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BRE Global Trails Report

Summary of Findings from Ultimate Fire Pump Skid Project

Prepared for: **Ultimate Fire Systems Ltd**

Date: **4 April 2019**

Report Number: **P105650-1000 Issue: 1**

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Table of Contents

1 Introduction

The objective of this trials programme was,

- to determine the performance of a pump skid unit, when operated for a 1000 runtime cycle,
- to conduct a running trial on the pump skid to examine the actual flow characteristic against the manufacturer`s specification,
- to conduct various pressure trials on the pump skid unit.

This activity was undertaken as an initial trials programme under BRE project reference: P105650 and this report solely presents the findings from this trails event, it does not constitute an approval, certification or endorsement of the product.

2 Equipment and data supplied

2.1 Details of Equipment Supplied

The pump skid unit and associated ancillaries were provided by Ultimate Fire Systems Limited.

The equipment was delivered to site, installed and commission to run on the BRE Global pump tank test facility system, by the client Ultimate Fire Systems Ltd. and their partners, on **25th August 2016**.

The client stated that the controller was provided and programmed by Universal Panels & Systems and that the pump, control valves and tank unit were provided by The Water Hydraulics Co. Limited.

General assembly drawing FCP 505-WH-DR (Annex 1) and Document 551-001 (Annex 1), were provided by the client at the outset of the programme. The client stated that these documents were representative of the layout and components used in the unit as initially supplied to site.

During the course of the project, modifications were made by the client and BRE have not been provided with details of the modifications made to the system during the programme. BRE cannot therefore confirm the relationship between the unit supplied and the final assembly. These documents provided in the data (section 2.2) of this report are therefore supplied for information only.

2.2 Data

The following information was supplied by the client:

Drawing Number	Description	Doc Name	Revision / Date
FCP-505-WH-DR	Pump Layout	FCP 505-WH-DR V3 5pp 23.10.2016	Rev 3 09/12/2106
FPC-207-WH-M	Valve Manuals – WH	FCP-507-WH-M v1 23.10.2106	Rev v1 23/10/2016
FCP-501-UPS-DR	Schematic Wiring Diagram	FCP Test Circuit Diagram	Rev 1 07/09/2106
FCP-502-WH-DR	Schematic Wiring Diagram	FCP Pump Test Circuit Diagram	Rev 1 31/08/2016
FCP-503-UPS-CL	Component List for Panel (UPS)	FCP Panel Component List	Rev 1 01/09/2016
551-001	P1 P60 Dual Powerpack Assembly	Not Advised	Rev 02 04/05/2016

2.3 Specifications Provided by Client

The pressure and flow specifications provided by the client and used for the trial were:

- High-pressure line: 90bar ± 6% 90 ± 5.4 bar
- High-pressure Outlet: 85bar ± 6% 85 ± 5.1bar
- Low-pressure line: Greater than 12bar

Flowrate Delivery: minimum of 4.5 litres per minute.

Outlet K factor per head 4.5.

These performance specifications were supplied by the client as a signed declaration on 15/12/2016.

3 Trials Programme

3.1 1000 Runtime Cycle

The cycling protocol was below established in conjunction with the client for this phase of the trial.

I. Initial start / stop:

1. Controller boots.
2. Starts timing for 6 minutes to allow tank to fill.
3. Software is enabled via input P1 on controller by pressing start button on control panel.
4. Software is stopped by pressing stop button on control panel or reaching 1001 cycles.

II. Cycling operation:

1. Tank filling. All inputs and outputs are inactive. Duration: 6 minutes
2. Control activates, (Display value (counter) increases by one),
3. Open state pressure switch starts pump at 20Hz speed (Pressure spec. by UFS). LP solenoid pulsed for 3 seconds. Pump stops when LP pressure switch makes (closes) at pressure set by UFS.
4. In the event of a leakage / pressure drop developing on the LP line step II.3. is repeated to maintain required system pressure.
5. Dump valve opens and filling valve closes 1 minute after control is activated (step II.2.)
6. Dump valve creates pressure drop on LP line, pressure switch opens.
7. Open state pressure switch starts pump at 20Hz speed. LP Solenoid pulsed for 3 seconds.
8. Initiation of fire fight mode: Failing to build the pressure back on the LP line for 20 seconds.
9. Pump speed increases to 53 Hz (Pressure spec. by UFS) and HP Solenoid is pulsed for 4 seconds.
10. Pump stopped by low water level (input P3). Dump valve closes Tank filling valve opens. Cycle returns to step II.1.

This operational protocol was programmed into the system controller by the client. Figure 1 shows the software reference sheet provided by the client. BRE Global have not undertaken any review or investigation of the control equipment, software protocols or suitability for operation beyond the functionality of the unit to deliver the required operational sequencing for the system to deliver the 1000 cycle function trial.

Figure 1: Software description sheet

Customer:	Ultimate Fire Systems Ltd. (UFS)
Software description:	RDM PRO750AI/AO Controlled Water Mist System Control (TEST)
Software file name:	TDB-UFS-1007-V.2.1.tdb
Project drawing number: UPS Electrical / Mechanical	UFS-1007.01.01.dwg (ISS.3) / The Water Hydraulics Ltd. 509-002A
Programmer:	Peter Zarnoczki
Site:	BRE, Watford
Date:	10.10.2016

3.2 Set Up

BRE equipment

The pump skid unit was installed in the BRE pump tank facility. Three pressure sensors were used to monitor the pressures at the high-pressure line, at the high-pressure outline and at the low-pressure outline. The pressure was monitored at 1 sec intervals.

Inventories:

- Pressure transducer IN 4660, type: Druck PMP 1400, rating: 400 Bar.
- Pressure transducer IN 1643, type: Druck PMP 4070, rating: 100 Bar.
- Pressure transducer IN 1642, type: Druck PMP 4070, rating: 100 Bar.

3.3 Trial One (1000 Runtime Cycle)

Site installation by client: Date: **23-25/08/2016**

Photograph 1 and 2 show the initial installation of the unit.

Photograph 1 – Plan view

Photograph 2 – Front view

To facilitate the cycling trials a solenoid valve was added to the inlet line.

3.3.1 Run 1 (1000 Runtime Cycle)

The pump cycle controller programme was initiated by the client on **25/08/2016**.

Number of cycles: achieved 59

Outcome: The pump skid stopped operation after 59 cycles. Investigation by the client showed that the system circuit breaker was activated and switched the unit off. Photographs 3 and 4 shows the system post run.

Modifications: Following this run the main supply was changed by the client to increase the available current to address the addition of the extra solenoid valve which had been added to the unit as part of the trials set up.

Photograph 3

Photograph 4

3.3.2 Run 2 (1000 Runtime Cycle)

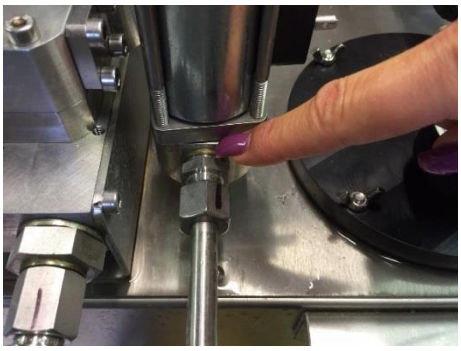
Following modifications to the system, as detailed in Run 1 (1000 runtime cycle), the system was restarted on **03/09/2016** at cycle 59.

Number of cycles: 299 (358 in Total)

Outcome: The pump skid was manually stopped by BRE staff at 358 cycles due to leakage at the valve on the weekly test line. Photographs 5, 6 and 7 shows the unit post run.

Modifications: The client removed the weekly test line from the pump skid and blanked off the connections.

Photograph 5



Photograph 6

Photograph 7

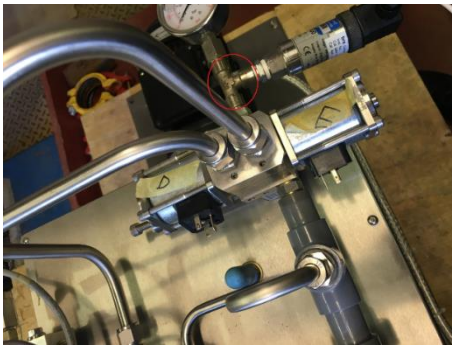
3.3.3 Run 3 (1000 Runtime Cycle)

Following the removal and blanking off the weekly test line the trial was restarted **11/09/2016** at cycle 358.

Number of cycles: 262 (620 in Total)

Outcome: At 620 cycles the pressure dropped outside the manufacturer`s specified figures and therefore the pump skid was manually stopped by BRE staff and the unit was collected for inspection by Water Hydraulics Co. Ltd.

Investigation: Water Hydraulics investigation reported that the pressure drop was from the distribution line. It was noted that the fittings used for the transducers supplied by BRE Global were not stainless steel and maybe the cause of the leak. Inspection report reference IR – OA5832 – 509-002.880, dated **21/09/2016**, signed by Ed Hasnip was supplied to BRE by the client **23/09/2016**. Photograph 8 and 9 shows the fitting post run.



Photograph 8

Photograph 9

3.4 Trial Two (1000 Runtime Cycle)

3.4.1 Run 1 (1000 Runtime Cycle)

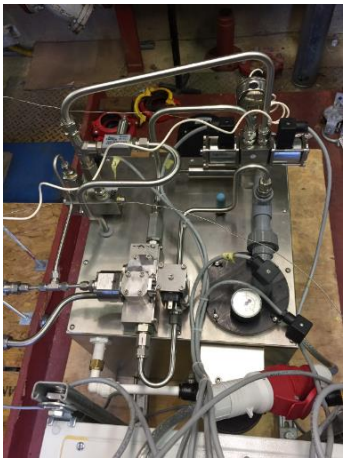
Following the inspection detailed in Run 3 (1000 runtime cycle of Run 1 under Trial one), the pressure transducer fittings were replaced, and the weekly test line that was removed following Run 2 was re-instated by Water Hydraulics Co. Ltd. The pump skid unit was then reinstalled onto the BRE pump tank test facility by the client on **11/10/2016**.

The trial was restarted from cycle 1 on **11/10/2016** and the 1000 cycle run was completed on **25/10/2016**

Number of cycles: achieved 1001

Outcome: The pump skid achieved the specified 1000 cycles. Photographs 10 and 11 shows the unit post run.

Photograph 10

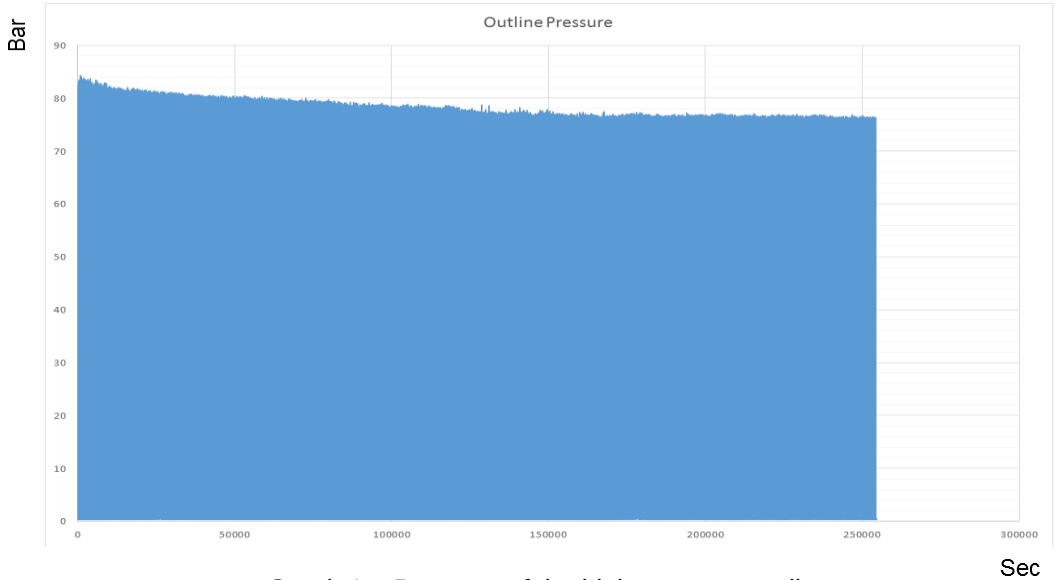


Photograph 11

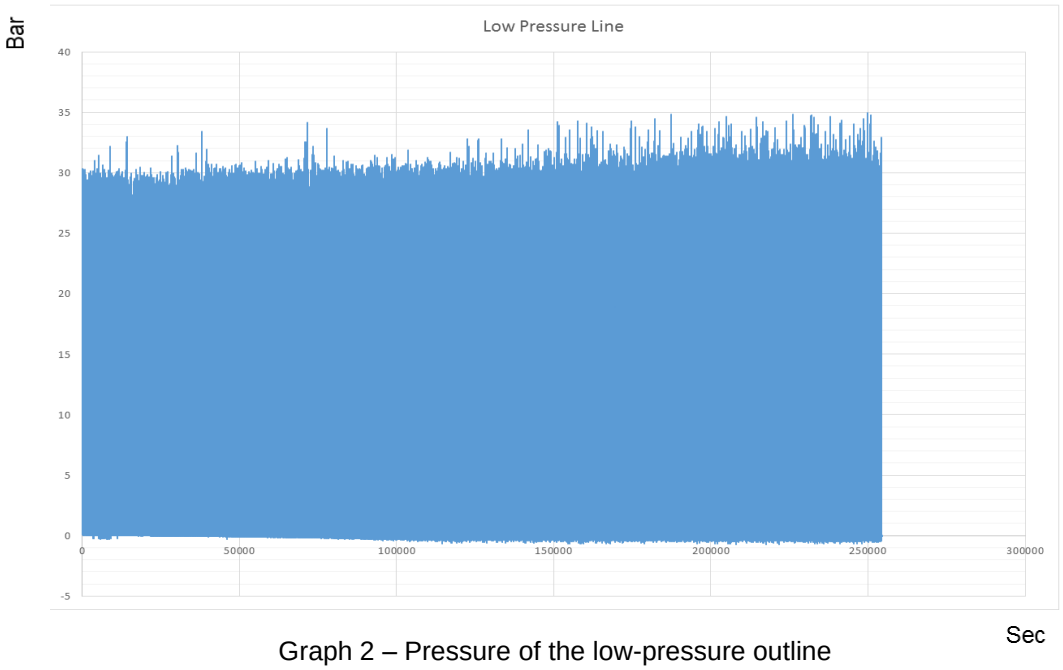
3.4.2 Data Records

3.4.2.1 Pressure Log of Total 1000 Cycle

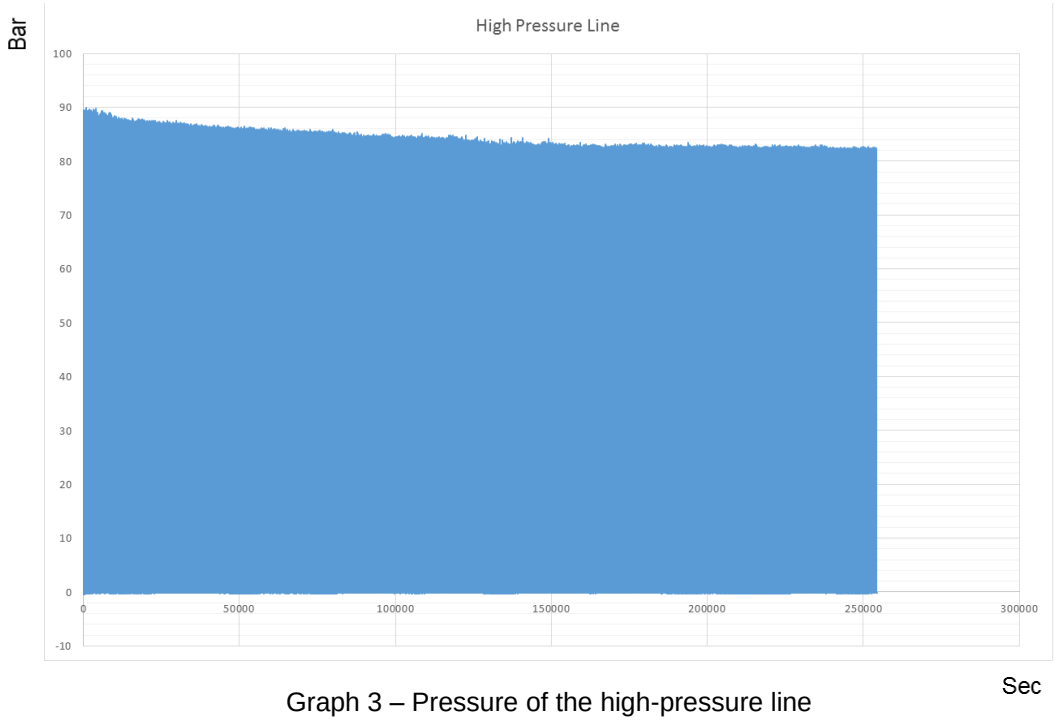
Graphs 1, 2 and 3 shows the pressure values recorded during the second cycling trial.



Graph 1 – Pressure of the high-pressure outline



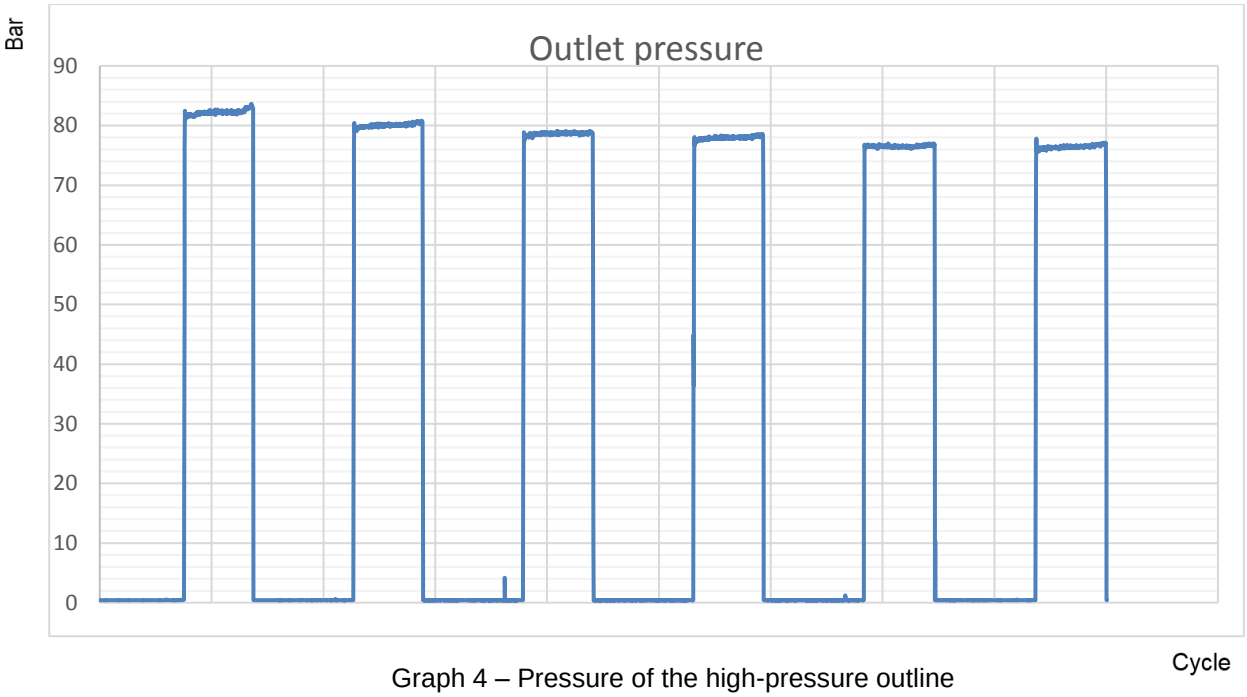
Graph 2 – Pressure of the low-pressure outline



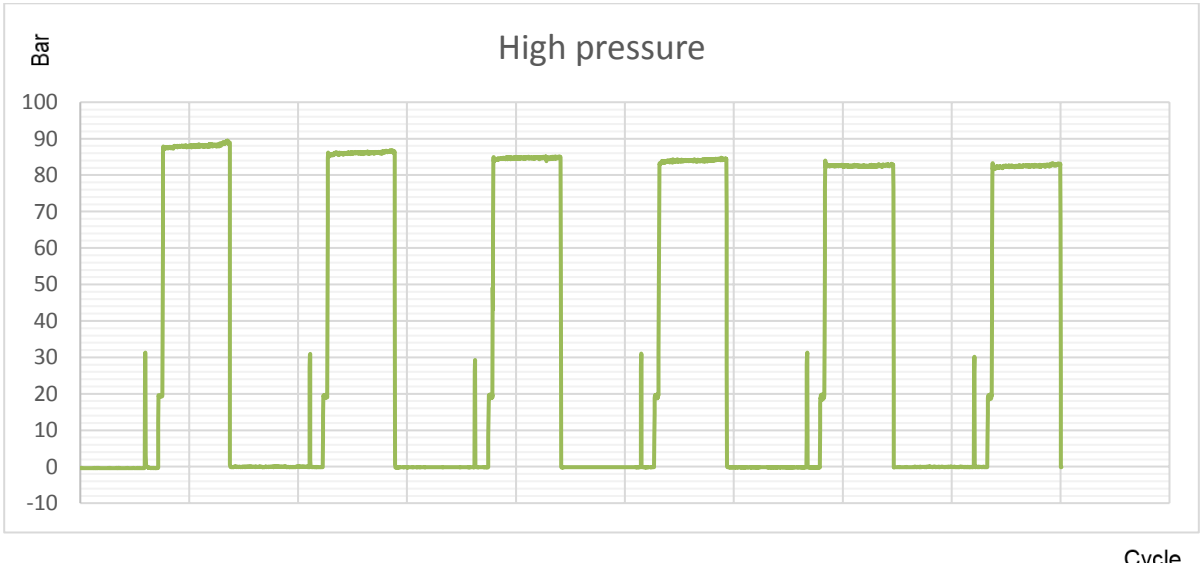
Graph 3 – Pressure of the high-pressure line

3.4.2.2 Pressure Log of Representative Cycles

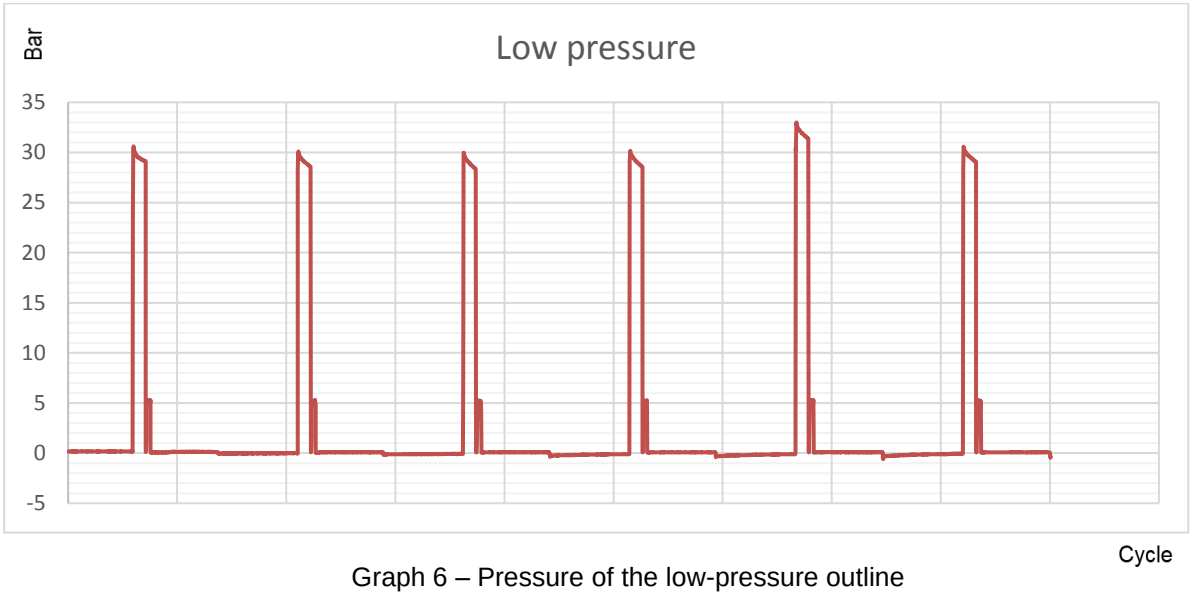
As an example of typical pressure cycles recorded, Graphs 4, 5 and 6 show the pressure values of the first and the last cycle from the sequence, together with four intermediate points which were monitored and logged by the pressure transducers detailed in this report.



Graph 4 – Pressure of the high-pressure outline



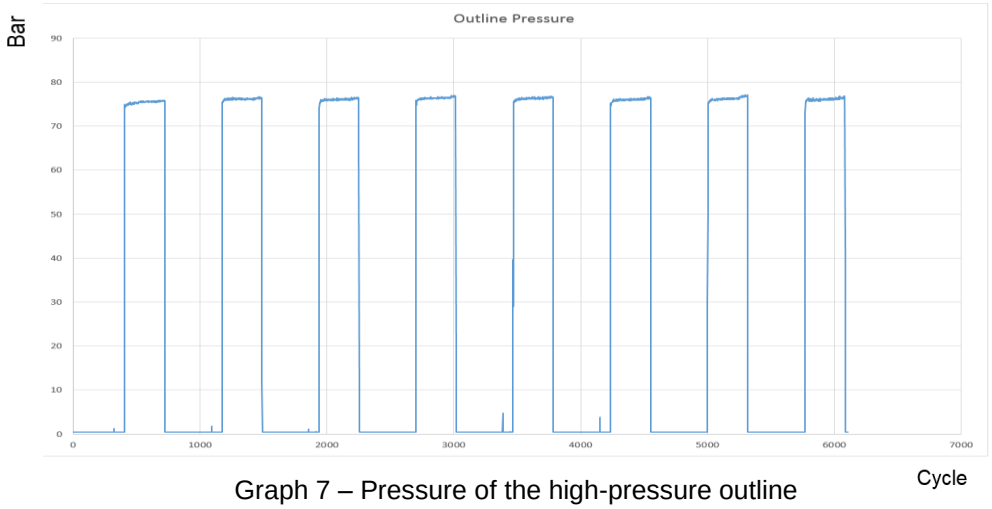
Graph 5 – Pressure of the high-pressure line



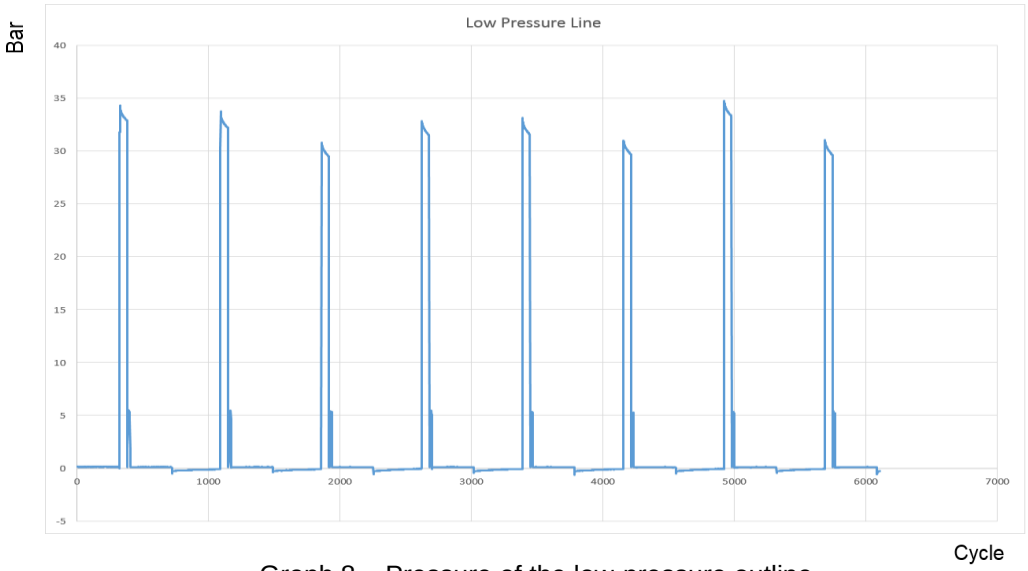
Graph 6 – Pressure of the low-pressure outline

3.4.2.3 Pressure Log Post Completion of 1000 Cycle

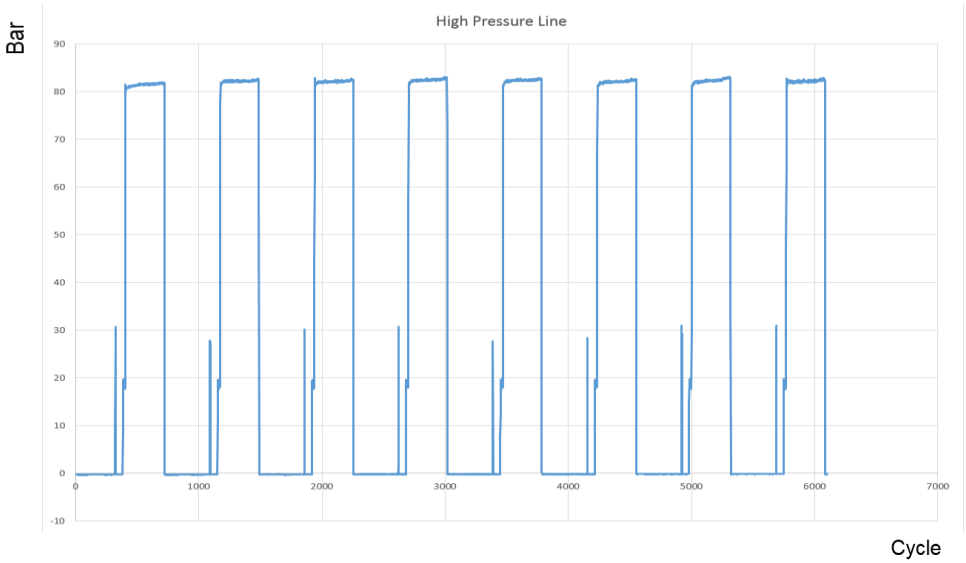
Graphs 7, 8 and 9 shows the pressure values of an additional 8 cycles post the completion of the 1000 cycle run. This was conducted on **25/10/2016**, 3 days after the 1000 cycles have been completed. The pressure values were monitored and logged by pressure transducers detailed in this report.



Graph 7 – Pressure of the high-pressure outline



Graph 8 – Pressure of the low-pressure outline



Graph 9 – Pressure of the high-pressure line

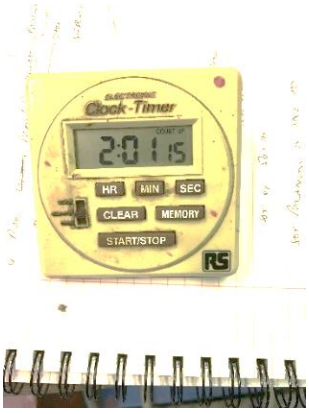
4 Trials Programme (Performance Characteristics)

4.1 2 Hours Continues Running Trial at Normal Working Pressure (Factory Set Up)

The pump controller programme was initiated by the client on **15/12/2016**.

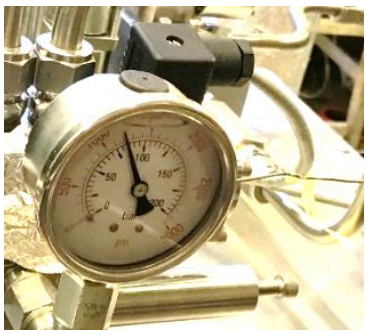
Description: The pump skid was run continuously at a nominal working pressure of 85 Bar, as specified by the client, for 2 hours.

Photograph 12 shows the timing of the trial. Photograph 13 shows the invertor set up for the trial. Photograph 14 shows the pressure gauge of the pump skid unit during the trial. Photograph 15 shows the parameters of the controller set up for the trial.

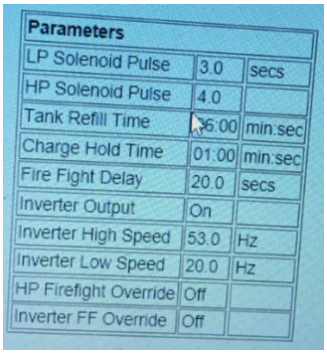


Photograph 12

Photograph 13



Photograph 14

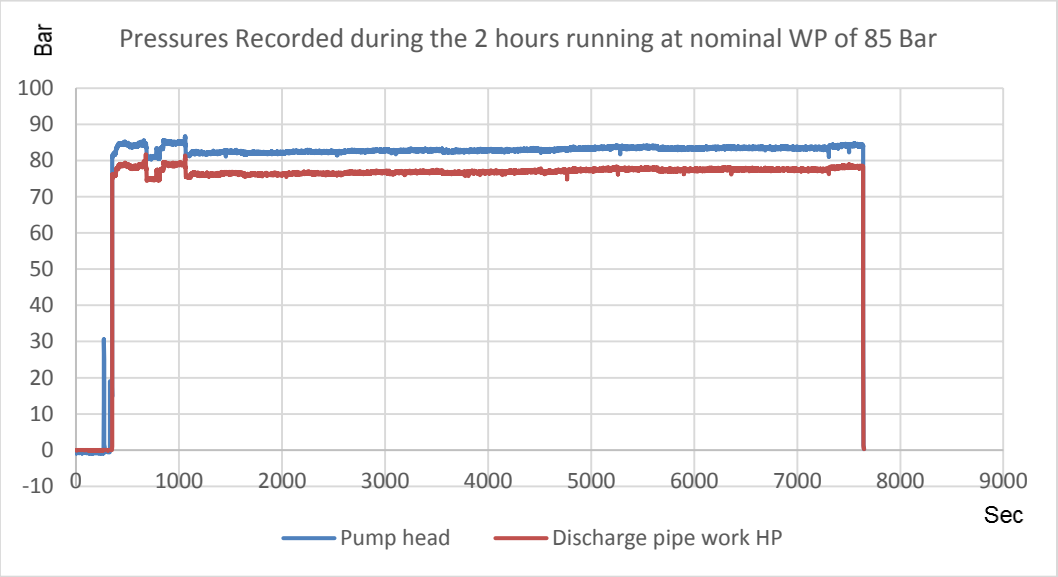


Parameters		
LP Solenoid Pulse	3.0	secs
HP Solenoid Pulse	4.0	
Tank Refill Time	06:00	min:sec
Charge Hold Time	01:00	min:sec
Fire Fight Delay	20.0	secs
Inverter Output	On	
Inverter High Speed	53.0	Hz
Inverter Low Speed	20.0	Hz
HP Firefight Override	Off	
Inverter FF Override	Off	

Photograph 15

Outcome: There was no leakage or damage observed to the unit or its components during or resulting from the 2-hour run trial.

Graph 10 shows the pressure values of the pump head and of the discharge pipe work at the high-pressure line, which were monitored and logged by the pressure transducers detailed in this report.



Graph 10

4.2 Recorded Flow Measurements

Description: the pump skid was fitted with a K4.5 water mist nozzle and run at the nominal working pressure of 85 bar for 1 minute. During this period the water discharged from the nozzle was collected and measured. Two water discharge runs were completed.

Run 1

Photograph 16 shows the weight of discharged water from the first system run was 4561g.

Photograph 16

Run 2

Photograph 17 shows the weight of discharged water from the second system run was 4648g.

Photograph 17

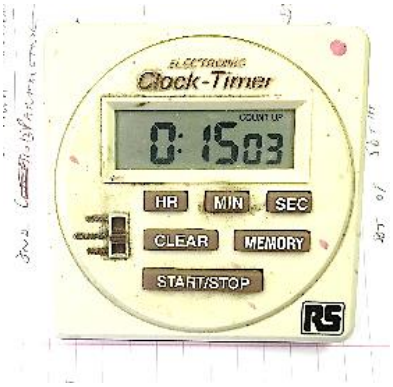
Outcome: The measured flow from each run was recorded as:

- Run 1 – 4,6 litres/minute
- Run 2 – 4,6 litres/minute.

4.3 Pump Skid Running at Maximum Specified Working Pressure (99 Bar for 15 Mins)

Description: The pump skid was run continuously at the client's maximum specified working pressure of 99 Bar for 15 minutes.

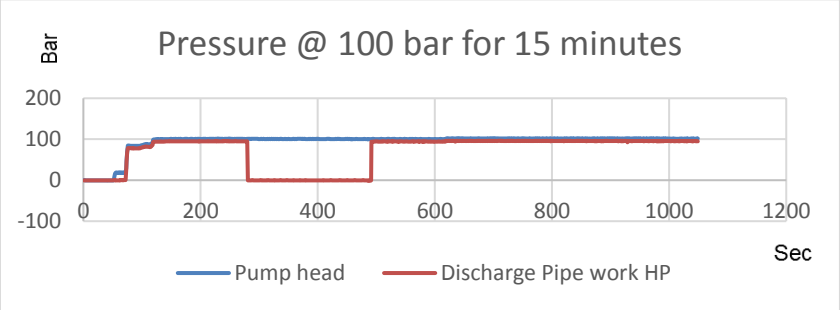
Photograph 18 shows the timing of the trial. Photograph 19 shows the pressure gauge of the pump skid unit during the trial.



Photograph 18

Photograph 19

Graph 11 shows the recorded pressures at the pump head and discharge pipe work for the high-pressure line, which were monitored and logged by the pressure transducers detailed in this report.



Graph 11

Notes: The wiring of the pressure transducer at the discharge pipe work at the high-pressure line became disconnected during the run sequence. Following detection of the signal loss the transducer cable was reconnected hence the discontinuity in the signal shown in the graph.

Modifications: To achieve the required pressure of 99 Bar, the pressure relief valve at the pump head was adjusted by Water Hydraulics on behalf of the client.

Outcome: There was no leakage or damage evident during the 15 minutes run time.

4.4 Pump Skid Running at 1.1 Times of the Maximum Specified Working Pressure (110 Bar for 5 Minutes Duration)

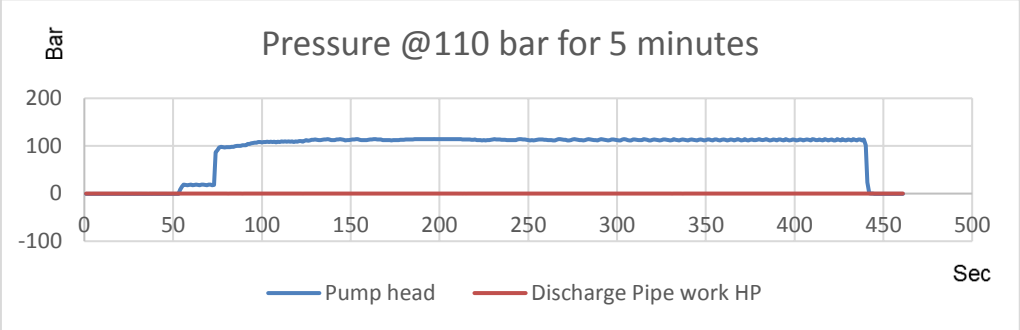
Description: The pump skid was running continuously at 1.1 times the maximum working pressure (as specified by the client) for 5 minutes.

Photograph 20 shows the timing of the trial. Photograph 21 shows the pressure gauge of the pump skid unit during the trial.

Photograph 20

Photograph 21

Graph 12 shows the recorded pressures at the pump head and discharge pipe work for the high-pressure line, which were monitored and logged by the pressure transducers detailed in this report.



Graph 12

Modifications: To achieve the required pressure, the pressure relief valve at the pump head was adjusted by Water Hydraulics. The pump skid unit was blanked off at the discharge pipe line (high pressure).

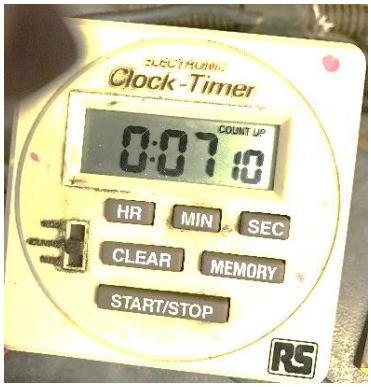
Outcome: There was no leakage or damage observed during the 5 minutes run time.

4.5 Check of the Invertor

Description: The invertor was run through a series of cycles at differing frequencies and the pressure the system pressures were monitored, Graph 13. The pressure relief valve of the pump skid unit head was re-set prior to the start of the sequence.

- Initial step; the frequency of the invertor set to the original 53Hz, refer to the first three peaks of Graph 13.
- The frequency was then increased to 60Hz and the run for 7 minutes; refers to the fourth peak in the Graph 13.
- Final step; the frequency was dropped back to 53Hz, the sample was run for a further 7 minutes, refers to the fifth peak of Graph 13.

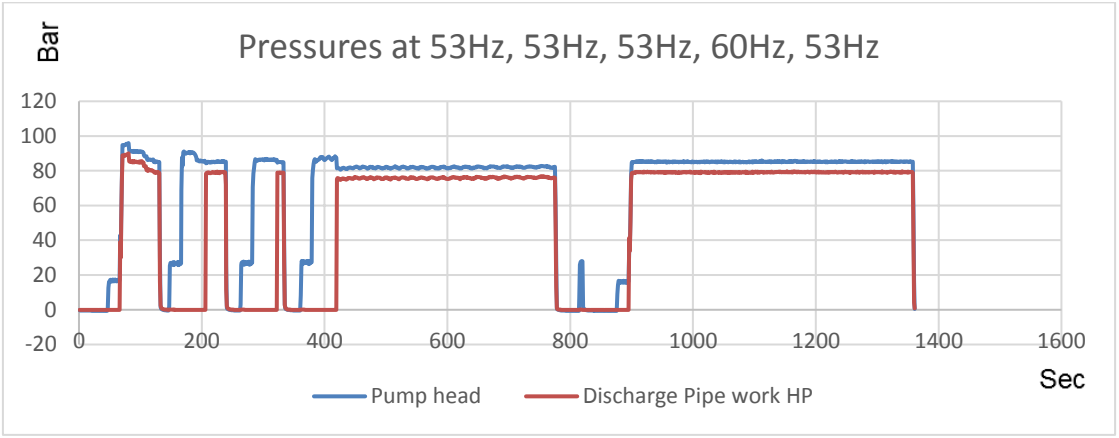
Photograph 22 shows the timing of the trial. Photograph 23 shows the pressure gauge of the pump skid unit during the trial.



Photograph 22

Photograph 23

Graph 13 shows the recorded pressures at the pump head and discharge pipe work for the high-pressure line, which were monitored and logged by the pressure transducers detailed in this report.



Graph 13

Outcome: No leakage or damage was observed from the unit during the invertor cycles.

5 Summary

This report states the facts from the findings of the trials programme as detailed above.

This report does not constitute an approval, certification or endorsement of the product.

Report Ends