



ZUIKERBOSCH PUMPING STATION

RAW WATER ENGINE ROOM 4

PUMP TEST REPORT FOR PUMP SET 5

DOCUMENT CODE

C 01075

WKS CODE

ZB # 4 0UGB



23 July 2018

PERFORMANCE TEST CONDUCTED ON PUMP SET 5 IN RAW WATER ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION

THE FOLLOWING POINTS WERE DETERMINED FOR THE PUMP-SET:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pump-set using a calibrated Differential Pressure Transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters which were calibrated by an NLA traceable laboratory. Accuracy class of the test pressure transmitters is 0.25%.

RESULTS

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency characteristics of the pump-set as well as calculations for power demand at duty point
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

SUMMARY OF PUMP-SET PERFORMANCE

DATE OF TEST:	27 June 2018
PUMPING STATION:	Zuikerbosch
PUMP-SET:	Raw water #5
PUMP-SET DUTY:	208 MI/d @ 8.00 m
OPERATING HOURS SINCE PREVIOUS TEST	8 554
TOTAL OPERATING HOURS	132 960

COMMENTS

A single test point obtained at the rate of flow at which the pump-set was found to be operating.
 The hydraulic actuators on the delivery valves of the raw water pump-sets do not permit throttling of the valves for test purposes.
 The fault on the metering circuit of raw water pump-set 5 has been rectified.

Suction and delivery pressure has been corrected to the centreline of the pump.	Z = 0 m.
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FLOW RATE AT TESTED GENERATED HEAD OF 8,687 m

Acceptance (MI/d)	TEST	DIFFERENCE	DEVIATION %
202.36	200.30	-2.06	-1.02

GENERATED HEAD AT TESTED FLOW OF 200,30 MI/d

Acceptance (m)	TEST	DIFFERENCE	DEVIATION %
8.83	8.69	-0.14	-1.62

PUMP-SET EFFICIENCY COMPARISON AT TESTED FLOW OF 200,30 MI/d

Acceptance (%)	TEST	DIFFERENCE	DEVIATION %
81.13	78.72	-2.41	-2.97

POWER DEMAND AT TESTED FLOW OF 200,30 MI/d

Acceptance (kW)	TEST	DIFFERENCE	DEVIATION %
247.61	264.93	17.32	7.00

ECONOMIC EVALUATION TO OVERHAUL PUMP-SET

Date of last overhaul	Not overhauled
Operating hours since acceptance or overhaul	132 960
Pump-set utilization	58 65%
Interest rate	10.00%
Energy charge (R/kWh)	R 0.85
Monthly saving if pump-set efficiency is restored to original efficiency	R 6,394.54
NPV of saving in electrical cost if pump-set is restored to original efficiency	R 366,830.53 *

* If the cost to overhaul the pump-set exceeds this amount, the overhaul of the pump-set is not viable.

CONCLUSION

The performance of raw water pump-set 5 is acceptable. Overhaul of the pump-set is not viable.

RECOMMENDATION

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
SENIOR MECHANICAL ENGINEERING ASSISTANT

P Lephuthing
MECHANICAL ENGINEERING ASSISTANT

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pump-set 5
Supplied under contract no.	1389
Date of test:	23 June 2018
Observer:	Q. van der Berg / P Lephuthing

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(Ml/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600/1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		132960.00
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		N/A
Date of Previous Performance Test		Apr 2017
Operating Hours Since Previous Performance Test		8554.00
Pump-set Utilization	(%)	58.65
Pumps on load		#1,#2, #3, #5, #6, #8 & #11

ZUIKERBOSCH RAW WATER PUMPSET 5

SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				MARCH 2006	APRIL 2008	OCTOBER 2009	February 2011	August 2012	October 2013	October 2014	April 2016	April 2017	June 2018
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test1	Test 1	Test 1	Test 1	Test 1	Test 1	Test 1	Test 1	Test 1
Voltage (V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00				406.00	393.00	396.00	396.00	394.00	399.00
Frequency (Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00				50.00	50.20	50.20	50.00	50.00	50.00
Power Factor	0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69				-0.97	-0.96	-0.96	-0.97	-0.96	-0.97
Ammeter 1st Stage (Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00				350.00	349.00	341.00	505.00	518.00	511.00
Energy Meter (kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55				39.05	37.56	36.74	36.94	37.91	37.33
Time (sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head (mmHg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451	193.176	218.033	236.377	229.566	169.379	220.986	238.225
Del Pressure (kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977	127.513	120.509	109.596	113.446	140.831	113.674	107.859
Suction Pressure (kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361	38.881	39.368	36.701	40.008	47.104	36.362	38.035
Speed (r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00	424.00	423.00	424.00	423.00	423.00	423.00	424.00

CALCULATED RESULTS FOR PUMP SET:-

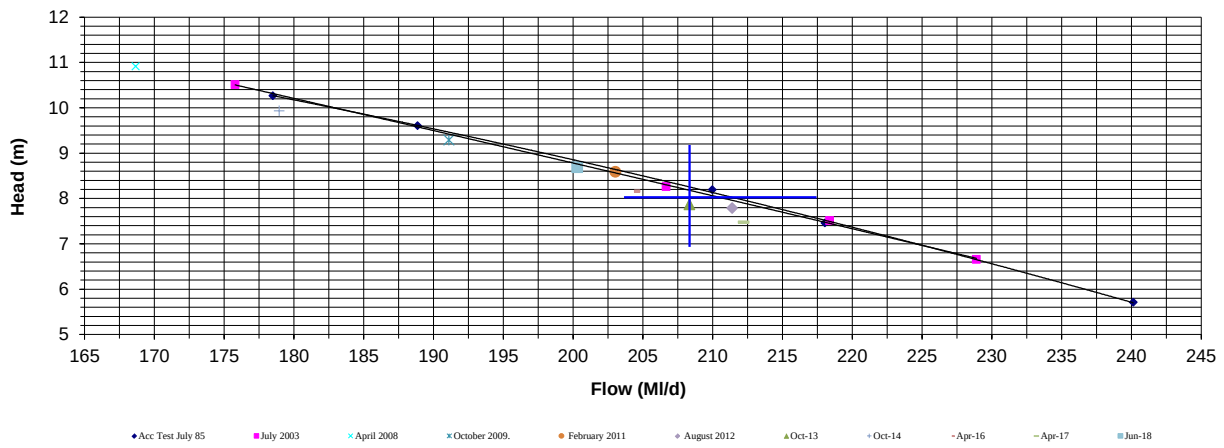
Motor Current (Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00				350.00	349.00	341.00	505.00	518.00	511.00
Stage kW (kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300				234.300	225.360	220.440	221.640	227.460	225.180
Flow (M/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66	191.11	203.03	211.40	208.33	178.95	204.40	212.22
Velocity Head (m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234	0.300	0.339	0.367	0.356	0.263	0.343	0.370
Generated Head (m)	5.710	7.459	8.193	9.605	10.265	6.854	7.512	8.261	10.509	8.819	10.911	9.287	8.588	7.784	7.868	9.930	8.160	7.475
Water kW (kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516	201.104	197.574	186.466	185.741	201.353	188.993	179.760
Efficiency (%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64	81.99			85.83	87.67	84.59	83.80	88.52	83.93	80.26

POWER DEMAND AT DUTY POINT :-

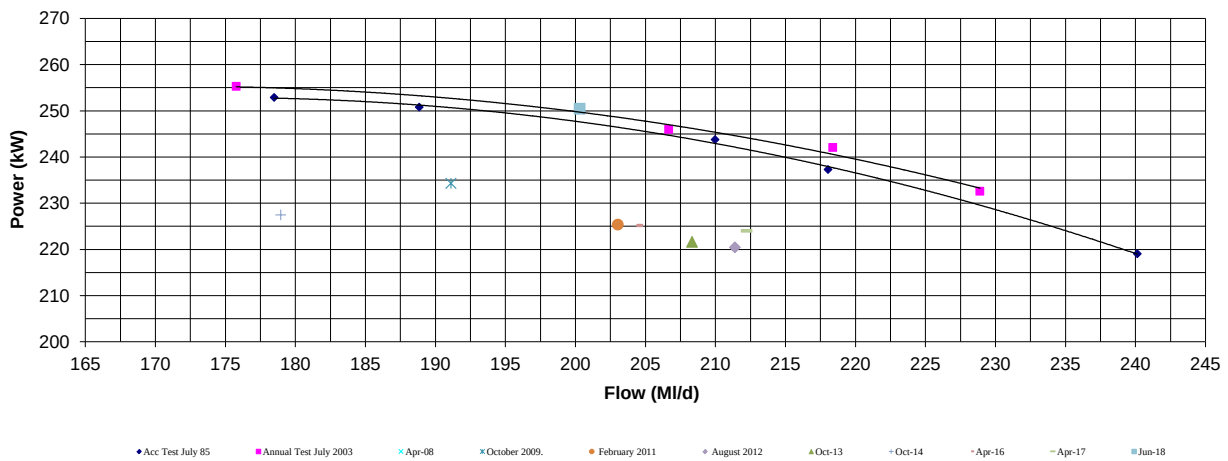
Calculations are based on test with the flow rate nearest to duty point

Flow rate used:		209.97	M/d		206.67	M/d		191.11	203.03	211.40	208.33	178.95	204.40	212.22	200.30
Efficiency at this point		79.95	%		78.64	%		85.83	87.67	84.59	83.80	88.52	83.93	80.26	78.72
Power demand at duty point		235.82	kW		239.77	kW		219.67	215.07	222.90	224.99	212.99	224.65	234.93	239.51
Percentage of guaranteed demand		98.88	%		100.53	%		92.11	90.17	93.46	94.34	89.31	94.19	98.50	100.42

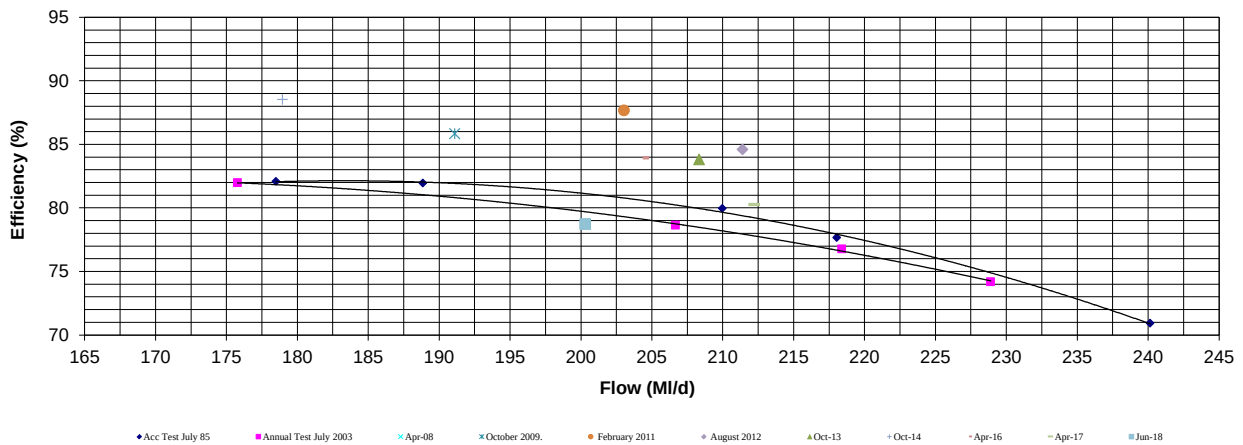
Q - H Curve
Raw Water Pump 5



Q - kW Curve
Raw Water Pump 5



Q - Efficiency Curve
Raw Water Pump 5





11 July 2017

PERFORMANCE TEST CONDUCTED ON PUMP SET 5 IN RAW WATER ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION

THE FOLLOWING POINTS WERE DETERMINED FOR THE PUMP-SET:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pump-set using a calibrated Differential Pressure Transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters which were calibrated by an NLA traceable laboratory. Accuracy class of the test pressure transmitters is 0.25%.

RESULTS

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency characteristics of the pump-set as well as calculations for power demand at duty point
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

SUMMARY OF PUMP-SET PERFORMANCE

DATE OF TEST:	19 April 2017
PUMPING STATION:	Zuikerbosch
PUMP-SET:	Raw water #5
PUMP-SET DUTY:	208 Ml/d @ 8.00 m
OPERATING HOURS SINCE PREVIOUS TEST	8 495
TOTAL OPERATING HOURS	124 406

COMMENTS

A single test point obtained at the rate of flow at which the pump-set was found to be operating.
The hydraulic actuators on the delivery valves of the raw water pump-sets do not permit throttling of the valves for test purposes.
There is a fault on the metering circuit of raw water pump-set 5.

FLOW RATE AT TESTED GENERATED HEAD OF 7.475 m

Acceptance (Ml/d)	TEST	DIFFERENCE	DEVIATION %
218.61	212.22	-6.39	-2.92

GENERATED HEAD AT TESTED FLOW OF 212.22 Ml/d

Acceptance (m)	TEST	DIFFERENCE	DEVIATION %
7.97	7.475	-0.50	-6.21

PUMP-SET EFFICIENCY COMPARISON AT TESTED FLOW OF 212.22 Ml/d

Acceptance (%)	TEST	DIFFERENCE	DEVIATION %
79.22	80.26	1.04	1.31

POWER DEMAND AT TESTED FLOW OF 212.22 Ml/d

Acceptance (kW)	TEST	DIFFERENCE	DEVIATION %
241.65	223.98	-17.67	-7.31

ECONOMIC EVALUATION TO OVERHAUL PUMP-SET

Date of last overhaul	Not overhauled
Operating hours since acceptance or overhaul	124 406
Pump-set utilization	56.72%
Interest rate	10.00%
Energy charge (R/kWh)	R 0.85
Monthly saving if pump-set efficiency is restored to original efficiency	R 0.00
NPV of saving in electrical cost if pump-set is restored to original efficiency	R 0.00

* If the cost to overhaul the pump-set exceeds this amount, the overhaul of the pump-set is not viable.

CONCLUSION

The performance of raw water pump-set 5 is acceptable. Overhaul of the pump-set is not viable.

RECOMMENDATION

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
SENIOR MECHANICAL ENGINEERING ASSISTANT

P Lephuthing
MECHANICAL ENGINEERING ASSISTANT

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pump-set 5
Supplied under contract no.	1389
Date of test:	19 April 2017
Observer:	P Lephuthing

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(Ml/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600/1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		124 406
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		N/A
Date of Previous Performance Test		Apr 2016
Operating Hours Since Previous Performance Test		8 495
Pump-set Utilization	(%)	56.72

ZUIKERBOSCH RAW WATER PUMPSET 5

SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				MARCH 2006	APRIL 2008	OCTOBER 2009	February 2011	August 2012	October 2013	October 2014	April 2016	April 2017
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test1	Test 1	Test 1	Test 1	Test 1	Test 1	Test 1	Test 1	Test 1
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00			406.00	393.00	396.00	396.00	394.00	399.00	404.00
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00			50.00	50.20	50.20	50.00	50.00	50.00	50.00
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69			-0.97	-0.96	-0.96	-0.97	-0.96	-0.96	-0.97
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00	505.00	518.00	511.00	501.00
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55			39.05	37.56	36.74	36.94	37.91	37.53	37.33
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451	193.176	218.033	236.377	229.566	169.379	220.986	238.225
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977	127.513	120.509	109.596	113.446	140.831	113.674	107.859
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361	38.881	39.368	36.701	40.008	47.104	36.362	38.035
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00	424.00	423.00	424.00	423.00	423.00	423.00	424.00

CALCULATED RESULTS FOR PUMP SET:-

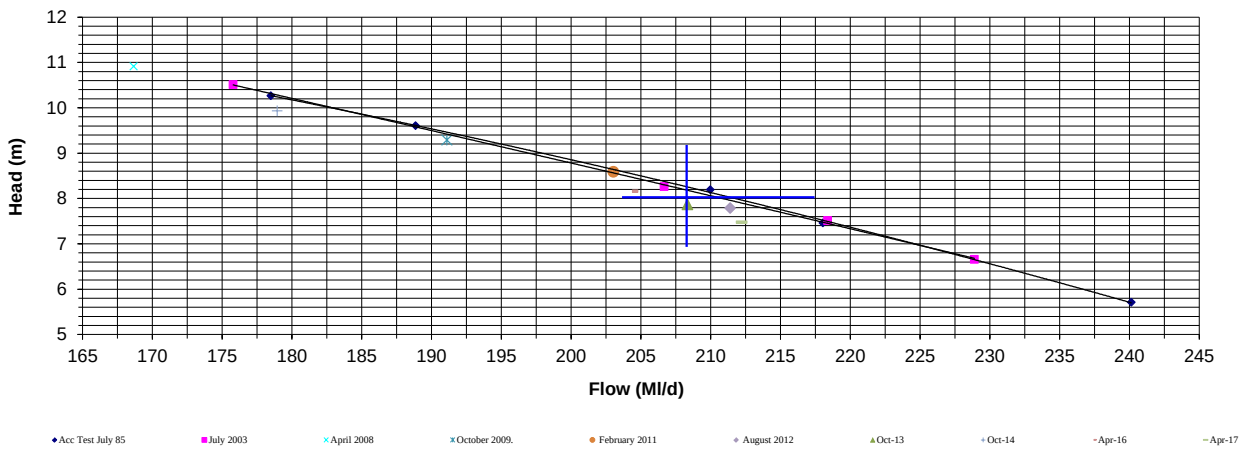
Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00	505.00	518.00	511.00	501.00
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Flow	(M/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66	191.11	203.03	211.40	208.33	178.95	204.40	212.22
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234	0.300	0.339	0.367	0.356	0.263	0.343	0.370
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.654	7.512	8.261	10.509	8.819	10.911	9.287	8.588	7.784	7.868	9.930	8.160	7.475
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516	201.104	197.574	186.466	185.741	201.353	188.993	179.760
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64	81.99			85.83	87.67	84.59	83.80	88.52	83.93	80.26

POWER DEMAND AT DUTY POINT :-

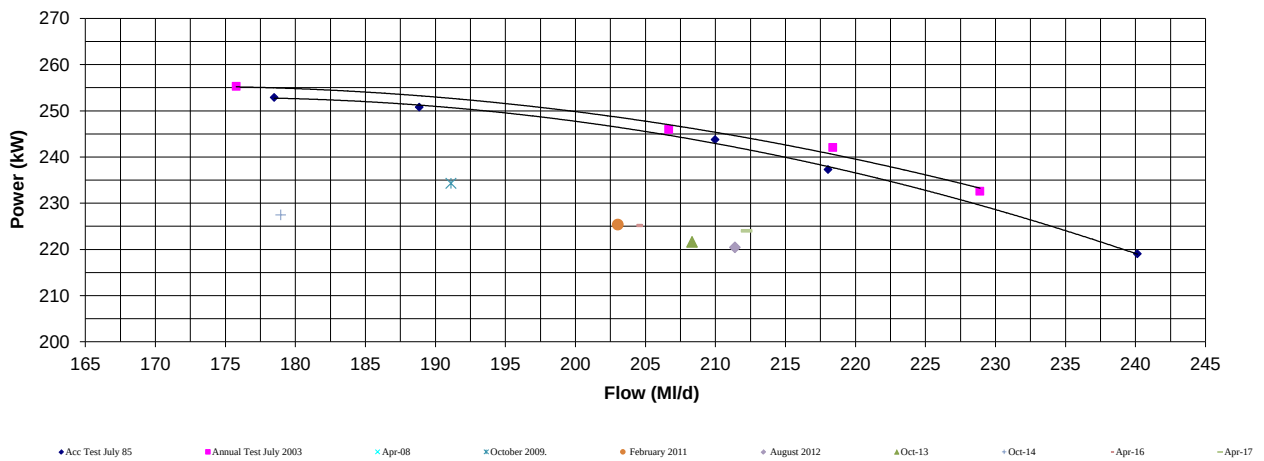
Calculations are based on test with the flow rate nearest to duty point

Flow rate used:		209.97	M/d	206.67	M/d	191.11	203.03	211.40	208.33	178.95	204.40	212.22
Efficiency at this point		79.95	%	78.64	%	85.83	87.67	84.59	83.80	88.52	83.93	80.26
Power demand at duty point		235.82	kW	239.77	kW	219.67	215.07	222.90	224.99	212.99	224.65	234.93
Percentage of guaranteed demand		98.88	%	100.53	%	92.11	90.17	93.46	94.34	89.31	94.19	98.50

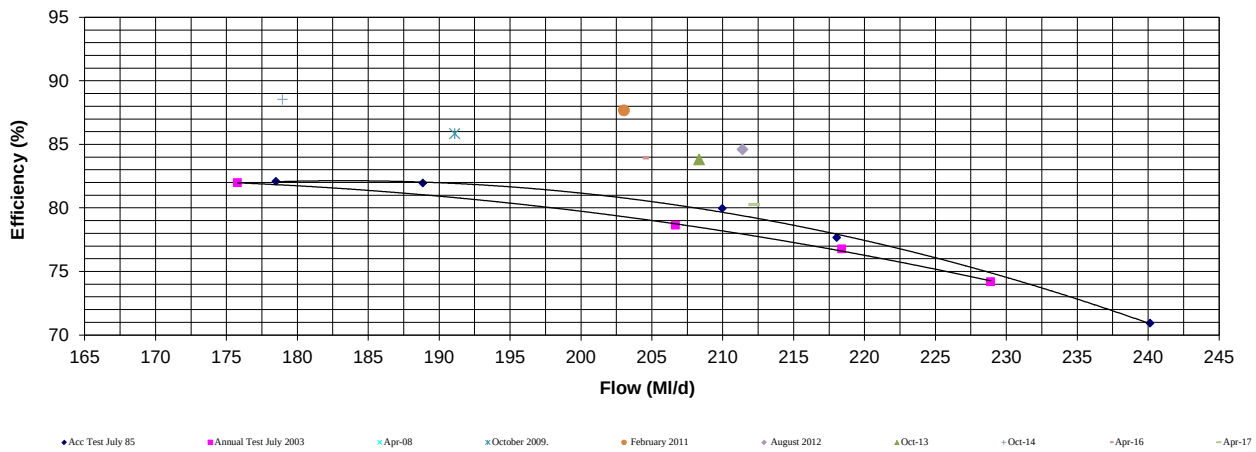
Q - H Curve
Raw Water Pump 5



Q - kW Curve
Raw Water Pump 5



Q - Efficiency Curve
Raw Water Pump 5





07 June 2016

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PUMP-SET:	Raw water #5
PUMP-SET DUTY:	208 Ml/d @ 8.00 m
OPERATING HOURS SINCE PREVIOUS TEST	12 326
TOTAL OPERATING HOURS	115 911

COMMENTS

A single test point obtained at the rate of flow at which the pump-set was found to be operating.
 The hydraulic actuators on the delivery valves of the raw water pump-sets do not permit throttling of the valves for test purposes.
 Wiring fault on the electrical test plug to be corrected.

FLOW RATE AT TESTED GENERATED HEAD OF 8.160 m

Acceptance (Ml/d)	TEST	DIFFERENCE	DEVIATION %
209.61	204.40	-5.21	-2.49

GENERATED HEAD AT TESTED FLOW OF 204.40 Ml/d

Acceptance (m)	TEST	DIFFERENCE	DEVIATION %
8.54	8.160	-0.38	-4.45

PUMP-SET EFFICIENCY COMPARISON AT TESTED FLOW OF 204.40 Ml/d

Acceptance (%)	TEST	DIFFERENCE	DEVIATION %
80.58	83.93	3.35	4.16

POWER DEMAND AT TESTED FLOW OF 204.40 Ml/d

Acceptance (kW)	TEST	DIFFERENCE	DEVIATION %
245.82	225.18	-20.64	-8.40

ECONOMIC EVALUATION TO OVERHAUL PUMP-SET

Date of last overhaul	Not overhauled
Operating hours since acceptance or overhaul	115 911
Pump-set utilization	52.47%
Interest rate	9.00%
Energy charge (R/kWh)	R 0.81
Monthly saving if pump-set efficiency is restored to original efficiency	R 0.00
NPV of saving in electrical cost if pump-set is restored to original efficiency	R 0.00

* If the cost to overhaul the pump-set exceeds this amount, the overhaul of the pump-set is not viable.

CONCLUSION

The performance of raw water pump-set 5 is acceptable. Overhaul of the pump-set is not viable.

RECOMMENDATION

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
SENIOR MECHANICAL ENGINEERING ASSISTANT

P Lephuthing
MECHANICAL ENGINEERING ASSISTANT

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pump-set 5
Supplied under contract no.	1389
Date of test:	19 April 2016
Observer:	P Lephuthing

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(Ml/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600/1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		115 911
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		N/A
Date of Previous Performance Test		Oct 2014
Operating Hours Since Previous Performance Test		12 326
Pump-set Utilization	(%)	52.47

ZUIKERBOSCH RAW WATER PUMPSET 5
SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				MARCH 2006	APRIL 2008	OCTOBER 2009	February 2011	August 2012	October 2013	October 2014	April 2016
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4		Test1	Test 1	Test 1	Test 1	Test 1	Test 1	Test 1
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00				406.00	393.00	396.00	396.00	394.00
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00				50.00	50.20	50.20	50.00	50.00
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69				-0.97	-0.96	-0.96	-0.97	-0.96
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00				350.00	349.00	341.00	505.00	518.00
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55				39.05	37.56	36.74	36.94	37.91
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451	193.176	218.033	236.377	229.566	169.379	220.986
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977	127.513	120.509	109.596	113.446	140.831	113.674
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361	38.881	39.368	36.701	40.008	47.104	36.362
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00	424.00	423.00	424.00	423.00	423.00	423.00

CALCULATED RESULTS FOR PUMP SET:-

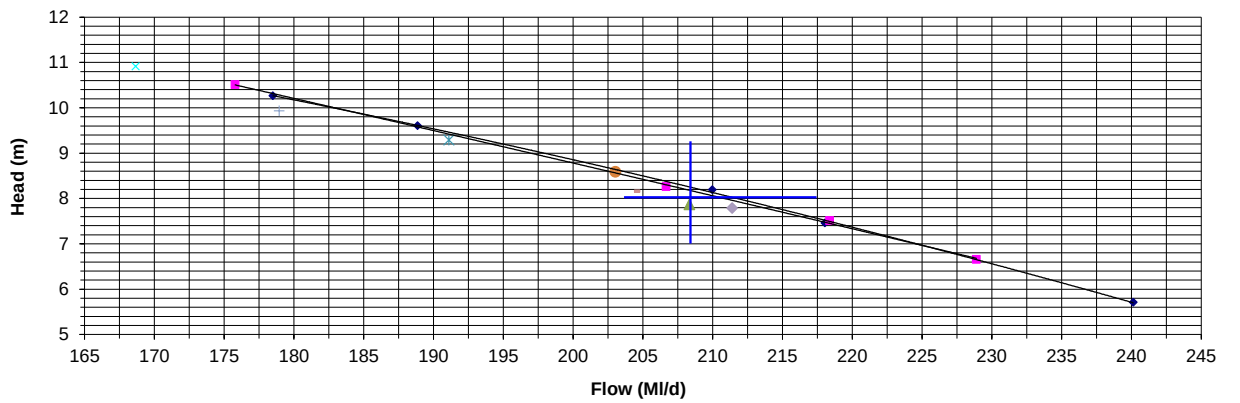
Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00	505.00	518.00	511.00
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300			234.300	225.360	220.440	221.640	227.460	225.180
Flow	(Ml/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66	191.11	203.03	211.40	208.33	178.95	204.40
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234	0.300	0.339	0.367	0.356	0.263	0.343
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.654	7.512	8.261	10.509	8.819	10.911	9.287	8.588	7.784	7.868	9.930	8.160
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516	201.104	197.574	186.466	185.741	201.353	188.993
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64	81.99			85.83	87.67	84.59	83.80	88.52	83.93

POWER DEMAND AT DUTY POINT :-

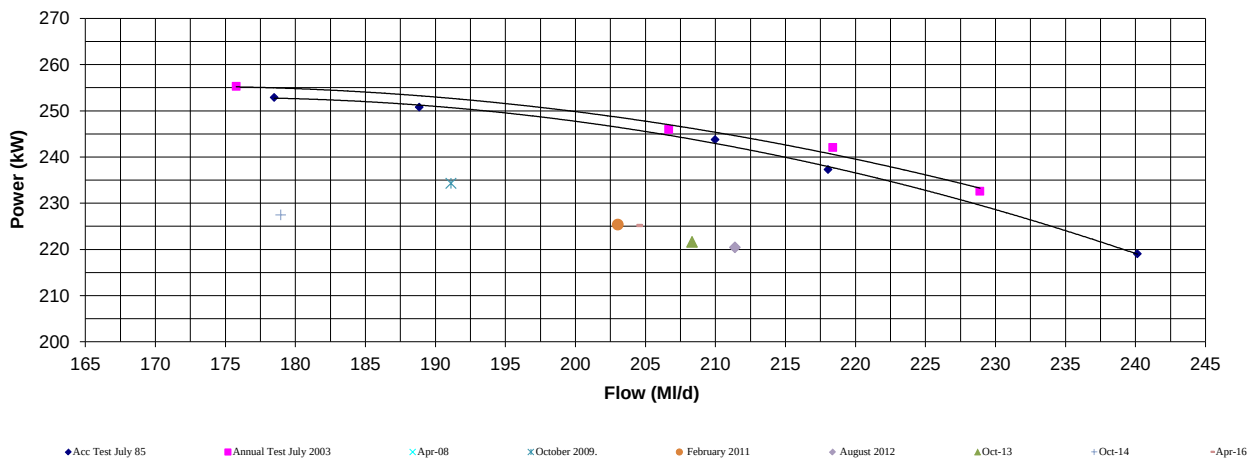
Calculations are based on test with the flow rate nearest to duty point

Flow rate used:		209.97	Ml/d	206.67	Ml/d	191.11	203.03	211.40	208.33	178.95	204.40
Efficiency at this point	%	79.95	%	78.64	%	85.83	87.67	84.59	83.80	88.52	83.93
Power demand at duty point	kW	235.82	kW	239.77	kW	219.67	215.07	222.90	224.99	212.99	224.65
Percentage of guaranteed demand	%	98.88	%	100.53	%	92.11	90.17	93.46	94.34	89.31	94.19

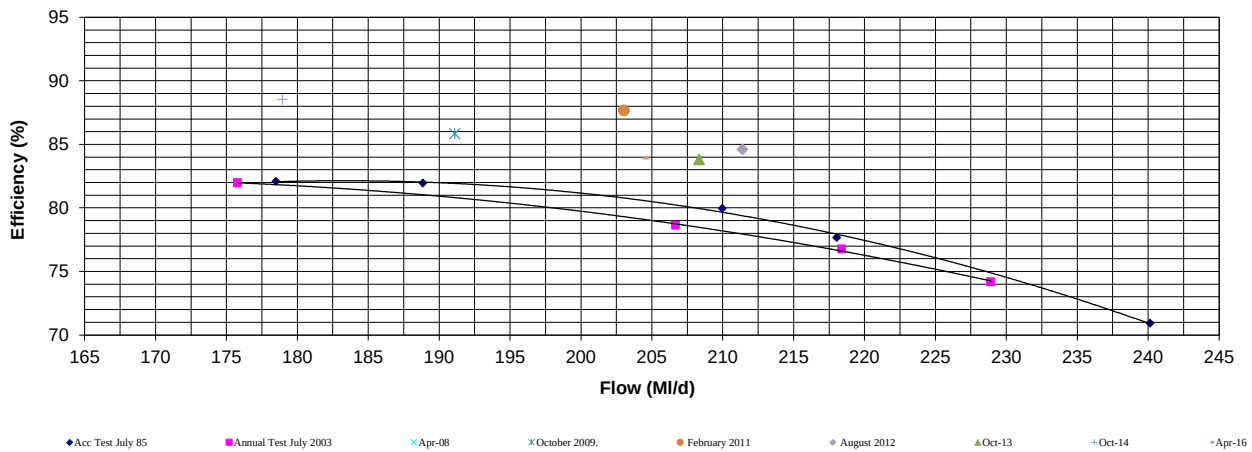
Q - H Curve
Raw Water Pump 5



Q - kW Curve
Raw Water Pump 5



Q - Efficiency Curve
Raw Water Pump 5





31 October 2014

PERFORMANCE TEST CONDUCTED ON PUMP SET 5 IN RAW WATER ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION

THE FOLLOWING POINTS WERE DETERMINED FOR THE PUMP-SET:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pump-set using a calibrated Differential Pressure Transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters which were calibrated by an NLA traceable laboratory. Accuracy class of the test pressure transmitters is 0.25%.

RESULTS

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency characteristics of the pump-set as well as calculations for power demand at duty point
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

SUMMARY OF PUMP-SET PERFORMANCE

DATE OF TEST:	14 October 2014
PUMPING STATION:	Zuikerbosch
PUMP-SET:	Raw water #5
PUMP-SET DUTY:	208 Ml/d @ 8.00 m
OPERATING HOURS SINCE PREVIOUS TEST	7 744
TOTAL OPERATING HOURS	103 585

COMMENTS

A single test point obtained at the rate of flow at which the pump-set was found to be operating.
 The hydraulic actuators on the delivery valves of the raw water pump-sets do not permit throttling of the valves for test purposes.
 Wiring fault on the electrical test plug to be corrected.

FLOW RATE AT TESTED GENERATED HEAD OF 9,930 m

Acceptance (Ml/d)	TEST	DIFFERENCE	DEVIATION %
183.9	178.95	-4.95	-2.69

GENERATED HEAD AT TESTED FLOW OF 178.95 Ml/d

Acceptance (m)	TEST	DIFFERENCE	DEVIATION %
10.24	9.930	-0.31	-3.03

PUMP-SET EFFICIENCY COMPARISON AT TESTED FLOW OF 178.95 Ml/d

Acceptance (%)	TEST	DIFFERENCE	DEVIATION %
82.07	88.52	6.45	7.86

POWER DEMAND AT TESTED FLOW OF 178.95 Ml/d

Acceptance (kW)	TEST	DIFFERENCE	DEVIATION %
252.71	234.56	-18.15	-7.18

ECONOMIC EVALUATION TO OVERHAUL PUMP-SET

Date of last overhaul	Not overhauled
Operating hours since acceptance or overhaul	103 585
Pump-set utilization	51.79%
Interest rate	9.00%
Energy charge (R/kWh)	R 0.70
Monthly saving if pump-set efficiency is restored to original efficiency	R 0.00
NPV of saving in electrical cost if pump-set is restored to original efficiency	R 0.00

* If the cost to overhaul the pump-set exceeds this amount, the overhaul of the pump-set is not viable.

CONCLUSION

The performance of raw water pump-set 5 is acceptable. Overhaul of the pump-set is not viable.

RECOMMENDATION

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
SENIOR MECHANICAL ENGINEERING ASSISTANT

P Lephuthing
MECHANICAL ENGINEERING ASSISTANT

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pump-set 5
Supplied under contract no.	1389
Date of test:	14 October 2014
Observer:	P Lephuthing

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(Ml/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600/1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		103 585
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		N/A
Date of Previous Performance Test		Oct 2013
Operating Hours Since Previous Performance Test		7 744
Pump-set Utilization	(%)	51.79

ZUIKERBOSCH RAW WATER PUMPSET 5
SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				MARCH 2006	APRIL 2008	OCTOBER 2009	February 2011	August 2012	October 2013	October 2014
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test1	Test 1	Test 1	Test 1	Test 1	Test 1	Test 1
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00			406.00	393.00	396.00	396.00	394.00
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00			50.00	50.20	50.20	50.00	50.00
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69			-0.97	-0.96	-0.96	-0.97	-0.96
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00	505.00	518.00
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55			39.05	37.56	36.74	36.94	37.91
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451	193.176	218.033	236.377	229.566	169.379
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977	127.513	120.509	109.596	113.446	140.831
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361	38.881	39.368	36.701	40.008	47.104
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00	424.00	423.00	424.00	423.00	423.00

CALCULATED RESULTS FOR PUMP SET:-

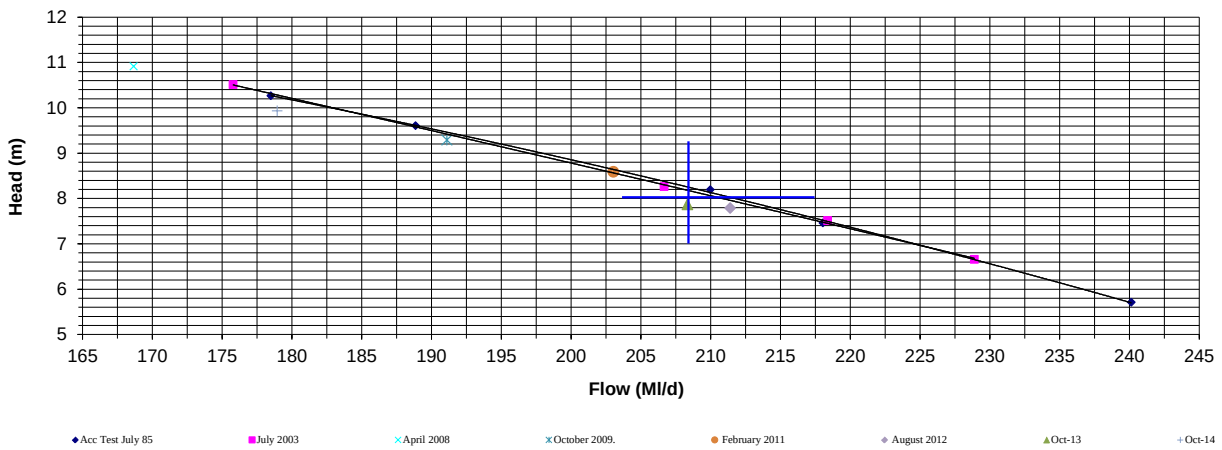
Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00	505.00	518.00
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300			234.300	225.360	220.440	221.640	227.460
Flow	(Ml/d	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66	191.11	203.03	211.40	208.33	178.95
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234	0.300	0.339	0.367	0.356	0.263
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.654	7.512	8.261	10.509	8.819	10.911	9.287	8.588	7.784	7.868	9.930
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516	201.104	197.574	186.466	185.741	201.353
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64	81.99			85.83	87.67	84.59	83.80	88.52

POWER DEMAND AT DUTY POINT :-

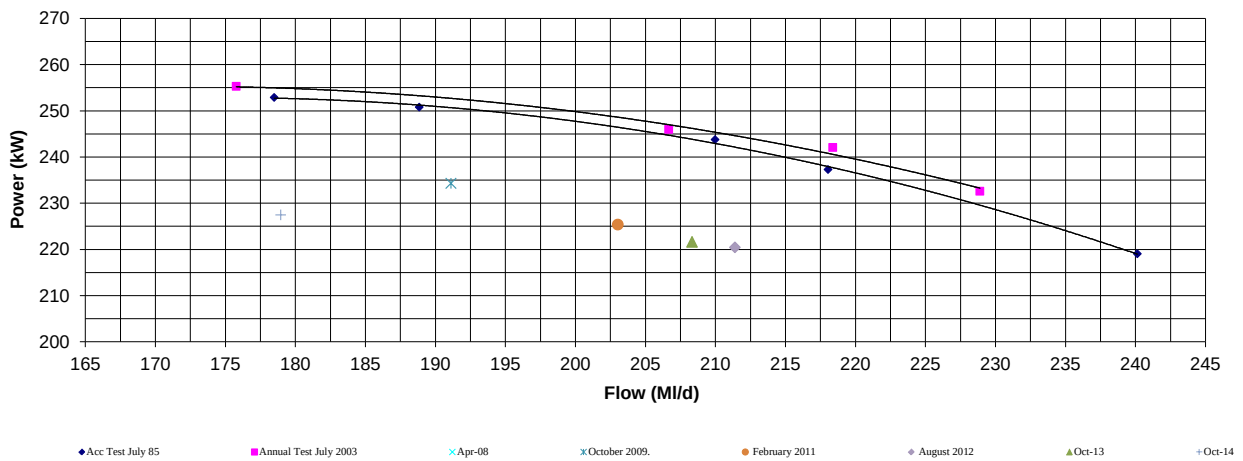
Calculations are based on test with the flow rate nearest to duty point

Flow rate used:		209.97	Ml/d	206.67	Ml/d	191.11	203.03	211.40	208.33	178.95
Efficiency at this point		79.95	%	78.64	%	85.83	87.67	84.59	83.80	88.52
Power demand at duty point		235.82	kW	239.77	kW	219.67	215.07	222.90	224.99	212.99
Percentage of guaranteed demand		98.88	%	100.53	%	92.11	90.17	93.46	94.34	89.31

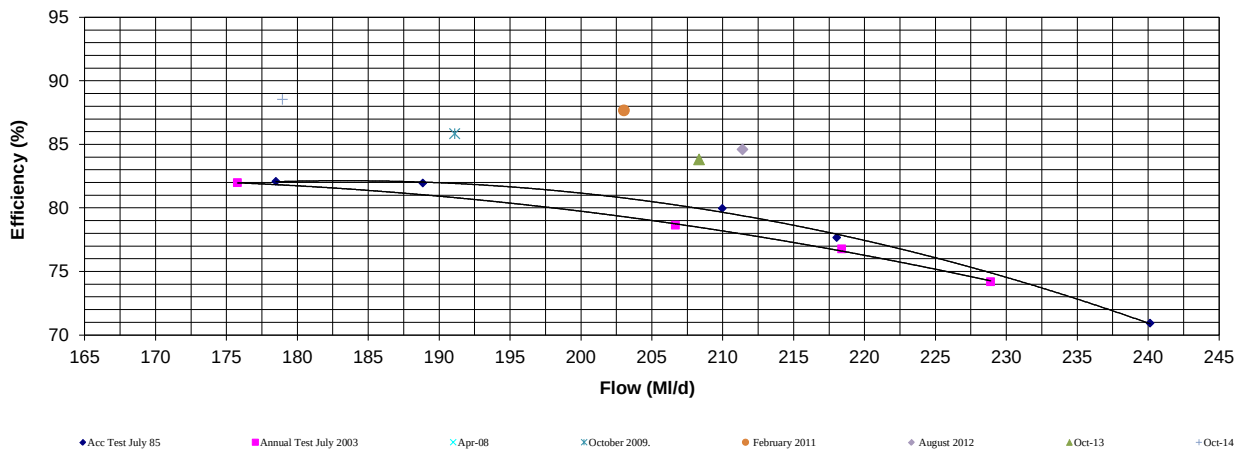
Q - H Curve
Raw Water Pump 5



Q - kW Curve
Raw Water Pump 5



Q - Efficiency Curve
Raw Water Pump 5





19 November 2013

PERFORMANCE TEST CONDUCTED ON PUMP SET 5 IN RAW WATER ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION

THE FOLLOWING POINTS WERE DETERMINED FOR THE PUMP-SET:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pump-set using a calibrated Differential Pressure Transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters which were calibrated by an NLA traceable laboratory. Accuracy class of the test pressure transmitters is 0.25%.

RESULTS

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency characteristics of the pump-set as well as calculations for power demand at duty point
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

SUMMARY OF PUMP-SET PERFORMANCE

DATE OF TEST:	24 October 2013
PUMPING STATION:	Zuikerbosch
PUMP-SET:	Raw water #5
PUMP-SET DUTY:	208 Ml/d @ 8.00 m
OPERATING HOURS SINCE PREVIOUS TEST	7 348
TOTAL OPERATING HOURS	95 841

COMMENTS

A single test point obtained at the rate of flow at which the pump-set was found to be operating.
 The hydraulic actuators on the delivery valves of the raw water pump-sets do not permit throttling of the valves for test purposes.
 Wiring fault on the electrical test plug to be investigated and corrected.

FLOW RATE AT TESTED GENERATED HEAD OF 7,868 m

Acceptance (Ml/d)	TEST	DIFFERENCE	DEVIATION %
213.5	208.33	-5.17	-2.42

GENERATED HEAD AT TESTED FLOW OF 208,33 Ml/d

Acceptance (m)	TEST	DIFFERENCE	DEVIATION %
8.25	7.868	-0.38	-4.63

PUMP-SET EFFICIENCY COMPARISON AT TESTED FLOW

Acceptance (%)	TEST	DIFFERENCE	DEVIATION %
79.95	83.80	3.85	4.82

POWER DEMAND AT TESTED FLOW

Acceptance (kW)	TEST	DIFFERENCE	DEVIATION %
243.84	232.40	-11.44	-4.69

ECONOMIC EVALUATION TO OVERHAUL PUMP-SET

Date of last overhaul	Not overhauled
Operating hours since acceptance or overhaul	95 841
Pump-set utilization	49.58%
Interest rate	9.00%
Energy charge (R/kWh)	R 0.64
Monthly saving if pump-set efficiency is restored to original efficiency	R 0.00
NPV of saving in electrical cost if pump-set is restored to original efficiency	R 0.00

* If the cost to overhaul the pump-set exceeds this amount, the overhaul of the pump-set is not viable.

CONCLUSION

The hydraulic of raw water pump-set 5 is acceptable. Overhaul of the pump-set is not viable. Electrical metering to be rectified.

RECOMMENDATION

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
SENIOR MECHANICAL ENGINEERING ASSISTANT

P Lephuthing
MECHANICAL ENGINEERING ASSISTANT

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pump-set 5
Supplied under contract no.	1389
Date of test:	24 October 2013
Observer:	P Lephuthing

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(Ml/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600/1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		95 841
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		N/A
Date of Previous Performance Test		Aug 2012
Operating Hours Since Previous Performance Test		7 348
Pump-set Utilization	(%)	49.58

ZUIKERBOSCH RAW WATER PUMPSET 5

SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				MARCH 2006	APRIL 2008	OCTOBER 2009	February 2011	August 2012	October 2013
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test1	Test 1	Test 1	Test 1	Test 1	Test 1
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00			406.00	393.00	396.00	396.00
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00			50.00	50.20	50.20	50.00
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69			-0.97	-0.96	-0.96	-0.97
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00	505.00
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55			39.05	37.56	36.74	36.94
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451	193.176	218.033	236.377	229.566
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977	127.513	120.509	109.596	113.446
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361	38.881	39.368	36.701	40.008
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00	424.00	423.00	424.00	423.00

CALCULATED RESULTS FOR PUMP SET:-

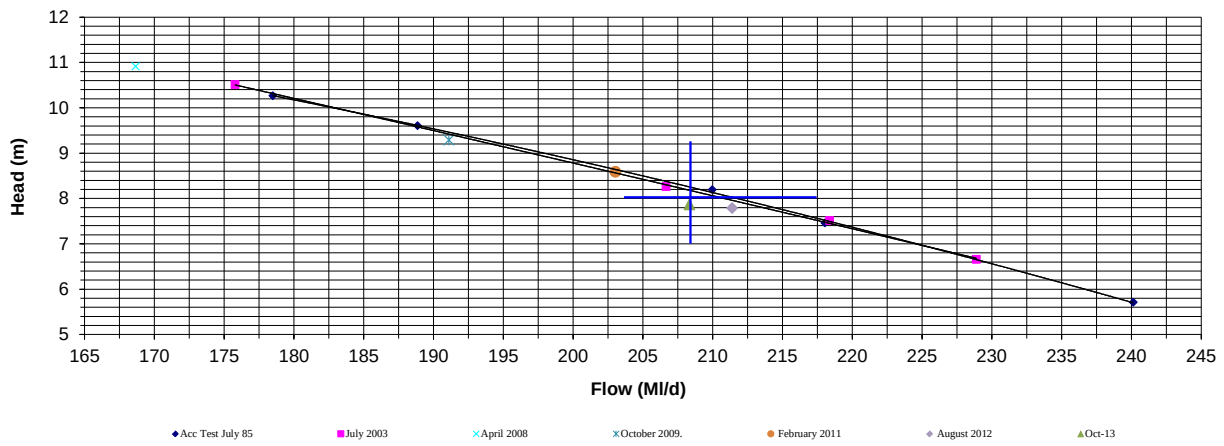
Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00	505.00
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300			234.300	225.360	220.440	221.640
Flow	(M/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66	191.11	203.03	211.40	208.33
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234	0.300	0.339	0.367	0.356
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.654	7.512	8.261	10.509	8.819	10.911	9.287	8.588	7.784	7.868
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516	201.104	197.574	186.466	185.741
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64	81.99			85.83	87.67	84.59	83.80

POWER DEMAND AT DUTY POINT :-

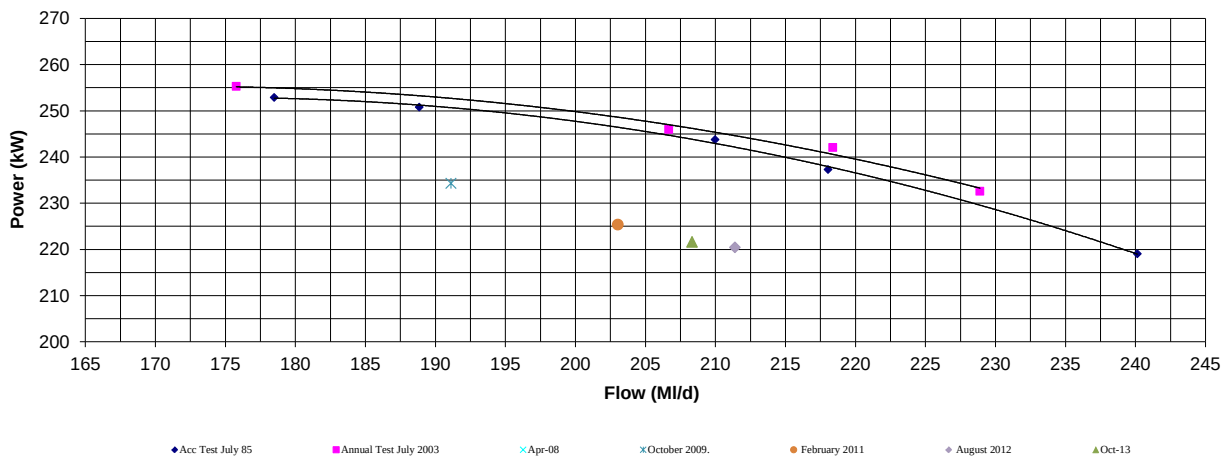
Calculations are based on test with the flow rate nearest to duty point

Flow rate used:		209.97	M/d		206.67	M/d		191.11		203.03		211.40		208.33
Efficiency at this point		79.95	%		78.64	%		85.83		87.67		84.59		83.80
Power demand at duty point		235.82	kW		239.77	kW		219.67		215.07		222.90		224.99
Percentage of guaranteed demand		98.88	%		100.53	%		92.11		90.17		93.46		94.34

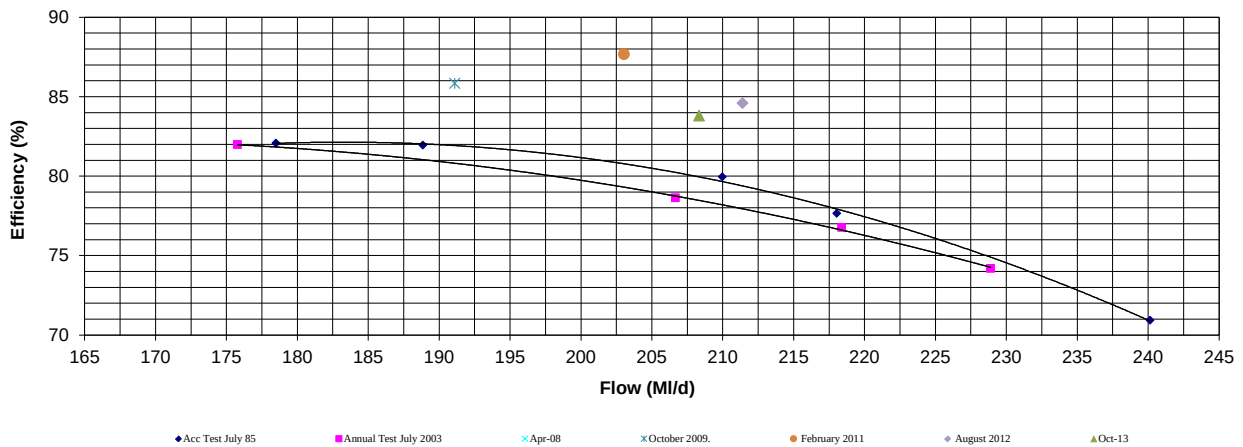
Q - H Curve
Raw Water Pump 5



Q - kW Curve
Raw Water Pump 5



Q - Efficiency Curve
Raw Water Pump 5





22 August 2012

PERFORMANCE TEST CONDUCTED ON PUMP SET 5 IN RAW WATER ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION

THE FOLLOWING POINTS WERE DETERMINED FOR THE PUMP-SET:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pump-set using a calibrated Differential Pressure Transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters which were calibrated by an NLA traceable laboratory. Accuracy class of the test pressure transmitters is 0.25%.

RESULTS

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency characteristics of the pump-set as well as calculations for power demand at duty point
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

SUMMARY OF PUMP-SET PERFORMANCE

DATE OF TEST:	17 February 2011
PUMPING STATION:	Zuikerbosch
PUMP-SET:	Raw water #5
PUMP-SET DUTY:	208 Ml/d @ 8.00 m
OPERATING HOURS SINCE PREVIOUS TEST	7 700
TOTAL OPERATING HOURS	88 493

COMMENTS

A single test point obtained at the rate of flow at which the pump-set was found to be operating.

The hydraulic actuators on the delivery valves of the raw water pump-sets do not permit throttling of the valves for test purposes.

Wiring fault on the electrical test plug to be investigated and corrected.

FLOW RATE AT TESTED GENERATED HEAD

Acceptance (Ml/d)	TEST	DIFFERENCE	DEVIATION %
211.75	211.40	-0.35	-0.17

GENERATED HEAD AT TESTED FLOW

Acceptance (m)	TEST	DIFFERENCE	DEVIATION %
8.28	7.784	-0.50	-5.99

PUMP-SET EFFICIENCY COMPARISON AT TESTED FLOW

Acceptance (%)	TEST	DIFFERENCE	DEVIATION %
79.95	84.00	4.05	5.07

POWER DEMAND AT TESTED FLOW

Acceptance (kW)	TEST	DIFFERENCE	DEVIATION %
235.82	222.90	-12.92	-5.48

ECONOMIC EVALUATION TO OVERHAUL PUMP-SET

Date of last overhaul	Not overhauled
Operating hours since acceptance or overhaul	88 493
Pump-set utilization	47.62%
Interest rate	9.00%
Energy charge (R/kWh)	R 0.48
Monthly saving if pump-set efficiency is restored to original efficiency	R 0.00
NPV of saving in electrical cost if pump-set is restored to original efficiency	R 0.00
* If the cost to overhaul the pump-set exceeds this amount, the overhaul of the pump-set is not viable.	

CONCLUSION

The performance of raw water pump-set 5 is acceptable. Overhaul of the pump-set is not viable.

RECOMMENDATION

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
PUMP TEST TECHNICIAN

P Lephuthing
PUMP TEST FITTER

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pump-set 5
Supplied under contract no.	1389
Date of test:	22 August 2012
Observer:	P Lephuthing

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(Ml/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600/1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		88 493
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		N/A
Date of Previous Performance Test		Feb 2011
Operating Hours Since Previous Performance Test		8 868
Pump-set Utilization	(%)	47.62

ZUIKERBOSCH RAW WATER PUMPSET 5
SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				MARCH 2006	APRIL 2008	OCTOBER 2009	February 2011	August 2012
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test1	Test 1	Test 1	Test 1	Test 1
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00			406.00	393.00	396.00
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00			50.00	50.20	50.20
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69			-0.97	-0.96	-0.96
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55			39.05	37.56	36.74
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451	193.176	218.033	236.377
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977	127.513	120.509	109.596
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361	38.881	39.368	36.701
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00	424.00	423.00	424.00

CALCULATED RESULTS FOR PUMP SET:-

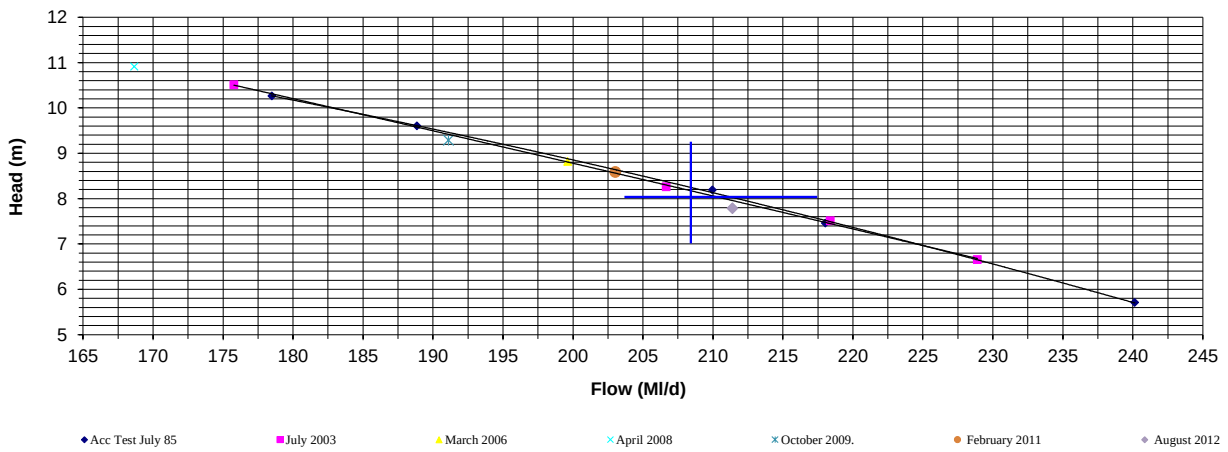
Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00	341.00
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300			234.300	225.360	220.440
Flow	(MI/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66	191.11	203.03	211.40
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234	0.300	0.339	0.367
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.654	7.512	8.261	10.509	8.819	10.911	9.287	8.588	7.784
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516	201.104	197.574	186.466
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64	81.99			85.83	87.67	84.59

POWER DEMAND AT DUTY POINT :-

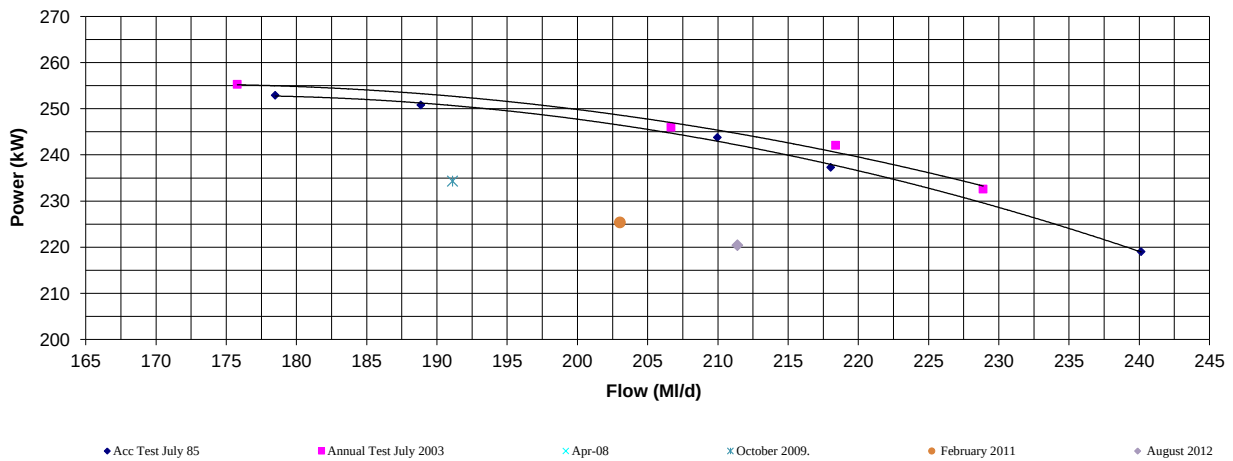
Calculations are based on test with the flow rate nearest to duty point

Flow rate used:		209.97	MI/d		206.67	MI/d		191.11		203.03		211.40
Efficiency at this point		79.95	%		78.64	%		85.83		87.67		84.59
Power demand at duty point		235.82	kW		239.77	kW		219.67		215.07		222.90
Percentage of guaranteed demand		98.88	%		100.53	%		92.11		90.17		93.46

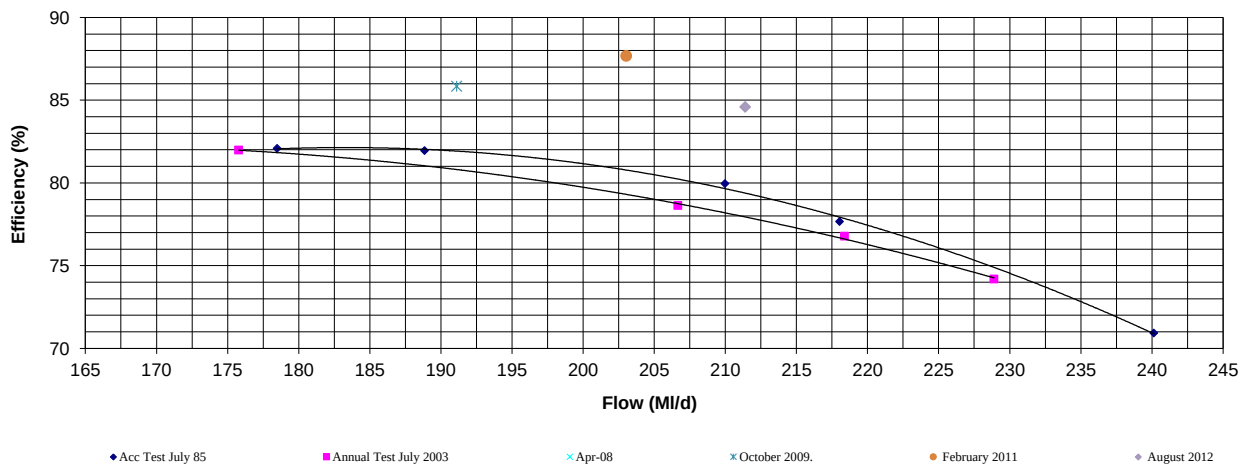
Q - H Curve
Raw Water Pump 5



Q - kW Curve
Raw Water Pump 5



Q - Efficiency Curve
Raw Water Pump 5





24 March 2011

PERFORMANCE TEST CONDUCTED ON PUMP SET 5 IN RAW WATER ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION

THE FOLLOWING POINTS WERE DETERMINED FOR THE PUMP-SET:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pump-set using a calibrated Differential Pressure Transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters which were calibrated by an NLA traceable laboratory. Accuracy class of the test pressure transmitters is 0.25%.

RESULTS

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency characteristics of the pump-set as well as calculations for power demand at duty point
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

SUMMARY OF PUMP-SET PERFORMANCE

DATE OF TEST:	17 February 2011
PUMPING STATION:	Zuikerbosch
PUMP-SET:	Raw water #5
PUMP-SET DUTY:	208 Ml/d @ 8.00 m
OPERATING HOURS SINCE PREVIOUS TEST	8 868
TOTAL OPERATING HOURS	80 793

COMMENTS

A single test point obtained at the rate of flow at which the pump-set was found to be operating.

The hydraulic actuators on the delivery valves of the raw water pump-sets do not permit throttling of the valves for test purposes.

Wiring fault on the electrical test plug to be investigated and corrected.

FLOW RATE AT TESTED GENERATED HEAD

Acceptance (Ml/d)	TEST	DIFFERENCE	DEVIATION %
203.75	203.03	-0.72	-0.35

GENERATED HEAD AT TESTED FLOW

Acceptance(m)	TEST	DIFFERENCE	DEVIATION %
8.59	8.56	-0.03	-0.37

PUMP-SET EFFICIENCY COMPARISON AT TESTED FLOW

Acceptance (%)	TEST	DIFFERENCE	DEVIATION %
N/A	N/A	N/A	N/A

POWER DEMAND AT TESTED FLOW

Acceptance (kW)	TEST	DIFFERENCE	DEVIATION %
N/A	N/A	N/A	N/A

ECONOMIC EVALUATION TO OVERHAUL PUMP-SET

Date of last overhaul	Not overhauled
Operating hours since acceptance or overhaul	80 793
Pump-set utilization	46.17%
Interest rate	9.00%
Energy charge (R/kWh)	R 0.37
Monthly saving if pump-set efficiency is restored to original efficiency	R 0.00
NPV of saving in electrical cost if pump-set is restored to original efficiency	R 0.00

* If the cost to overhaul the pump-set exceeds this amount, the overhaul of the pump-set is not viable.

CONCLUSION

The performance of raw water pump-set 5 is acceptable. Overhaul of the pump-set is not viable.

RECOMMENDATION

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
PUMP TEST TECHNICIAN

P Lephuthing
PUMP TEST FITTER

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pump-set 5
Supplied under contract no.	1389
Date of test:	17 February 2011
Observer:	P Lephuthing

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(MI/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600/1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		80 793
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		N/A
Date of Previous Performance Test		Oct 2009
Operating Hours Since Previous Performance Test		8 868
Pump-set Utilization	(%)	46.17

ZUIKERBOSCH RAW WATER PUMPSET 5
SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				MARCH 2006	APRIL 2008	OCTOBER 2009	February 2011
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test1	Test 1	Test 1	Test 1
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00			406.00	393.00
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00			50.00	50.20
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69			-0.97	-0.96
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55			39.05	37.56
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451	193.176	218.033
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977	127.513	120.509
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361	38.881	39.368
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00	424.00	423.00

CALCULATED RESULTS FOR PUMP SET:-

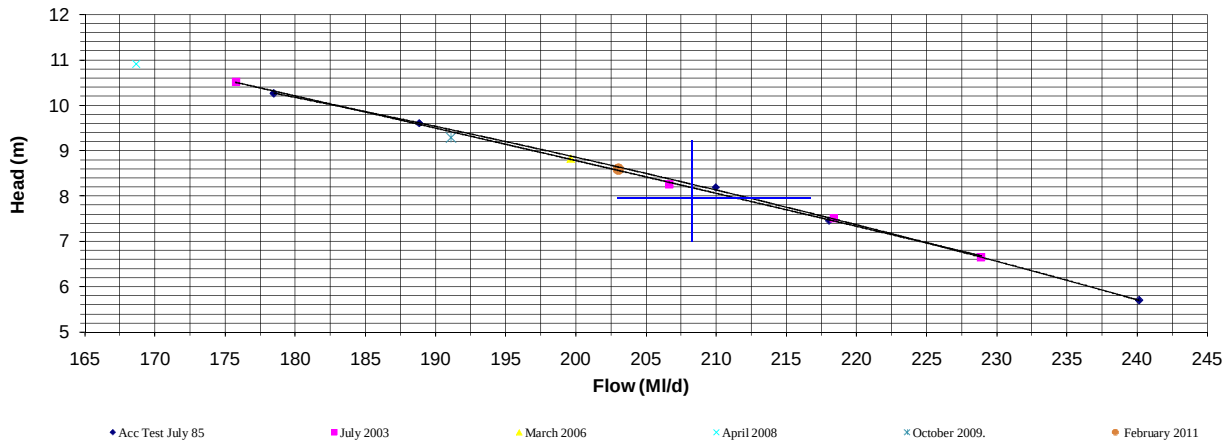
Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			350.00	349.00
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300			234.300	225.360
Flow	(MI/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66	191.11	203.03
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234	0.300	0.339
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.654	7.512	8.261	10.509	8.819	10.911	9.287	8.588
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516	201.104	197.574
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64	81.99			85.83	87.67

POWER DEMAND AT DUTY POINT :-

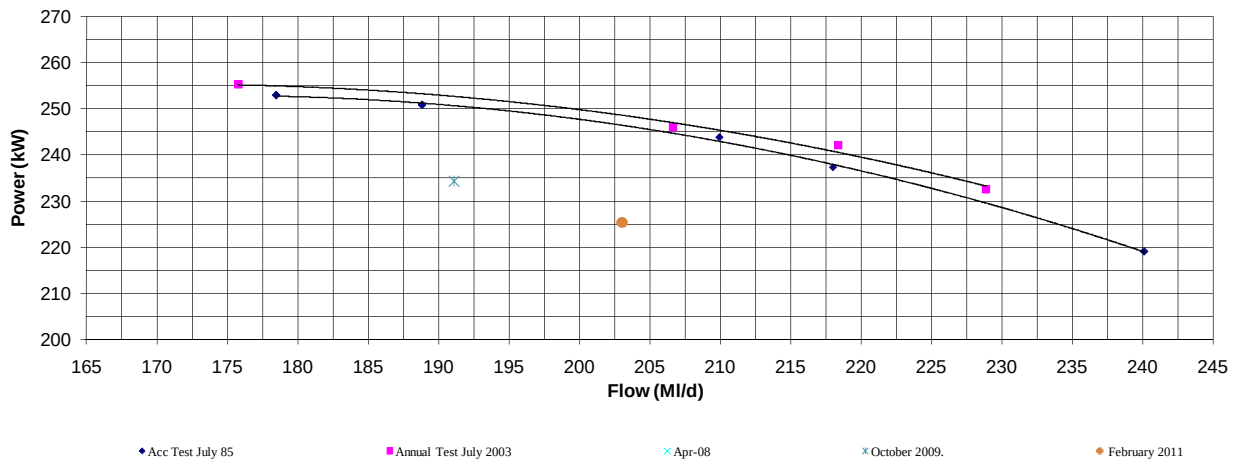
Calculations are based on test with the flow rate nearest to duty point

Flow rate used:		209.97	MI/d	206.67	MI/d	191.11	203.03
Efficiency at this point		79.95	%	78.64	%	85.83	87.67
Power demand at duty point		235.82	kW	239.77	kW	219.67	215.07
Percentage of guaranteed demand		98.88	%	100.53	%	92.11	90.17

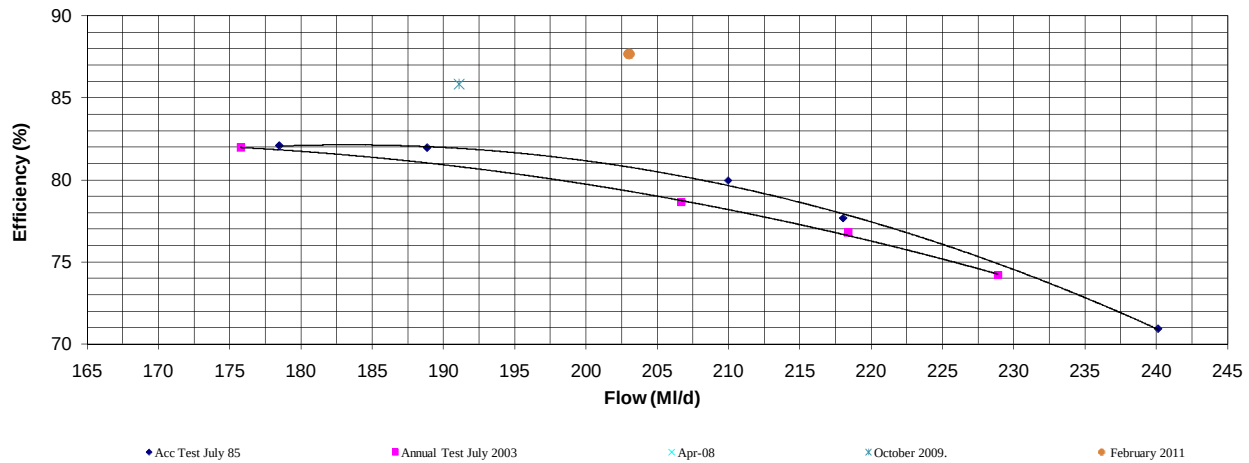
Q - H Curve
Raw Water Pump 5



Q - kW Curve
Raw Water Pump 5



Q - Efficiency Curve
Raw Water Pump 5





10 November 2009

PERFORMANCE TEST CONDUCTED ON PUMP SET 5 IN RAW WATER ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION

THE FOLLOWING POINTS WERE DETERMINED FOR THE PUMP-SET:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi installed in the delivery pipeline of the pump-set using a calibrated differential pressure transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters which were calibrated by an NLA traceable laboratory. Accuracy class of the test pressure transmitters is 0.25%.

RESULTS

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency characteristics of the pump-set as well as calculations for power demand at duty point
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

SUMMARY OF PUMP-SET PERFORMANCE

DATE OF TEST:	07 October 2009
PUMPING STATION:	Zuikerbosch - Raw Water
PUMP-SET:	5
PUMP-SET DUTY:	208 Ml/d @ 8 m
OPERATING HOURS SINCE PREVIOUS TEST	7 877
TOTAL OPERATING HOURS	71 925

COMMENTS

A single test point was obtained at the rate of flow at which the pump-set was found to be operating. The hydraulic actuators on the delivery valves of the raw water pump-sets do not permit throttling of the valves for test purposes.

Electrical energy was not recorded due to a wiring fault on the electrical test plug.

FLOW RATE AT THE MEASURED GENERATED HEAD

Acceptance or after overhaul (Ml/d)	TEST	DIFFERENCE	DEVIATION %
193.72	191.11	-2.61	-1.35

GENERATED HEAD AT THE MEASURED FLOW

Acceptance or after overhaul (m)	TEST	DIFFERENCE	DEVIATION %
9.46	9.29	-0.17	-1.83

PUMP-SET EFFICIENCY COMPARISON AT MEASURED FLOW

Acceptance or after overhaul (%)	TEST	DIFFERENCE	DEVIATION %
N/A	N/A	N/A	N/A

POWER DEMAND AT MEASURED FLOW

Acceptance or after overhaul (kW)	TEST	DIFFERENCE	DEVIATION %
N/A	N/A	N/A	N/A

ECONOMIC EVALUATION TO OVERHAUL PUMP-SET

Date of last overhaul	Not overhauled
Operating hours since acceptance or overhaul	71 925
Pump-set utilization	63.66%
Interest rate	9.00%
Energy charge (R/kWh)	R 0.3071
Monthly saving if pump-set efficiency is restored to original efficiency	N/A
NPV of saving in electrical cost if pump-set is restored to original efficiency	N/A

* If the cost to overhaul the pump-set exceeds this amount, the overhaul of the pump-set is not viable.

CONCLUSION

The H-Q performance of raw water pump-set 5 is acceptable. Overhaul of the pump-set is not viable.

RECOMMENDATION

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
PUMP TEST TECHNICIAN

P Lephuthing
PUMP TEST FITTER

ZUIKERBOSCH RAW WATER PUMP-SET 5

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				MARCH 2006	APRIL 2008	OCTOBER 2009
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test1	Test 1	Test 1
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00			
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00			
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69			
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55			
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451	193.176
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977	127.513
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361	38.881
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00	424.00

CALCULATED RESULTS FOR PUMP SET:-

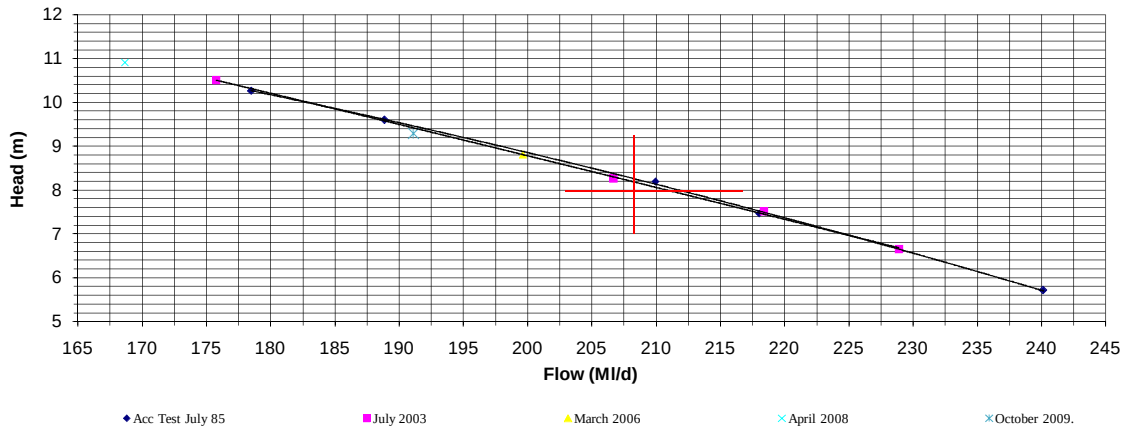
Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00			
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300			
Flow	(Ml/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66	191.11
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234	0.300
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.654	7.512	8.261	10.509	8.819	10.911	9.287
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516	201.104
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64				

POWER DEMAND AT DUTY POINT :-

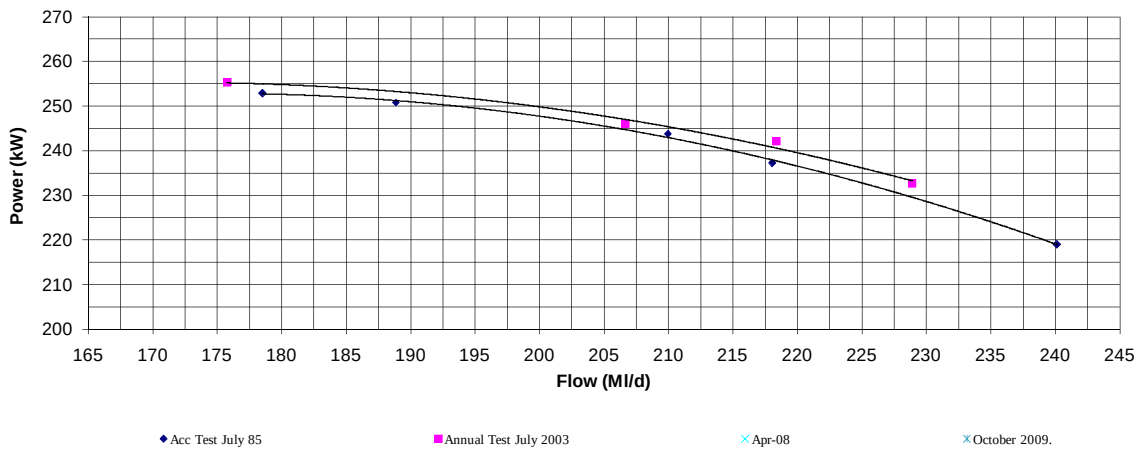
Calculations are based on test with the flow rate nearest to duty point

Flow rate used:	209.97	Ml/d	206.67	Ml/d
Efficiency at this point	79.95	%	78.64	%
Power demand at duty point	235.82	kW	239.77	kW
Percentage of guaranteed demand	98.88	%	100.53	%

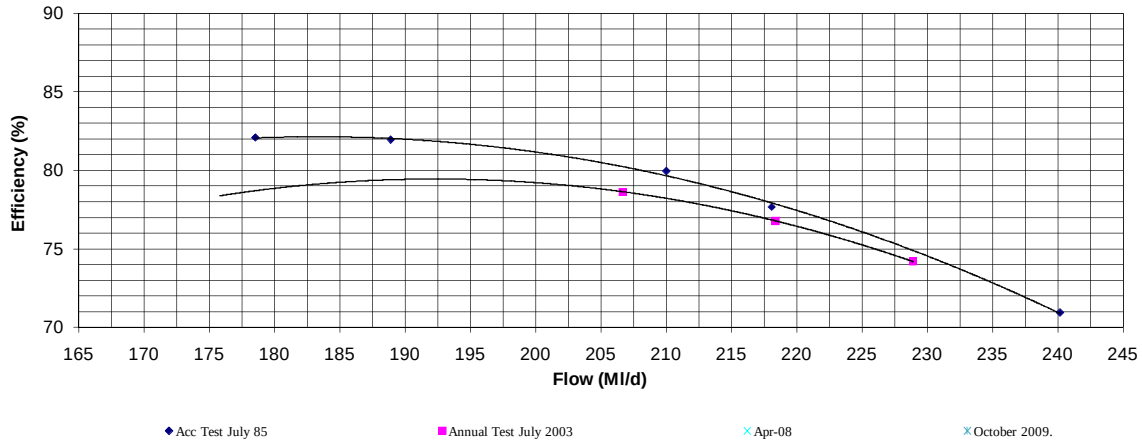
Q - H Curve
Raw Water Pump 5



Q - kW Curve
Raw Water Pump 5



Q - Efficiency Curve
Raw Water Pump 5





To: See Distribution List
From: Pump Test Technician
Date: 27 May 2008

Distribution List

General Manager – Operations Division
Chief Operations Engineer - Process
Chief Operations Engineer - Electrical
Chief Operations Engineer - Mechanical
Mechanical Engineer - Process
Executive Manager - Zuikerbosch pumping station
Maintenance Manager - Zuikerbosch pumping station
Operations Manager - Zuikerbosch pumping station
Planning Office Works Area 2 - Zuikerbosch pumping station

**PERFORMANCE TEST CONDUCTED ON PUMP-SET 5 IN RAW WATER
ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION**

Object

Routine test.

The following points were determined for the pump-set:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two-wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pump-set using a calibrated differential pressure transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters calibrated by an NLA traceable laboratory.

Results

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency of the pump-set as well as calculations for power demand at duty point.
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

Comments

General

A single test point was obtained at the rate of flow at which the pump-set was found to be operating. The hydraulic delivery valves on the raw water pump-sets cannot be utilized for throttling purposes during pump performance tests. The mentioned valves are either open or shut.

Electrical energy was not recorded due to a wiring fault on the electrical test plug.

Running Hours

Total operating hours since acceptance: 64 048.

Operating hours since previous performance test: 9 365.

Raw water pump-set 5 has not been overhauled.

The utilisation of raw water pump-set 5 during the period April 1997 to March 2008 was 61.58%.

Performance

The hydraulic performance of pump-set 5 is acceptable.

Recommendations

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
Operations (Process)

RAND WATER

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pumpset 5
Supplied under contract no.	1389
Date of test:	1-Apr-2008
Observer:	P Lephuthing

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(MI/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600:1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		64 048
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		N/A
Date of Previous Performance Test		Mar 2006
Operating Hours Since Previous Performance Test		9 365

ZUIKERBOSCH RAW WATER PUMP-SET 5

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				ROUTINE TEST MARCH 2006	ROUTINE TEST MARCH 2008
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test1	Test 1
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00		
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00		
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69		
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00		
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55		
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	150.451
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	150.977
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	47.361
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	423.00

CALCULATED RESULTS FOR PUMP SET:-

Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00		
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300		
Flow	(MI/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	168.66
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	0.234
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.654	7.512	8.261	10.509	8.819	10.911
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	172.581	185.874	193.446	209.317	199.471	208.516
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.19	76.78	78.64	81.99		

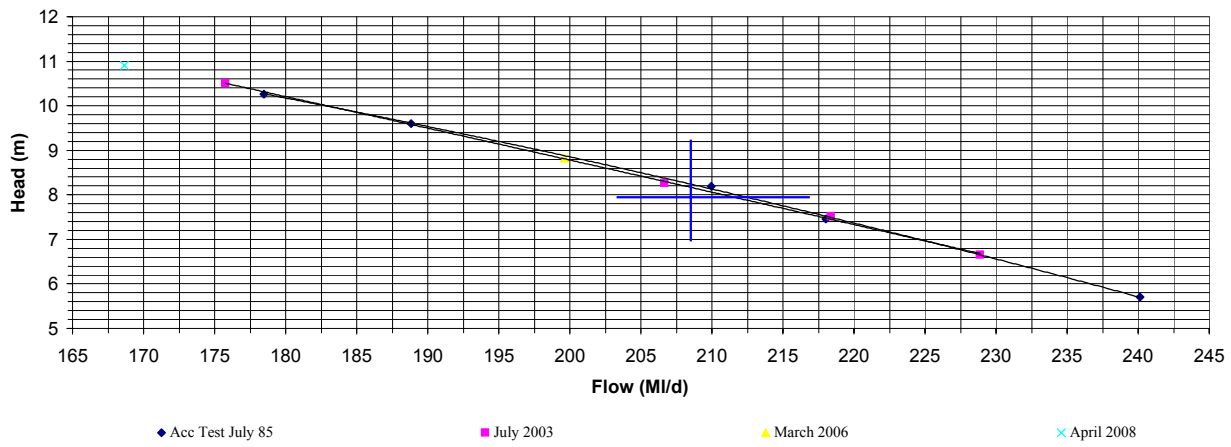
POWER DEMAND AT DUTY POINT :-

Calculations are based on test with the flow rate nearest to duty point

Flow rate used:	209.97	MI/d	206.67	MI/d
Efficiency at this point	79.95	%	78.64	%
Power demand at duty point	235.82	kW	239.77	kW
Percentage of guaranteed demand	98.88	%	100.53	%

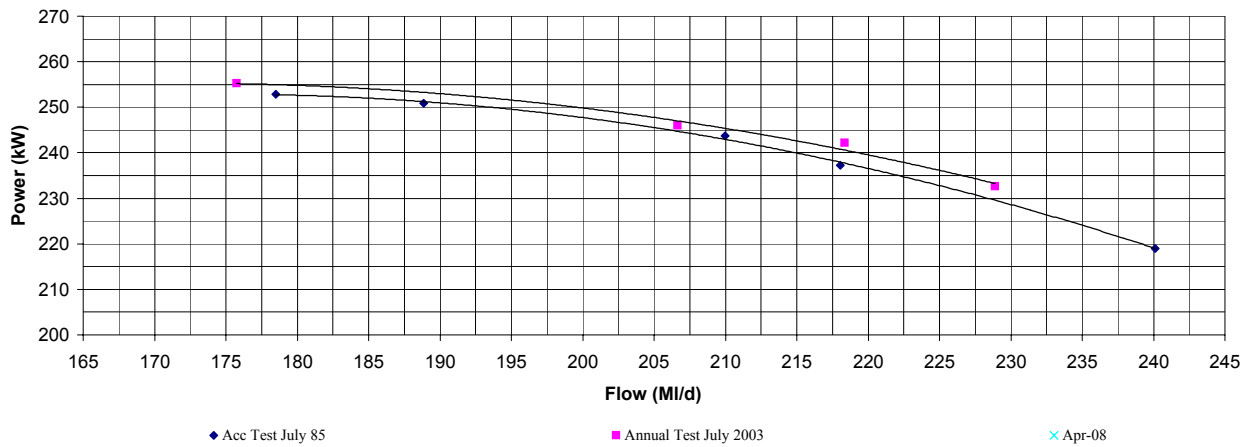
Q - H Curve

Raw Water Pump 5



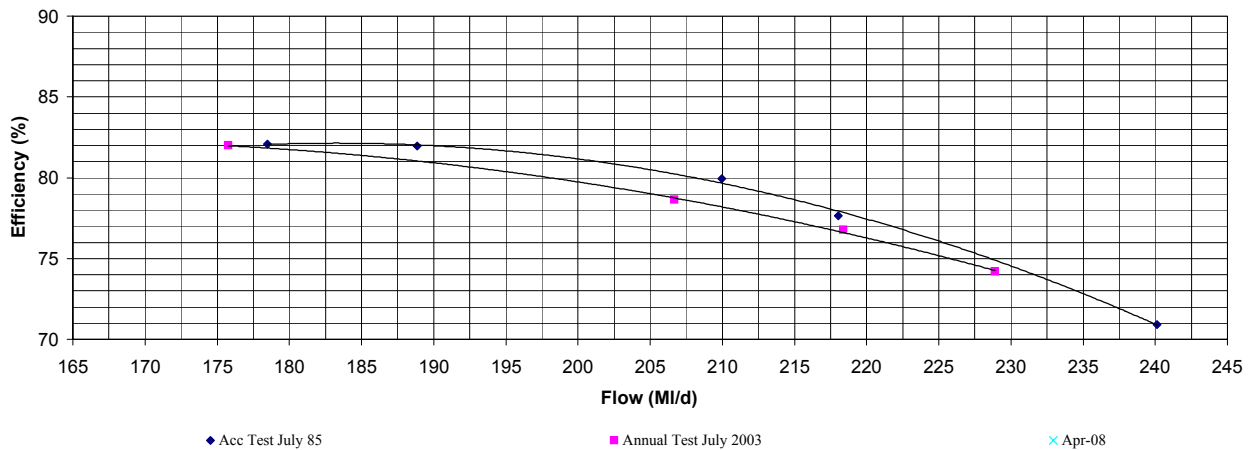
Q - kW Curve

Raw Water Pump 5



Q - Efficiency Curve

Raw Water Pump 5





To: See Distribution List
From: Pump Test Technician
Date: 18 April 2006

Distribution List

General Manager – Operations Division
Chief Operations Engineer - Process
Chief Operations Engineer - Electrical
Chief Operations Engineer - Mechanical
Mechanical Engineer - Process
Executive Manager - Zuikerbosch pumping station
Maintenance Manager Works Area 2 - Zuikerbosch pumping station
Operations Manager - Zuikerbosch pumping station
Planning Officer Works Area 2 - Zuikerbosch pumping station

**PERFORMANCE TEST CONDUCTED ON PUMP-SET 5 IN RAW WATER
ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION**

Object

Routine test.

The following points were determined for the pump-set:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pump-set was based on the two-wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pump-set using a calibrated differential pressure transmitter.

Head Measurement

The generated head of the pump-set was obtained from test pressure transmitters calibrated by an NLA traceable laboratory.

Results

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency of the pump-set as well as calculations for power demand at duty point.
2. Characteristic curves for the pump-set, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency

Comments

General

A single test point was obtained at the rate of flow at which the pump-set was found to be operating. The hydraulic delivery valves on the raw water pump-sets cannot be utilized for throttling purposes during pump performance tests. The mentioned valves are either open or shut.

Running Hours

Total operating hours since acceptance: 54 683.

Operating hours since previous performance test: 7 849.

Raw water pump-set 5 has not been overhauled.

The utilisation of raw water pump-set 5 during the period June 1998 to January 2006 was 38.08%.

Performance

The hydraulic performance of pump-set 5 has not deteriorated since the previous performance test.

Conclusion

The performance of raw water pump-set 5 is acceptable.

Recommendations

Raw water pump-set 5 to be tested after a further 8000 operating hours.

Q van der Berg
Potable Water Production (Process)

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pumpset 5
Supplied under contract no.	1389
Date of test:	15-Mar-2006
Observer:	Q. van der Berg

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 MF Bowl Pump
Duty Flow Rate	(MI/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600:1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000
Total Operating Hours		54 683
Return to Service After Last Overhaul		Not overhauled
Operating Hours Since Overhaul		54 683
Date of Previous Performance Test		Jul 2003
Operating Hours Since Previous Performance Test		7 849

ZUIKERBOSCH RAW WATER PUMP 5
SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

		ACCEPTANCE TEST JULY 1985					ROUTINE TEST JULY 2003				ROUTINE TEST MARCH 2006	
TEST		1	2	3	4	5	1	2	3	4	1	
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00		
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00		
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69		
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00		
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55		
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00	600.00	
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43	210.777	
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27	130.229	
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93	47.730	
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00	424.00	

CALCULATED RESULTS FOR PUMP SET:-

Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00		
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300		
Flow	(MI/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78	199.62	
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254	0.327	
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.722	7.610	8.350	10.401	8.754	
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	174.350	188.318	195.533	207.159	198.014	
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.95	77.79	79.49	81.14		

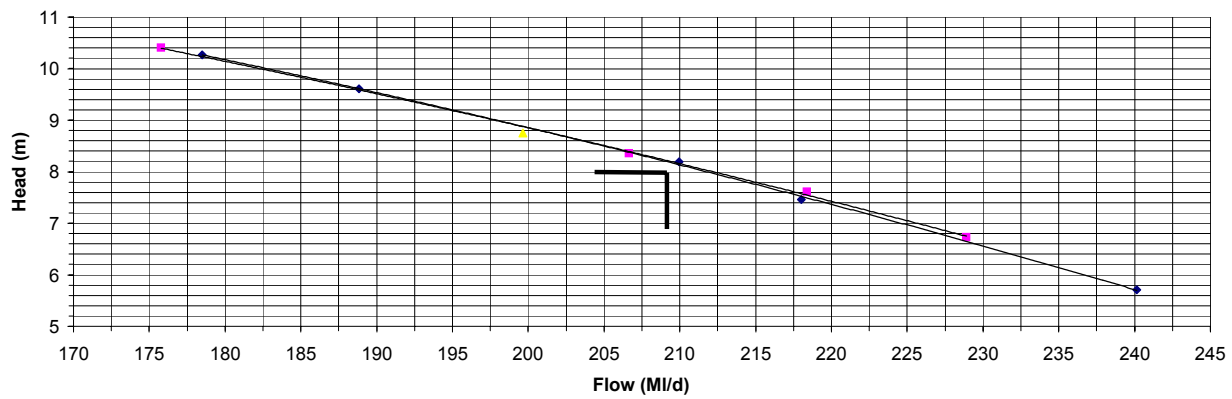
POWER DEMAND AT DUTY POINT :-

Calculations are based on test with the flow rate nearest to duty point

Flow rate used:	209.97	MI/d	206.67	MI/d
Efficiency at this point	79.95	%	79.49	%
Power demand at duty point	235.82	kW	237.21	kW
Percentage of guaranteed demand	98.88	%	99.46	%

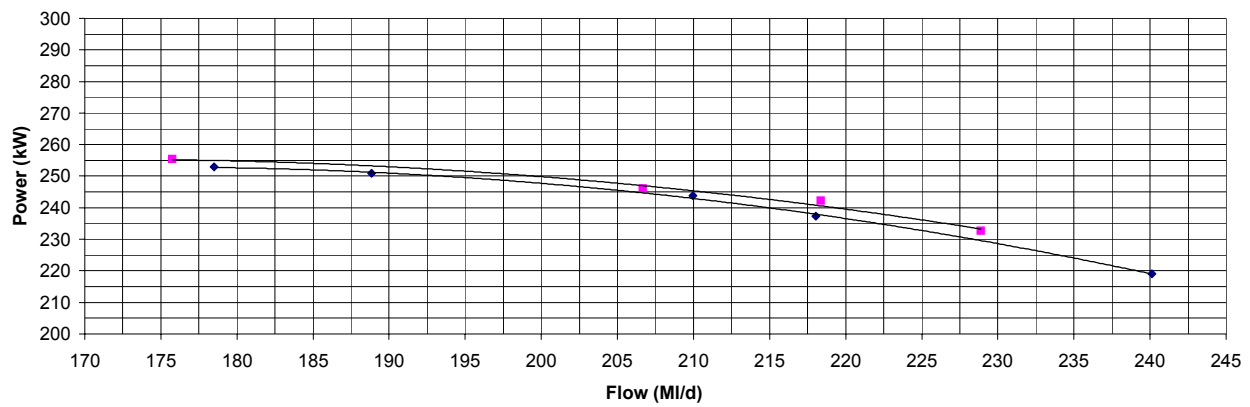
Q - H Curve

Raw Water Pump 5



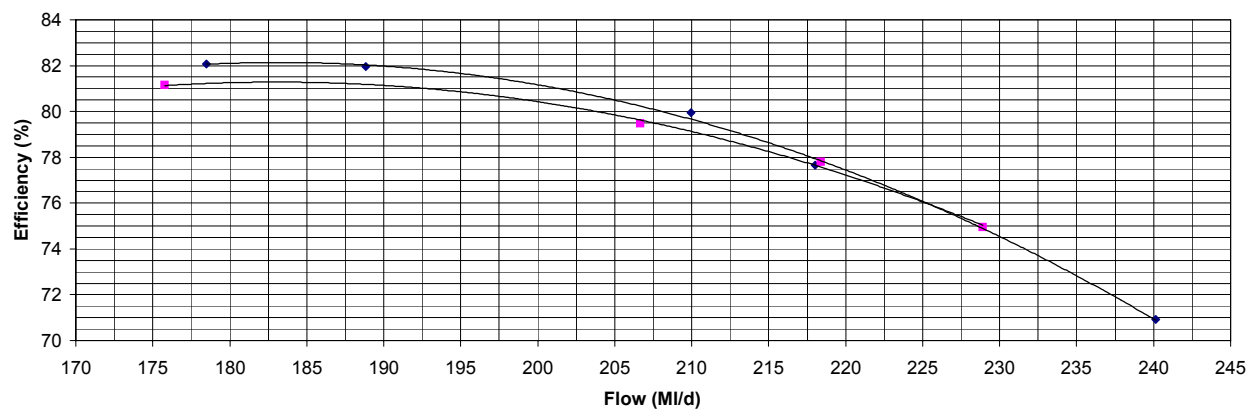
Q - kW Curve

Raw Water Pump 5



Q - Efficiency Curve

Raw Water Pump 5





To: See Distribution List

From: Pump Test Technician

Date: 04 August 2003

Distribution List

General Manager – Potable Water Production

Chief Engineer – Potable Water Production

Chief Operations Engineer - Process

Chief Operations Engineer - Electrical

Chief Operations Engineer - Mechanical

Mechanical Engineer - Process

Manager - Zuikerbosch pumping station

Maintenance Manager Works Area 2 - Zuikerbosch pumping station

Operations Manager - Zuikerbosch pumping station

Planning Officer Works Area 2 - Zuikerbosch pumping station

**PERFORMANCE TEST CONDUCTED ON PUMPSET 5 IN RAW WATER
ENGINE ROOM 4 AT ZUIKERBOSCH PUMPING STATION**

Object

Routine test.

The following points were determined for the pumpset:

1. Generated head at duty flow rate.
2. Pump power demand at duty flow rate.
3. Corresponding overall efficiency.
4. Overall vibration levels.

METHOD OF TESTING

Power Input Measurement

Electrical power demand of the pumpset was based on the two wattmeter method, using an electronic sub-standard energy meter.

Measurement of Flow Rate

The rate of flow was determined by measuring the differential pressure generated by a Venturi meter in the delivery pipeline of the pumpset using a calibrated differential pressure transmitter.

Head Measureme nt

The generated head of the pumpset was obtained from test pressure transmitters calibrated by an NLA traceable laboratory.

Results

The results of the test are shown on the attached copies of the following:

1. Pump test data sheets indicating all flow, head, power and efficiency of the pumpset as well as calculations for power demand at duty point.
2. Characteristic curves for the pumpset, namely:
 - a) Quantity - Head
 - b) Quantity - Power
 - c) Quantity -Efficiency
3. Overall vibration severity readings taken at duty point.

Comments

General

The hydraulic delivery valves on the raw water pumpsets cannot be utilized for throttling purposes during pump performance tests. The mentioned valves are either open or shut. Reducing the number of pumpsets operating on the same delivery system increased the rate of flow through the pumpset being tested.

Running Hours

Total operating hours since acceptance: 46 834.
Raw water pumpset 5 has not been overhauled.

The utilisation of raw water pump set 5 during the period June 1998 to June 2003 was 35.40%.

Performance

The efficiency of the pumpset at the duty rate of flow is 79.49% compared to the acceptance efficiency of 79.95%.

Vibration

The vibration severity levels measured on both the motor and pump fall within the 'Good' region of I.S.O. Standard 2373 Class 3 and 4 respectively.

Conclusion

The performance of raw water pumpset 5 is acceptable.

Recommendations

Raw water pumpset 5 to be tested after a further 8000 operating hours.

Q van der Berg

Potable Water Production (Process)

R A N D W A T E R

PUMP TEST REPORT

Station:	Zuikerbosch
Pump tested:	Raw Water Pumpset 5
Supplied under contract no.	1389
Date of test:	22-Jul-2003
Observer:	Q. van der Berg

Total operating hours:	46 834
Operating hours since previous test:	46 834

DETAILS ARE AS FOLLOWS :-

Pump Manufacturer		APE
Pump Type		700/1000 Mixed Flow Vert Spindle
Duty Flow Rate	(Ml/d)	208.00
Flow Meter Constant		13.750
Duty Generated Head	(m)	8.00
Guaranteed Demand	(kW)	238.50
Guaranteed Efficiency	(%)	79.02
Duty Speed	(r.p.m.)	422.00
Motor Manufacturer		GEC
Power Rating	(kW)	270.00
Voltage	(V)	400.00
Amps	(A)	560.00
Serial Number		2LM3709-01
CT. Ratio		600:1
Suction Diameter.	(mm)	1400.00
Delivery Diameter	(mm)	1000.00
Gravity	(m/s^2)	9.790
Density	(kg/m^3)	1000.000

Raw Water Pump 5 Vibration Test

Zuikerbosch

Stage : Speed (r.p.m.) : Flow rate (Ml/d) : Date :			1
			424
			232
			JUL 2003
Vibration severity in mm/sec. (rms)			
	Pump	Ax	0.95
		Nde Rad 1	0.68
		Nde Rad 2	0.99
		De Rad 1	2.80
		De Rad 2	1.70
	Motor	De Rad 1	0.64
		De Rad 2	1.30
		Nde Rad 1	0.85
		Nde Rad 2	0.97
		Ax	0.95

Note: De Rad 1 is measured in the same plane as the delivery pipework.

I.S.O. Standard 2373 CLASS 3

Vibration severity in (mm/sec.)			
Good	0.00	to	1.80
Satisfactory	1.80	to	4.50
Needs Attention	4.50	to	11.00
Danger	11.00	+	

I.S.O. Standard 2373 CLASS 4

Vibration severity in (mm/sec.)			
Good	0.00	to	2.80
Satisfactory	2.80	to	7.00
Needs Attention	7.00	to	18.00
Danger	18.00	+	

ZUIKERBOSCH RAW WATER PUMP 5
SITE READINGS ON SUBSTANDARD INSTRUMENTS :-

		ACCEPTANCE TEST JULY 1985					ANNUAL TEST JULY 2003			
	TEST	1	2	3	4	5	1	2	3	4
Voltage	(V)	420.00	420.00	410.00	410.00	420.00	417.00	411.00	410.00	409.00
Frequency	(Hz)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Power Factor		0.65	0.67	0.69	0.70	0.69	0.65	0.67	0.68	0.69
Ammeter 1st Stage	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00
Energy Meter	(kWh)	219.04	237.29	243.78	250.82	252.92	38.77	40.35	41.00	42.55
Time	(sec.)	600.20	600.20	900.30	600.10	600.10	600.00	600.00	600.00	600.00
Manometer Diff Head	(mmhg)	305.00	251.45	233.19	188.64	168.50	277.11	252.25	225.91	163.43
Del Pressure	(kPa)	83.68	102.19	109.98	124.97	131.94	109.90	118.56	125.91	148.27
Suction Pressure	(kPa)	32.42	32.99	33.32	33.80	34.01	48.30	47.89	47.60	48.93
Speed	(r.p.m.)	425.00	425.00	425.00	425.00	426.00	425.00	425.00	425.00	424.00

CALCULATED RESULTS FOR PUMP SET:-

Motor Current	(Amps)	467.91	490.40	496.40	506.90	509.90	487.00	502.00	506.00	522.00
Stage kW	(kW)	219.040	237.290	243.780	250.820	252.920	232.620	242.100	246.000	255.300
Flow	(Ml/d)	240.13	218.04	209.97	188.85	178.49	228.89	218.38	206.67	175.78
Velocity Head	(m)	0.474	0.390	0.362	0.293	0.262	0.430	0.392	0.351	0.254
Generated Head	(m)	5.710	7.459	8.193	9.605	10.265	6.722	7.610	8.350	10.401
Water kW	(kW)	155.353	184.276	194.914	205.545	207.595	174.350	188.318	195.533	207.159
Efficiency	(%)	70.92	77.66	79.95	81.95	82.08	74.95	77.79	79.49	81.14

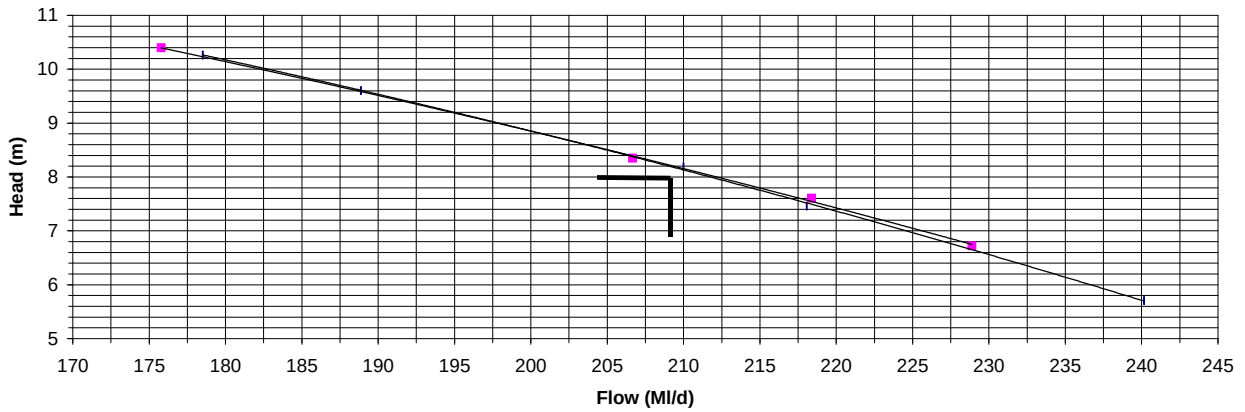
POWER DEMAND AT DUTY POINT :-

Calculations are based on test with the flow rate nearest to duty point

Flow rate used:	209.97	Ml/d	206.67	Ml/d
Efficiency at this point	79.95	%	79.49	%
Power demand at duty point	235.82	kW	237.21	kW
Percentage of guaranteed demand	98.88	%	99.46	%

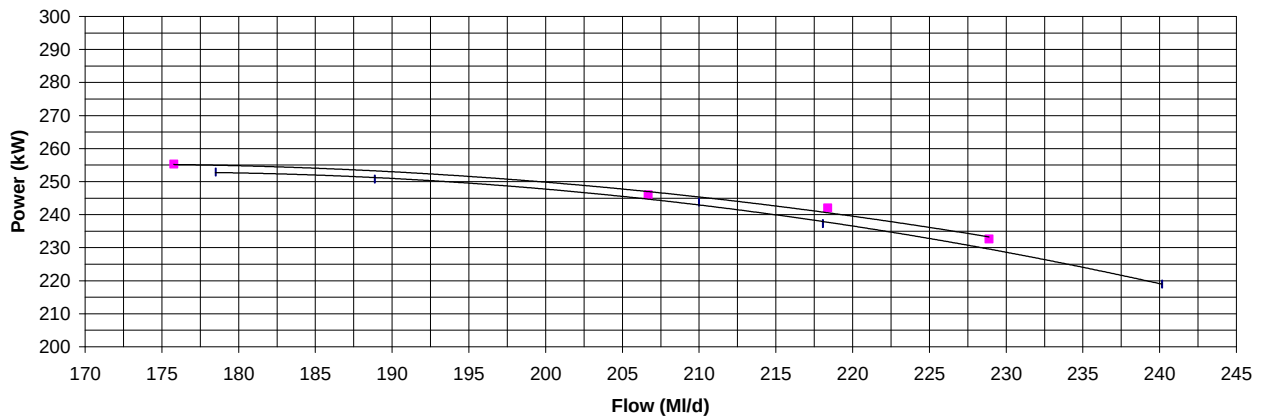
Q - H Curve

Raw Water Pump 5



Q - kW Curve

Raw Water Pump 5



Q - Efficiency Curve

Raw Water Pump 5

