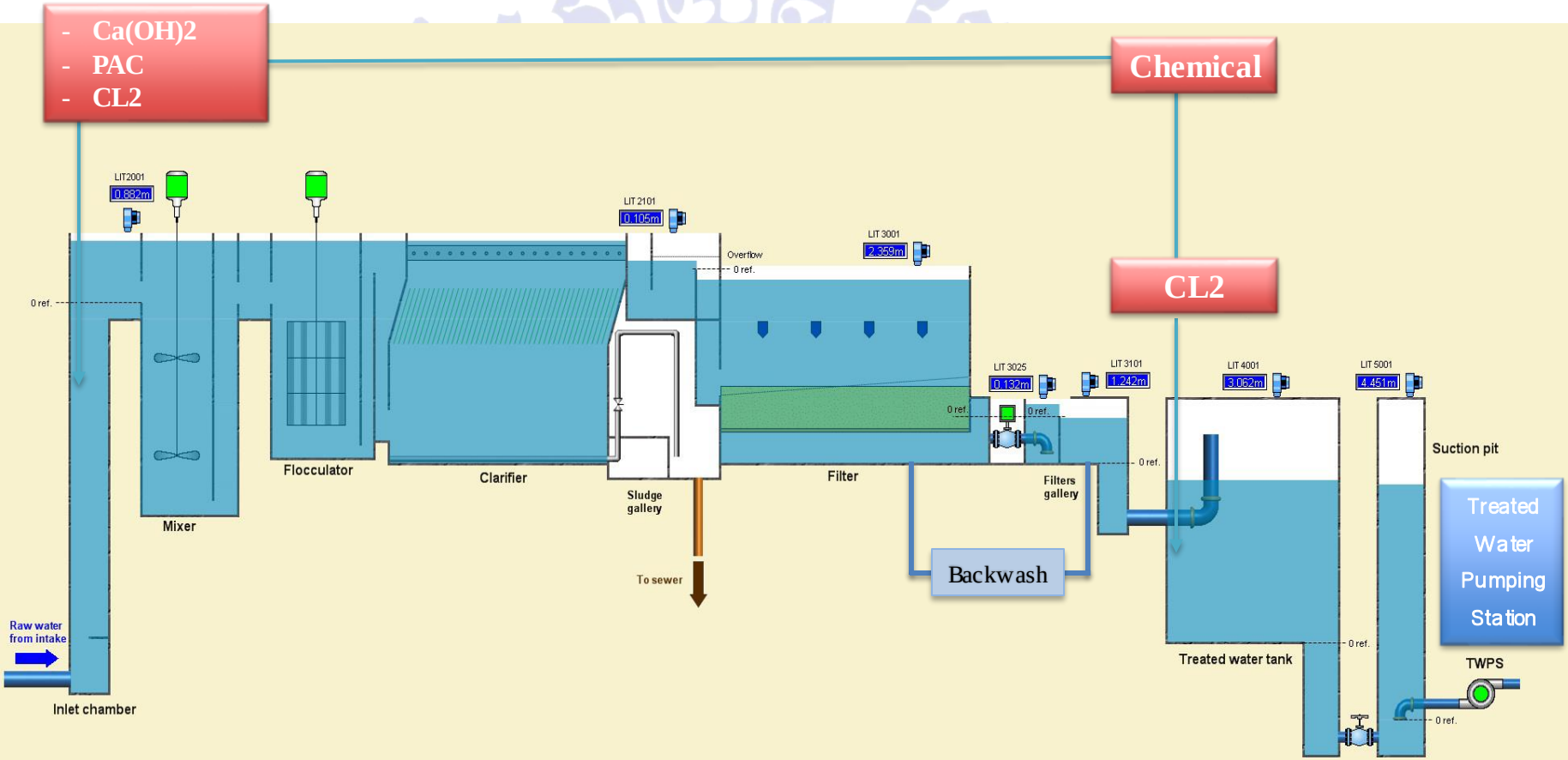
NIROTH WATER TREATMENT PLANT

Niroth WTP Overview…

Capacity=260,000m³/day

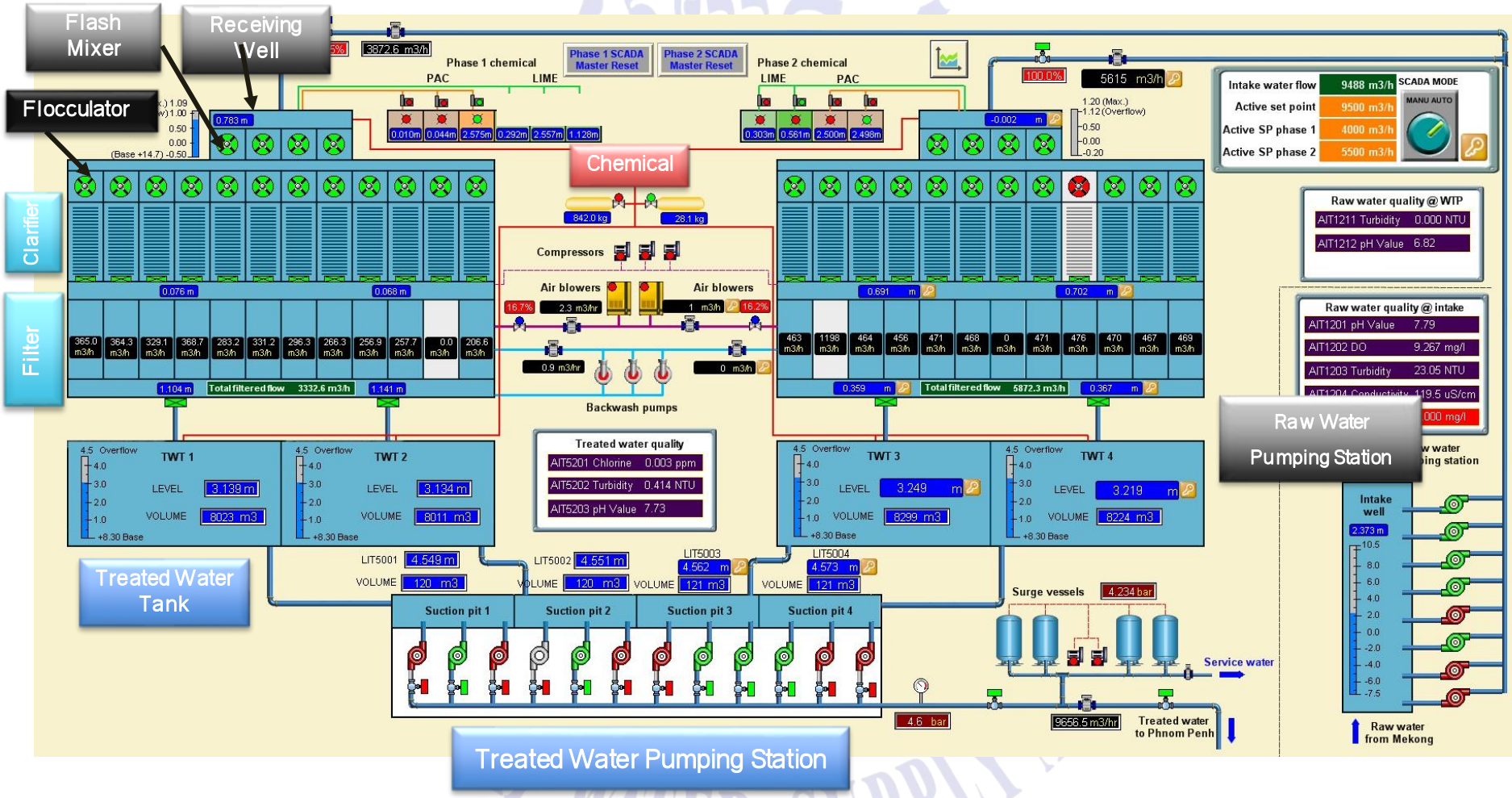
OPERATION OF WTP

PROCESS...



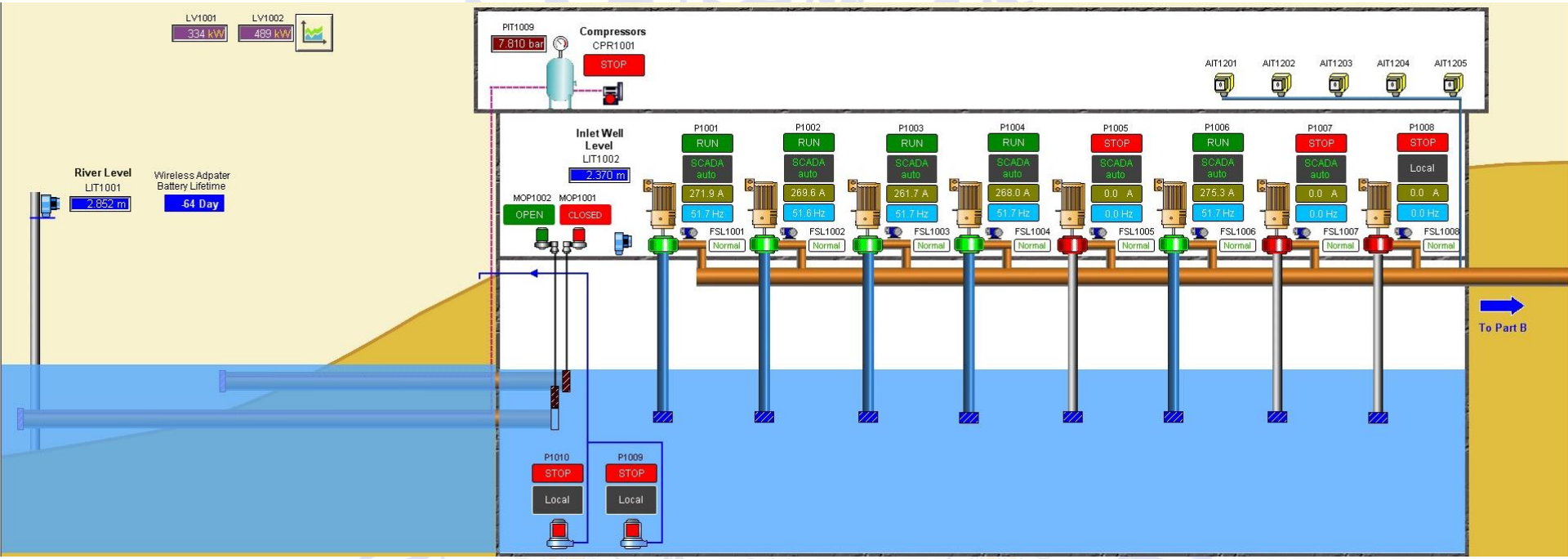
OPERATION OF WTP

PROCESS Overview…



OPERATION OF WTP

Operation and Maintenenance…



Specification:

- Raw Water Pump: 160kW, 2200m^3/h,
- Centrifugal Pump,
- Head 17m, 993rpm (PEME GOURDIN)
- Raw water pump Variable Frequency Drive, ABB

OPERATION OF WTP

Operation and Maintenenance…

Receiving Well…

Specification:

- Size: (W=1.40m x L=11m x H=8m)
- Inject Chemical: PAC, Chlorine and Lime

Flash Tank…

Specification:

To Mix Chemical and Raw Water

- Brand: WASSERWELT
- Motor: 5.5kw, 37.8RPM
- No: 4 tanks x 2 phases
- Each Size: (W=2.5m x L=2.5m x H=5.8m)

Flocculation Tank…

Specification:

To Mak big flog with slow speed of mixer

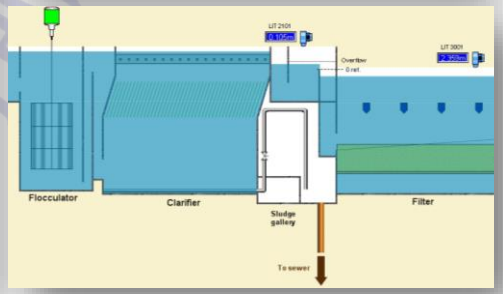
- Brand: WASSERWELT
- Motor: 5.5kw, 5.94RPM, equip with invertor to control speed (VAMECA)
- No: 12 tanks x 2 phases
- Each Size: (W=6.1m x L=6.1m x H=4.8m)

Clarifier Tank…

Specification:

To Settle the big flog to the bottom of the tanks and remaining light small flog will remove in the filtert.

- No: 12 tanks x 2 phases
- Size: (W=6.1 x L=12.5m x H=4.8m)



Filtration Tank…

Specification:

To remove remaining small flog from the clarifier.

- No: 12 tanks x 2 phases
- Size: (W=6.1m x L=13.1m x H=4.0m)
- Sand media dimeter: size= 0.90-1.20mm, Deep=1.00m
- Gravel size: 3.20mm
- Filtration area: 64m2
- Filtration rate: $8m^3.h^{-1}.m^{-2}$

OPERATION OF WTP

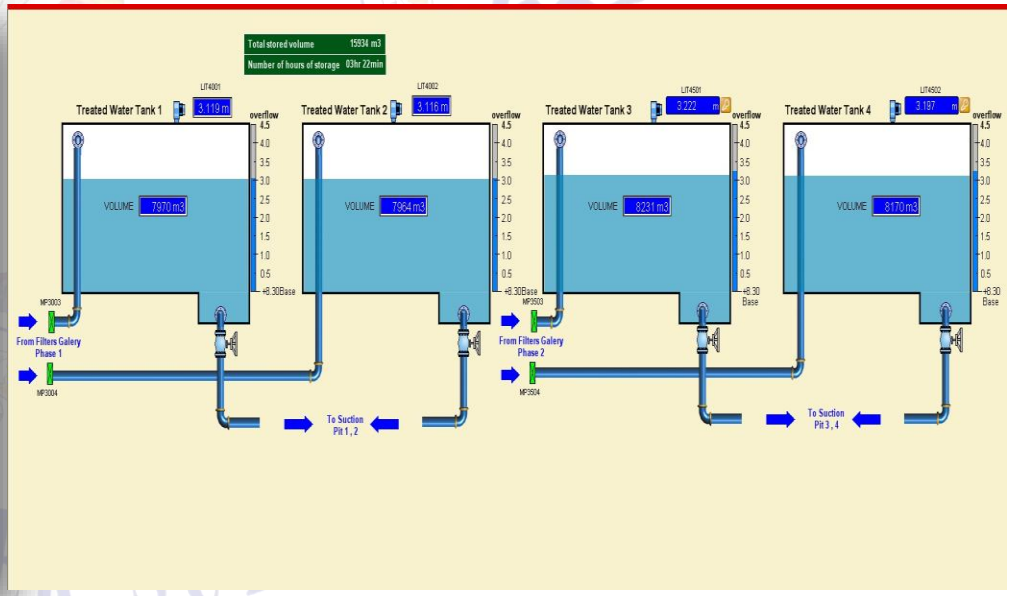
Filtration Tank…

Treated water Tank…

Specification:

To store treated water in order to pump to the city.

- No: 02 tanks x 2 phases
- Size: (W=47m x L=54m x H=4.5m)
- Capacity: 11,500m³ x 4 = 46,000 m³



OPERATION OF WTP

Treated water Pumping station…

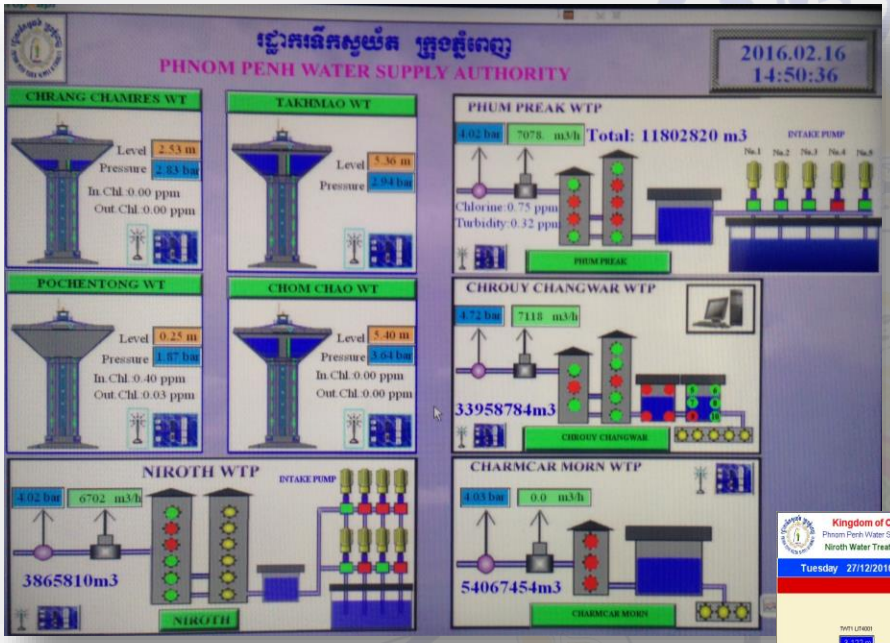
Specification:

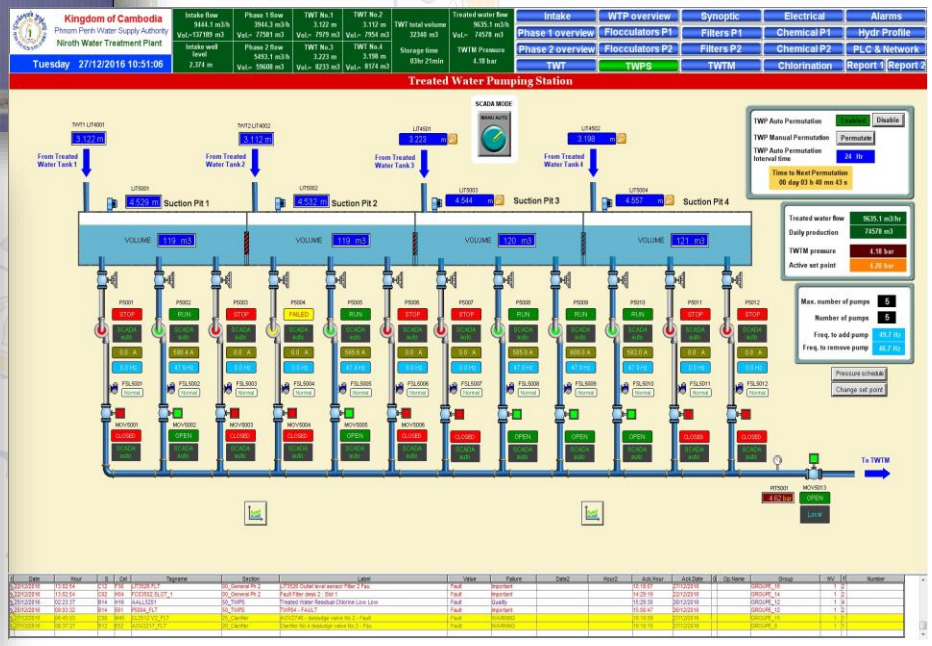
To supply treated water to the network for the customer

- No: 12 pumps
- Brand: KUBOTA, Double Suction volute pumps
- Capacity: 18,00m3/h, 500kw,53m
- Raw water pump Variable Frequency Drive, ABB

OPERATION OF WTP

Treated water Pumping station…



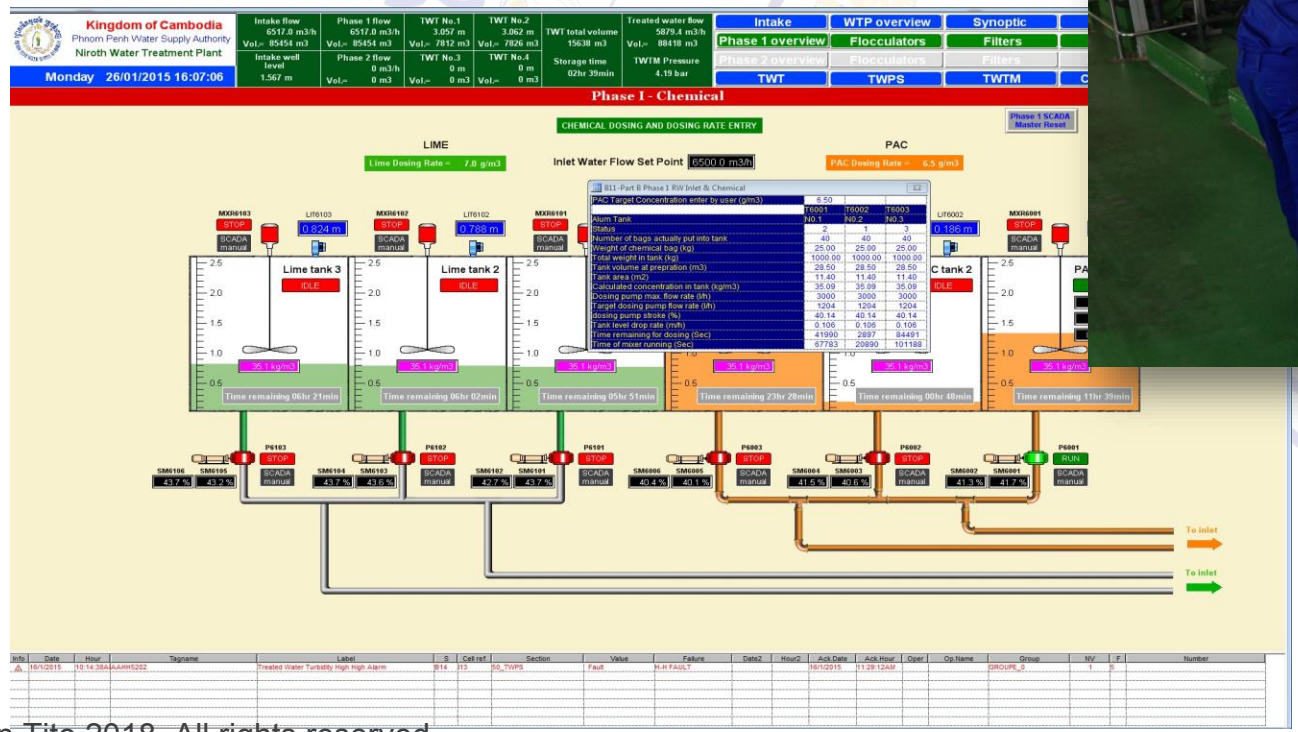


Chemical and Water Quality Management…

Chemical:

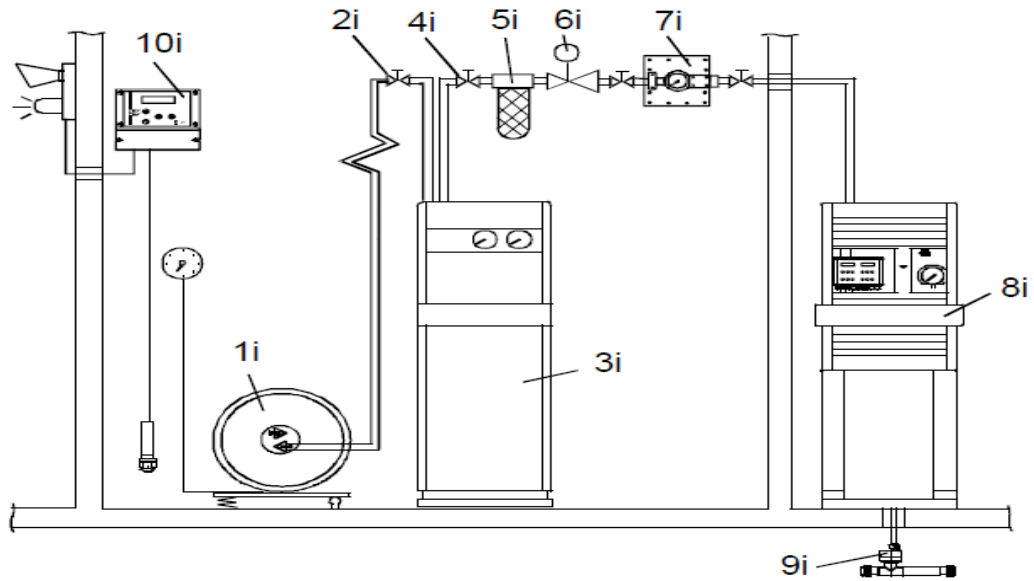
To treat the water we use the chemical as below:

- PAC: PolyAlumium Chloride= $Aln(OH)mCl(3n-m)(SO4)2p$
- Lime: $Ca(OH)_2$
- Chlorine: Cl_2



Chemical and Water Quality Management…

Chlorine system:

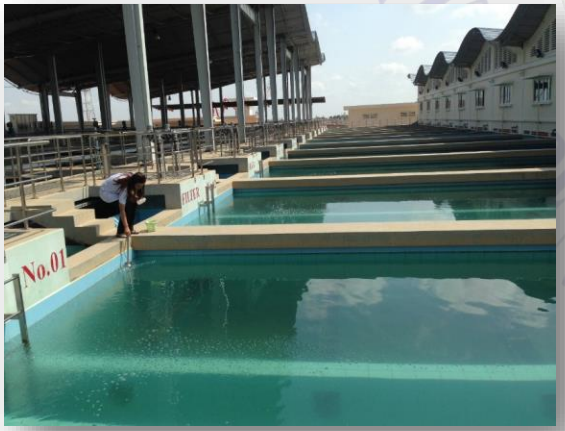


Chemical and Water Quality Management…

Water Quality Management:

To manage the water quality we check as below:

- Monitor water quality in the process 3 times per day
- Water quality weekly, monthly, yearly test
- Monitoring distribution water quality
- Working closely together with operator to produce clean safe water for people
- Quality of the is follow the National and WHO standard



WATER QUALITY

រដ្ឋាករទឹកស្វយ័តក្រុងភ្នំពេញ
PHNOM PENH WATER SUPPLY AUTHORITY
នាយកដ្ឋានផលិតកម្ម និងផ្គត់ផ្គង់ទឹក
DEPARTMENT OF PRODUCTION AND DISTRIBUTION
មន្ទីរពិសោធន៍/LABORATORY OFFICE

ព្រះរាជាណាចក្រកម្ពុជា
KINGDOM OF CAMBODIA
ជាតិ សាសនា ព្រះមហាក្សត្រ
NATION RELIGION KING

កំណត់ហេតុគុណភាពទឹកប្រចាំថ្ងៃរបស់រោងចក្រផលិតទឹកស្អាតនិរោធ

Daily report of water quality for Niroth Water Treatment Plant

Time	Parameters	Units	R-W	S-1,2	S-3,4	F-Old	F-New	Dis-W
8:30	Water temperature	°C	26.5	26.6	26.6	26.5	26.6	26.9
	pH		8.28	7.64	7.71	7.89	7.85	7.75
	Turbidity	NTU	15.0	2.39	3.0	0.26	0.13	0.21
	Free Available Chlorine	mg/l						0.82
	Total Available Chlorine	mg/l						1.11
	Conductivity	µS/cm	204	209	209	207	207	184.7
	Suspended Solids	mg/l	14	2	3			0
	Dissolved Oxygen	mg/l						
	Color by UV	TCU	10.23	11.44	7.63	1.38	1.38	1.81
	UV, absorption		0.015	0.006	0.066	0.011	0.001	0.001
11:00	Water temperature	°C	26.7	27.3	27.9	27.9	28.2	27.0
	pH		8.33	7.96	7.93	7.93	7.89	7.79
	Turbidity	NTU	19	2.0	2.91	0.27	0.45	0.17
	Free Available Chlorine	mg/l						1.21
	Total Available Chlorine	mg/l						1.41
	Water temperature	°C	28.2	26.8	27.4	27.0	27.4	26.6
	pH		8.30	8.05	7.94	8.00	7.95	7.86
	Turbidity	NTU	16	4.15	2.84	0.47	0.11	0.11
	Free Available Chlorine	mg/l						1.18
	Total Available Chlorine	mg/l						1.36
	Conductivity	µS/cm	209	213	213	212	213	211
	Suspended Solids	mg/l	13	3	2			0
	Total Dissolved Solids	mg/l						
	Total Coliform	cfu/100ml						
	E. coli	cfu/100ml						
	Ca hardness	mg/l						
	Total hardness	mg/l						
	Magnesium hardness	mg/l						
	Alkalinity	mg/l	63					52
	Organic sustances	mg/l						

Jar-test

Beaker		1	2	3	4	5	6	Result
PAC Dosing	mg/l	2	3	4	5	6	7	4
Lime Dosing	mg/l	0	0	0	0	0	0	
Turbidity	NTU	12.5	7.9	5.5	3.3	2.3	1.8	
pH		8.15	8.12	8.07	8.02	7.98	7.93	
Conductivity	µS/cm	206	206	207	207	208	208	

Poly Aluminium Chloride (PAC)

	Tank	Density	kg/m³	Pump
Time	Old clarifier(1;2)			
8:30	3	1.006	14.15	3
11:00				
14:30				
	New clarifier(3:4)			
8:30	1	1.006	14.15	1
11:00				
14:30				

Preparation

	Tank	Bag	Kg
PAC	3	15	375
	1	15	375

Chemical Dosing

Injection rate of PAC	8:30	11:00	14:30
Raw water Old(m^3/h)	5130	5050	5145
Raw waterNew(m^3/h)	5010	5051	5107
PAC			
Flow rate (Old) L/h	940	940	1672
Flow rate (New) L/h	1411	1411	1568
Stroke rate(Old) L/h(%)	40	40	72
Stroke rate(New)L/h(%)	38	38	42
Actual Dosing (g/m^3)	3.04	3.04	3.04
Chlorination Dosing			
Pre (Old&New) Kg/h	12.0	12.0	12.0
Post (Old&New) Kg/h	17.0	17.0	17.0
Actual Dosing (g/m3)	2.63	2.63	2.63

Note: R.W: 245940 m3
T.W: 233475 m3, 3,21
PAC: 750 Kg
Cl2: 615 Kg

Note: R-W: Raw Water S-Old: Settled Water Old
T-W:Treated Water F-Old: Filtered Water Old
S-New: Settled Water New F-New: Filtered Water New

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2018 January report of water analysis for Nirodh Water Treatement Plant

	Test		Raw water			CNDWQS	WHO	Treated water		
No	Parameters	Unit	Minimum	Average	Maximum			Minimum	Average	Maximum
	Daily Measurement									
1	Temperature	°C	26.2	27.3	29.1			26.0	27.6	29.7
2	pH		7.32	7.56	8.07	6.5-8.5	6.5-8.5	7.19	7.45	7.80
3	Turbidity	NTU	18	34	54	5	5	0.14	0.30	0.56
4	Conductivity	µS/cm	97	131	187	1600		111	138	188
5	Suspended solids	mg/l	15	26	40		1	0	0	0
6	Total Dissolve Solids	mg/l	49	66	94	800		56	69	94
7	Free Available Chlorine	mg/l				0.20-0.50	0.1-1.0	0.51	0.79	1.30
8	Total Available Chlorine	mg/l					2	0.66	0.91	1.53
	Weekly Measurement									
9	Total coliform	cfu/100ml	1000	1400	2000		0	0	0	0
10	E. coli	cfu/100ml	20	248	800		0	0	0	0
11	Ca hardness	mg/l	20	28	40			23	29	40
12	Total hardness	mg/l	36	48	65	300	N/A	36	46	64
13	Magesium hardness	mg/l	15	20	27			12	17	24
14	Alkalinity	mg/l	35	42	57			30	37	52
15	Organic sustances	mg/l	12.64	17.95	21.48			5.68	7.90	9.16
16	Dissolved oxygen	mg/l	6.90	7.45	8.53			7.76	8.44	8.85
17	Color	TCU	8.43	33.09	50.68	5	5	0.96	2.09	3.51
18	UV, absorption		0.012	0.050	0.075			0.001	0.003	0.009
	Monthly Measuremant			**Result**					**Result**	
19	Aluminium	mg/l		0.043		0.20	0.20		0.093	
20	Ammonia	mg/l		0.231		1.50	1.50		0.00	
21	Ammonia nitrogen	mg/l		0.19					0.00	
22	Carbon dioxide	mg/l		3.5					4.5	
23	Copper	mg/l		0.01		1	1		0.01	
24	Chloride	mg/l		22.0		250	250		25.0	
25	Cyanide	mg/l		0.002		0.07	0.07		0.002	
26	Chromium total	mg/l		0.04			0.05		0.03	
27	Chromium hexa	mg/l		0.011		0.05	0.05		0.01	
28	Fluoride	mg/l		0.03		1.50	1.50		0.10	
29	Iron	mg/l		0.31		0.30	0.30		0.00	
30	Manganese	mg/l		0.031		0.10	0.10		0.010	
31	Nitrate nitrogen	mg/l		0.40					0.30	
32	Nitrate	mg/l		1.768		50	50		1.326	
33	Nitrite nitrogen	mg/l		0.005					0.002	
34	Nitrite	mg/l		0.0164		3	3		0.007	
35	Zinc	mg/l		0.01		3	3		0.02	
36	Phosphate	mg/l		0.12					0.11	
37	Sulfide	mg/l		0.016		0.05	0.05		0.000	
38	Sulfate	mg/l		2		250	250		1	

ថ្ងៃ ខែ ឆ្នាំរកា នព្វស័ក ព.ស២៥៦១
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ប្រធានមន្ទីរពិសោធន៍

Implement by Maintenance Team

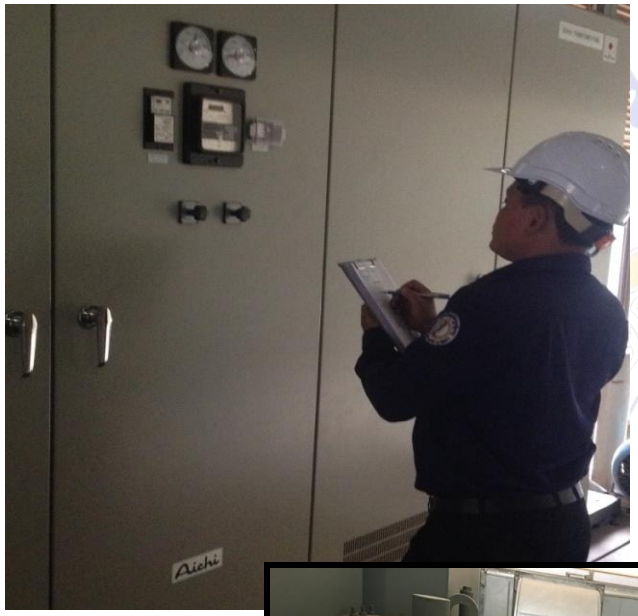
Weekly: Outside appearance, note abnormality.

Monthly: Outside, inside, clean, visual, vibration, noise, temperature check.

6 Month: Calibration(Analyzer/ Instrument), Grease and Lubricate.

Annually: Zero point check, protection relay/circuit, resistance, deep clean, alignment, Replace gland packing, etc.

Electrical and Mechanical Maintenance



ELECTRICAL AND MECHANICAL

Electrical and Mechanical Maintenance

ELECTRICAL AND MECHANICAL

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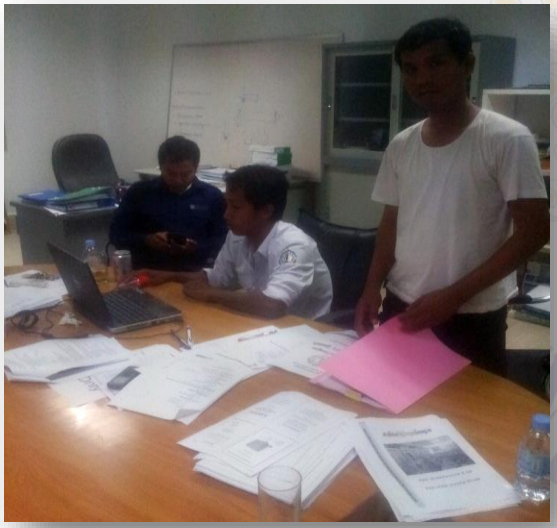
IMPROVEMENT PROGRAM…



WORK CHALLENGING

1- SOP need to be upgraded

2- Staffs knowledge is still limited

3- Integrated documentation of all the knowledge and long time work experiences for sharing to the next generations.

DESIRE FIELD OF TRAINING

Water Treatment Plant Management System

1- Operation management system

2- Water quality management system

3- Maintenance management system

4- Maintenance plan, Contingency plan

5- Long term facilities and equipment renewal plan

6- SOP management system

7- Effective human resource management

ご せいちょう

ありがとう

ございました！