Project

MEGASTACK: Stack Design for a Megawatt Scale PEM Electrolyser

JU FCH project in the Seventh Framework Programme
Theme: SP1-JTI-FCH.2013.2.3
Grant Agreement No.: 621233

D 5.3 Report on performance of the prototype short stack, including long term durability data and lifetime prediction

Nature of the deliverable	: Report
Associated Work Package(s)	: WP5: Large Scale Stack Prototype and Testing
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Content

1. Introduction

Below is a summary of the first 10 cell stack built for simulated real life conditions. The stack build procedure is documented in D5-2. Sensitive data has been removed from all graphs as this is a publicly available document.

Testing covered in this includes continuous operation for over 100 hours, and cyclic testing using a profile developed from the a different EU project. I-V curves were taken at start of life and end of test to look for any degradation, these are shown for comparison but the voltage values removed due to the sensitivity of the data.

After completing 100 hour tests using the project agreed CCMs it was decided that the engineering goals of the project had been achieved. Further testing was carried out using ITM developed CCMs noting significant performance and current density values. This testing is still ongoing in ITMs test labs.

2. Operating conditions and data logged in tests

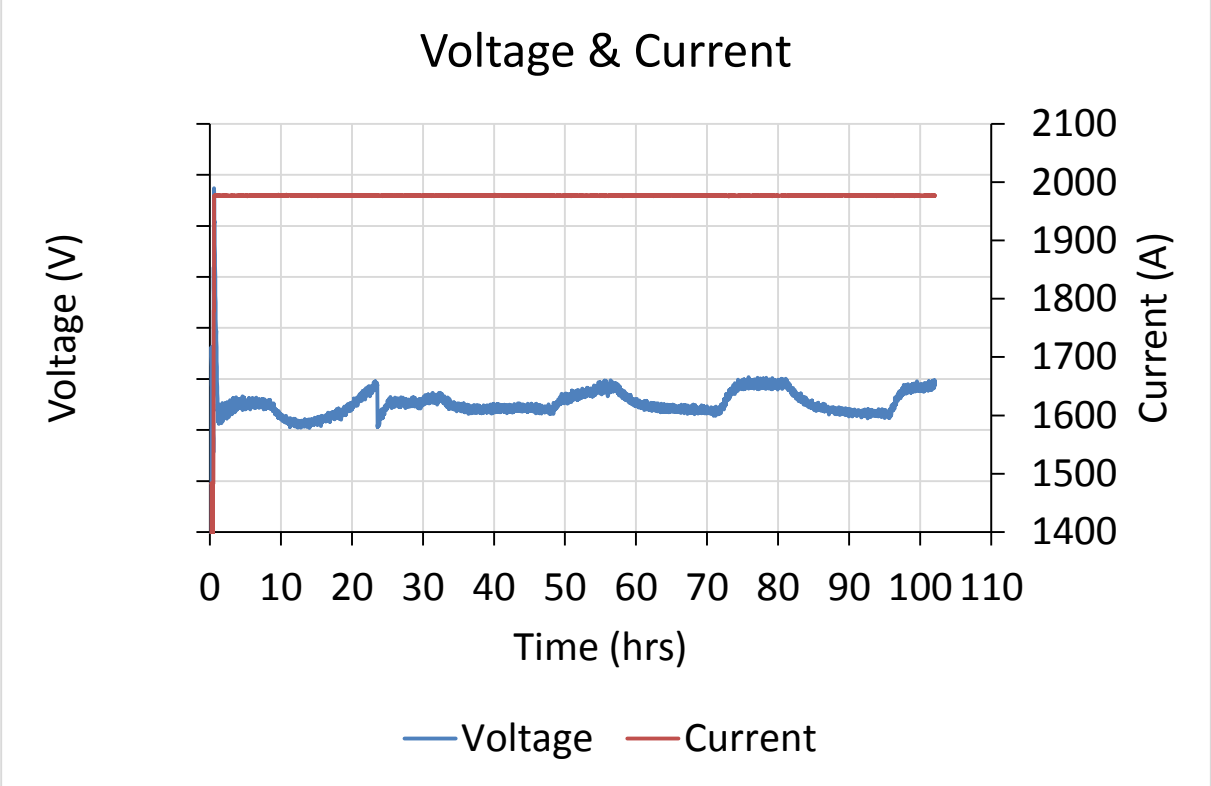
The following conditions were selected for performing real life conditions verification

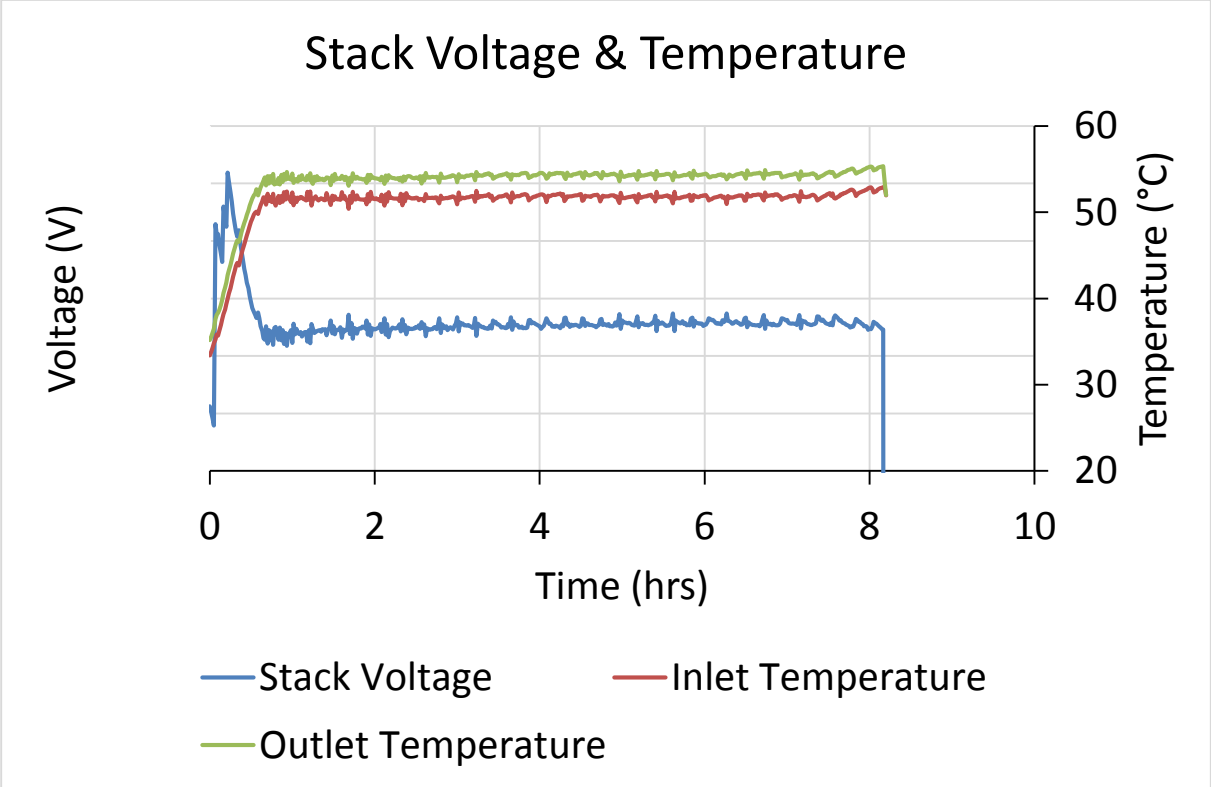
Parameter	Value
Operating current	0.1 – 3.0 Amps/cm²
Cathode (hydrogen) pressure	20 bar (pressure tested to 34)
Temperature	Limited to 60°C (self-heating)
Anode cell water flow rate	1.5 m³/hour

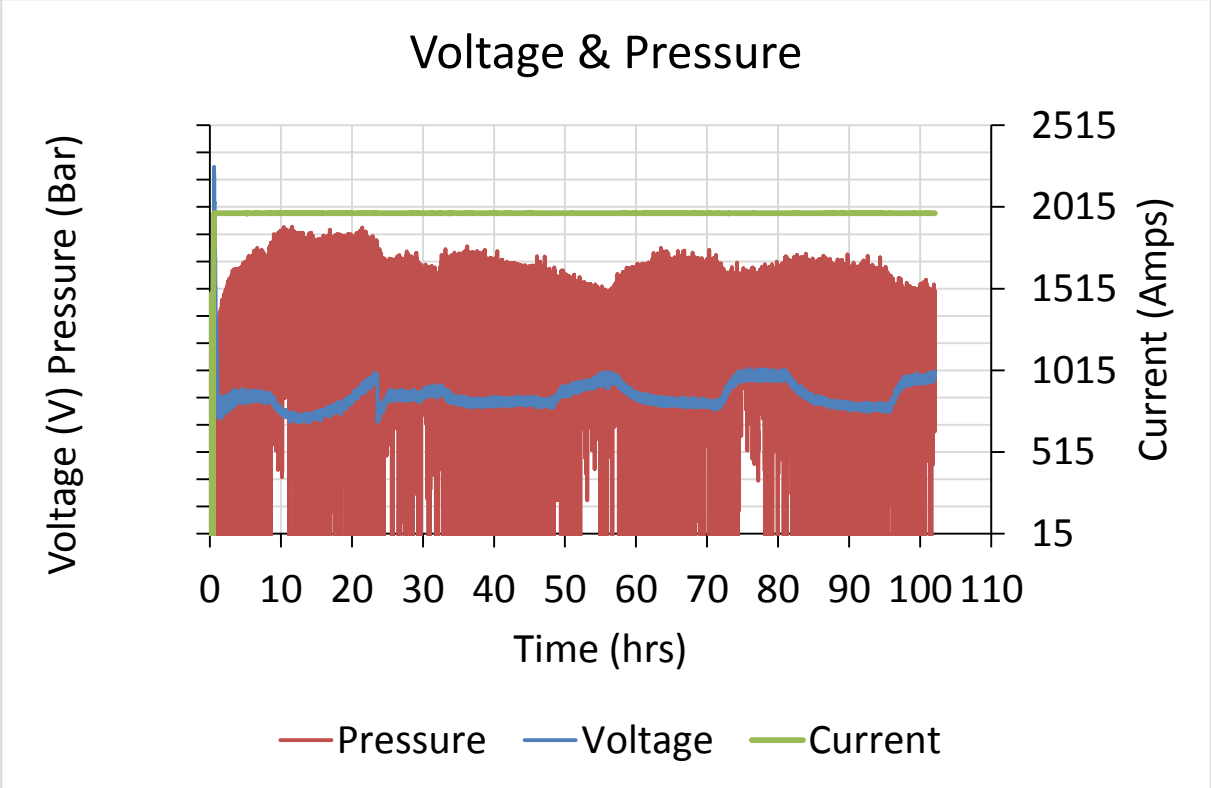
The following parameters were data logged at 5 minute intervals throughout the all tests

Parameter	Unit of measurement
Stack Current	Amps
Stack Voltage	Volts
Anode inlet temperature	°C
Anode outlet temperature	°C
Hydrogen pressure	Bar
Hydrogen in oxygen	%

3. Data gathered (project CCM) – Continuous running

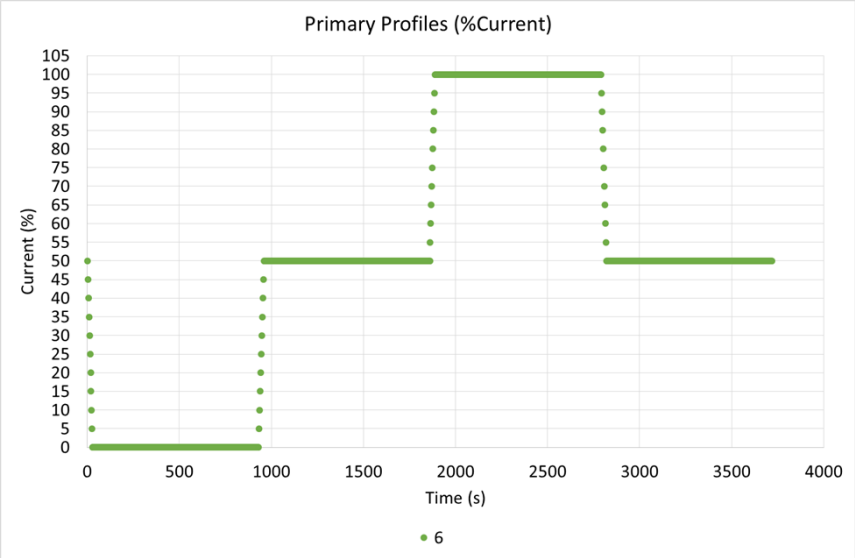


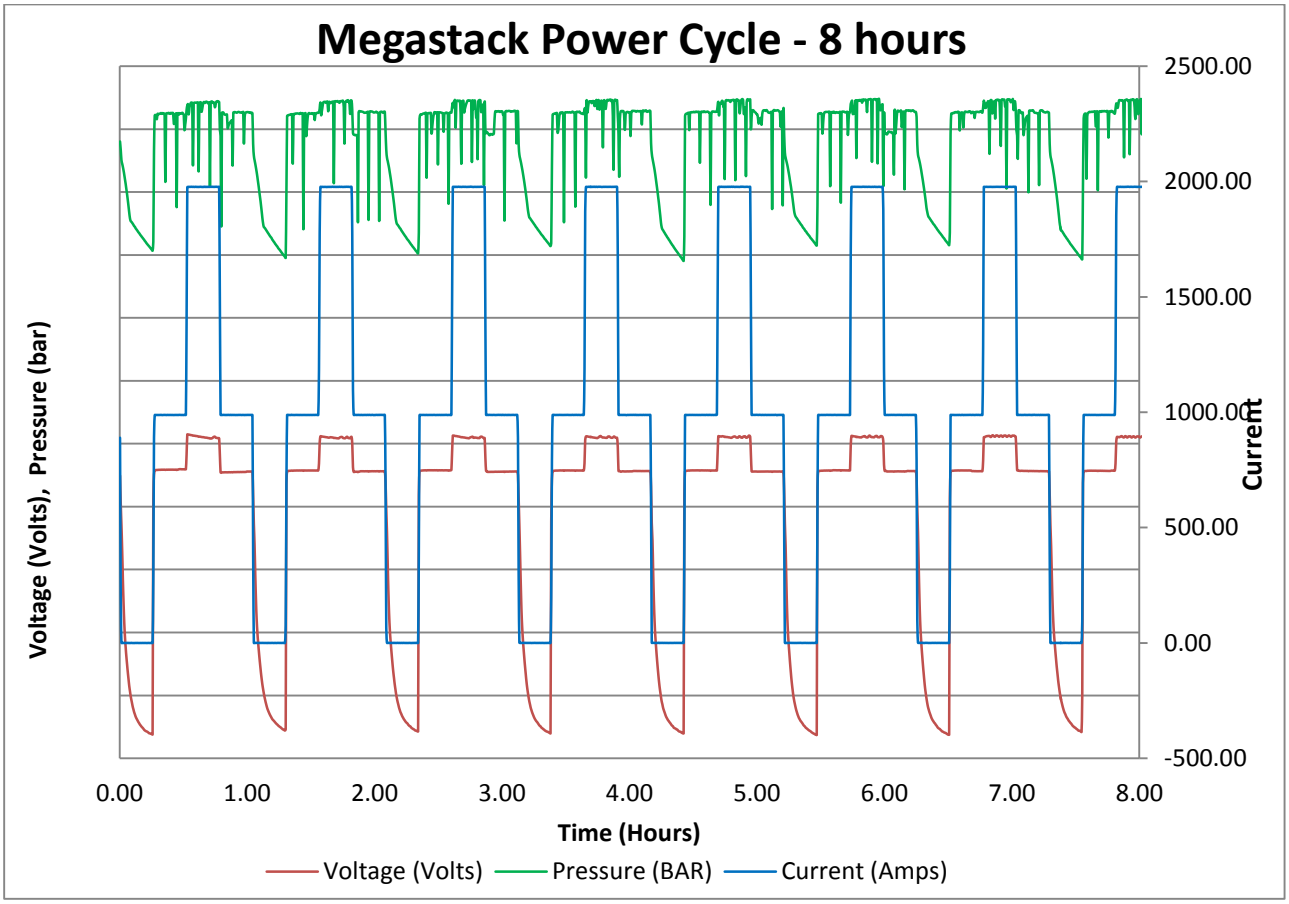


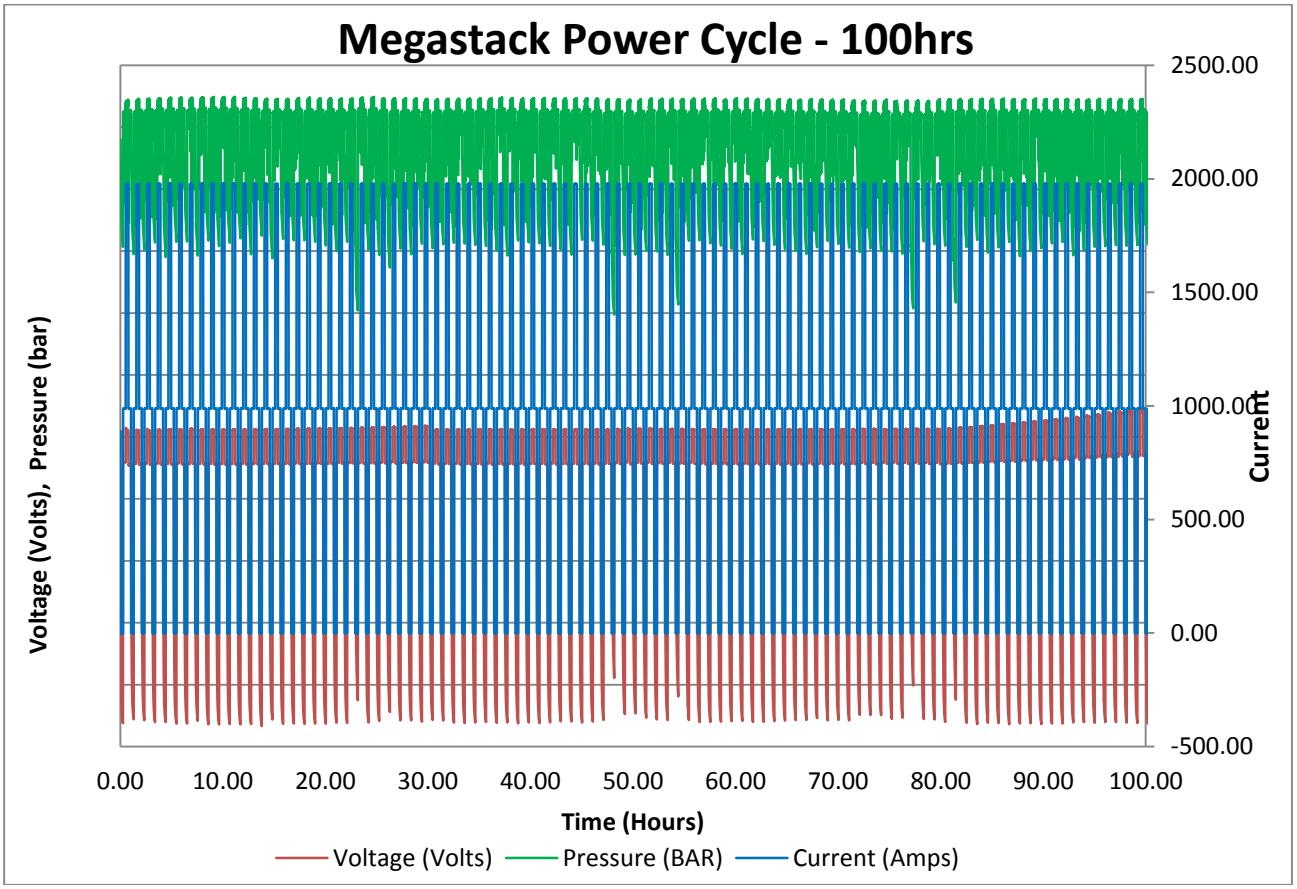

Voltage & Pressure
Voltage (V) Pressure (Bar)
Current (Amps)
2515
2015
1515
1015
515
15
0 10 20 30 40 50 60 70 80 90 100 110
Time (hrs)
Pressure
Voltage
Current

4. Data Gathered (project CCMs) – Cyclic Running

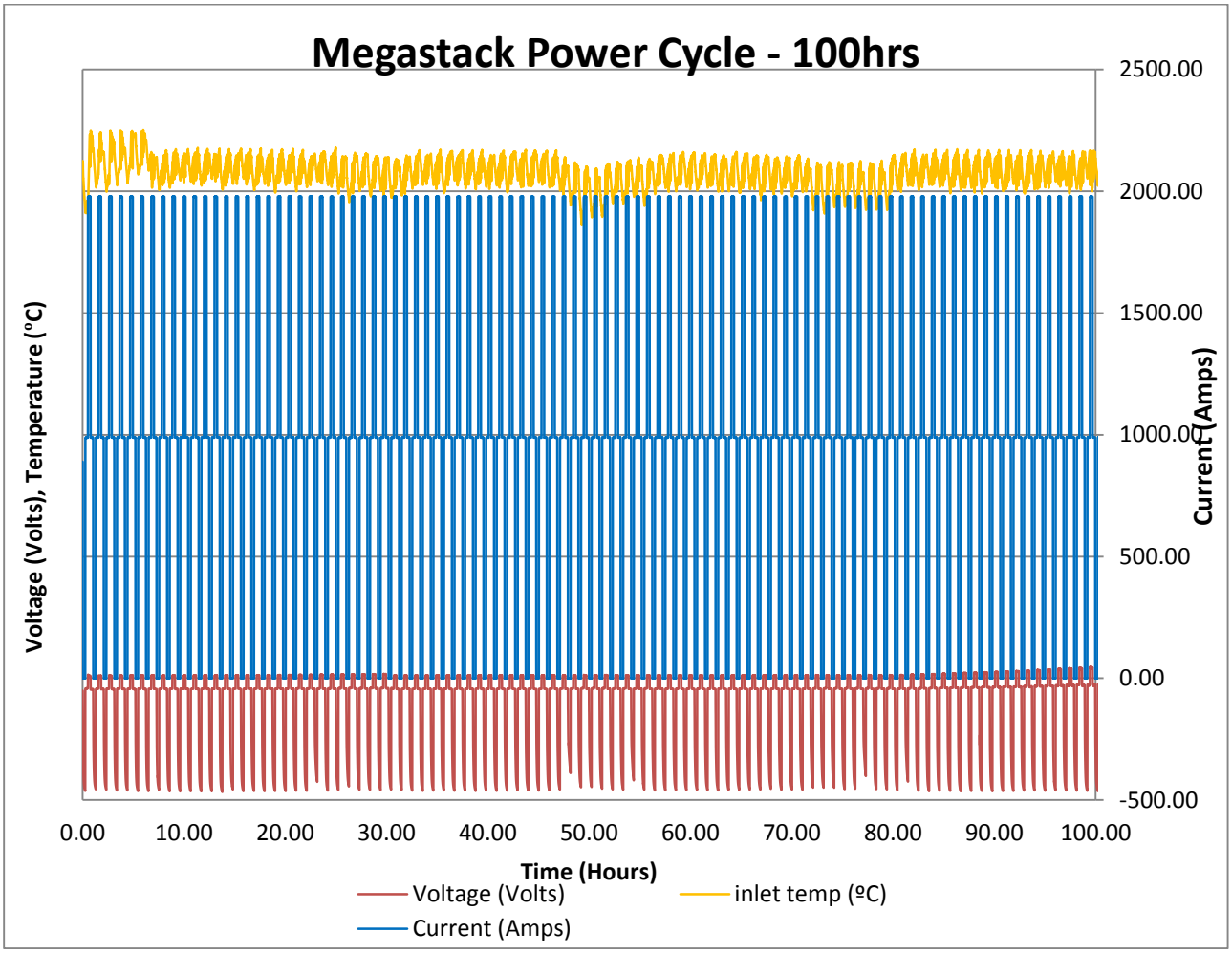
The profile shown below was developed as part of the in house development and reused for MEGAStack



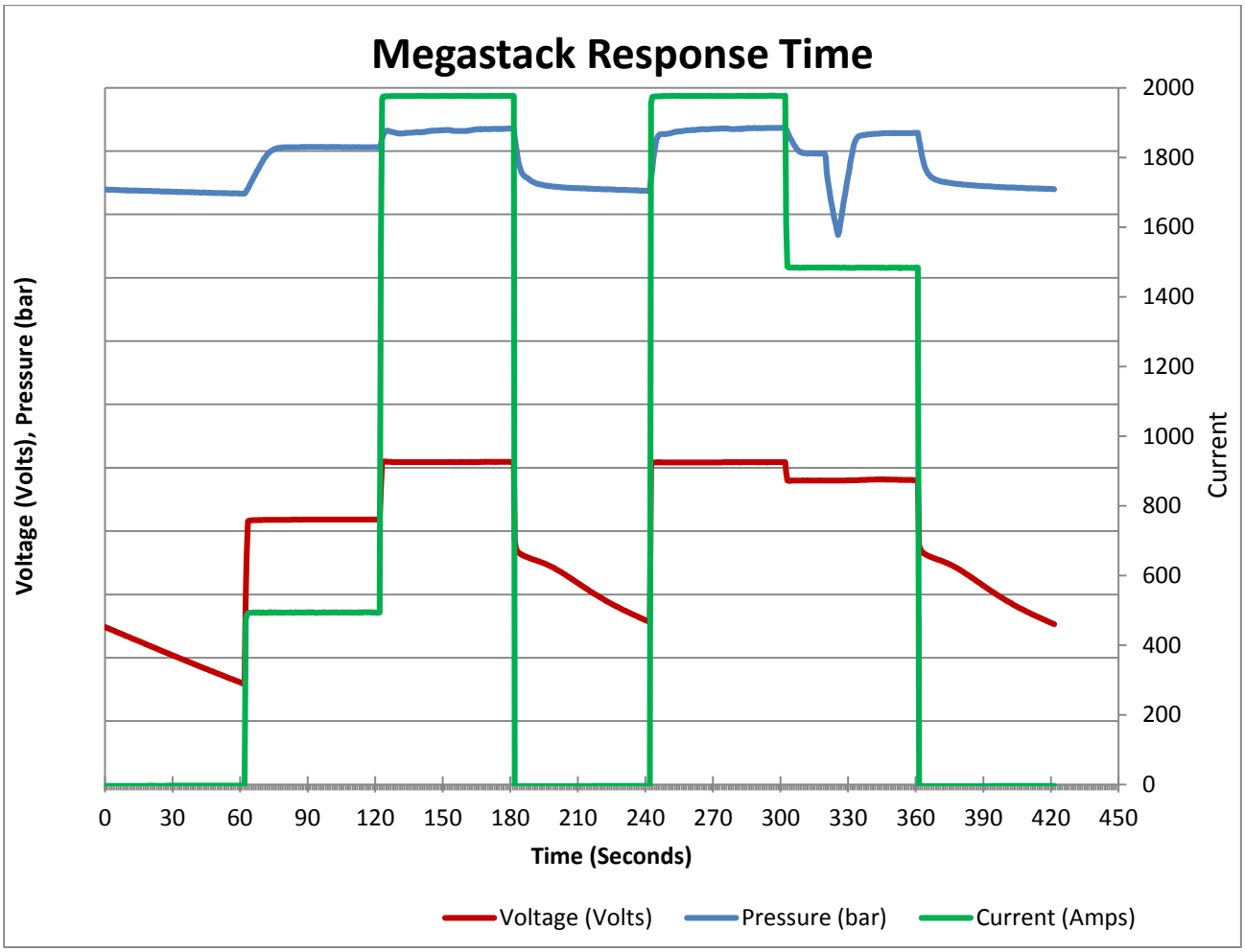




Voltage rise was noted in towards the end of the test due to external a plant issue controlling the contact pressure. This voltage rise was reversible after modifications to the BoP were made and were considered to be due to the early stage of testing. As the stack was removed to correct these issues it was decided to be a good stage to swap to ITM developed CCMS reported in sections 6 and 7

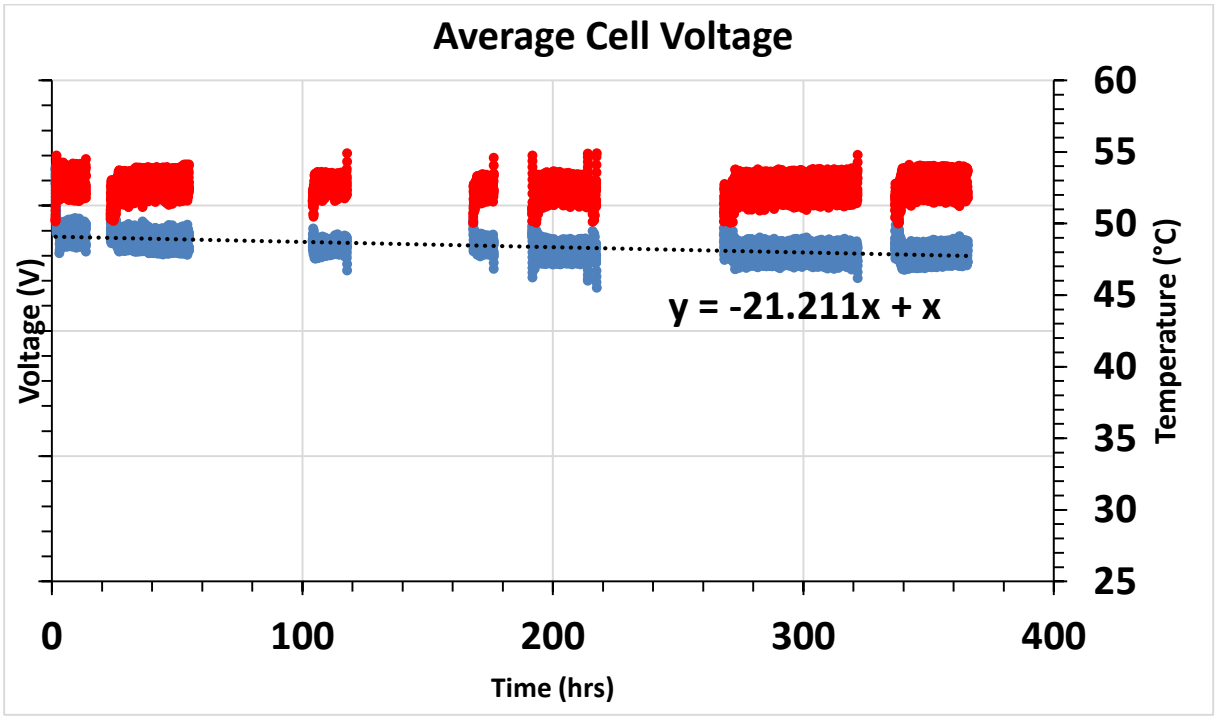

Megastack Power Cycle - 100hrs
2500.00
2000.00
1500.00
1000.00
500.00
0.00
-500.00
Voltage (Volts), Temperature (°C)
Current (Amps)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
Time (Hours)
Voltage (Volts)
inlet temp (ºC)
Current (Amps)

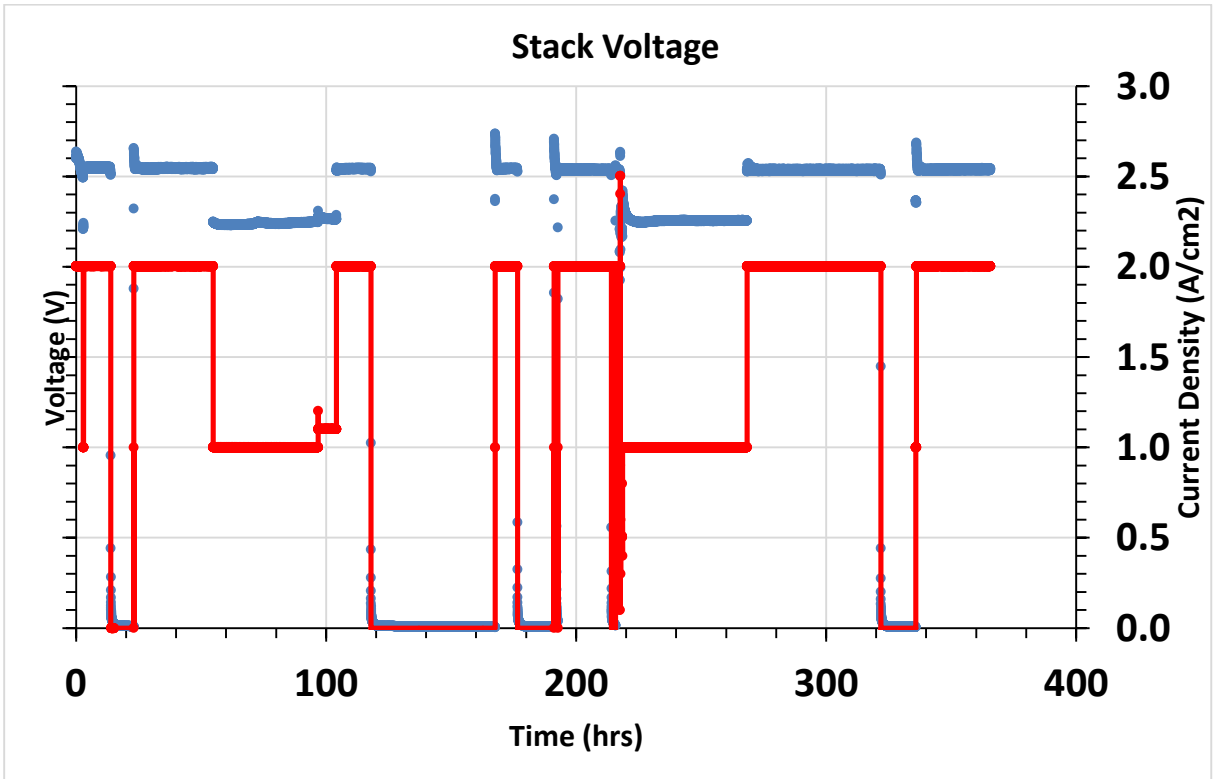
5. Data Gathered (Project CCMs) – Rapid Response



6 Data Gathered (ITM CCMs) – Longevity

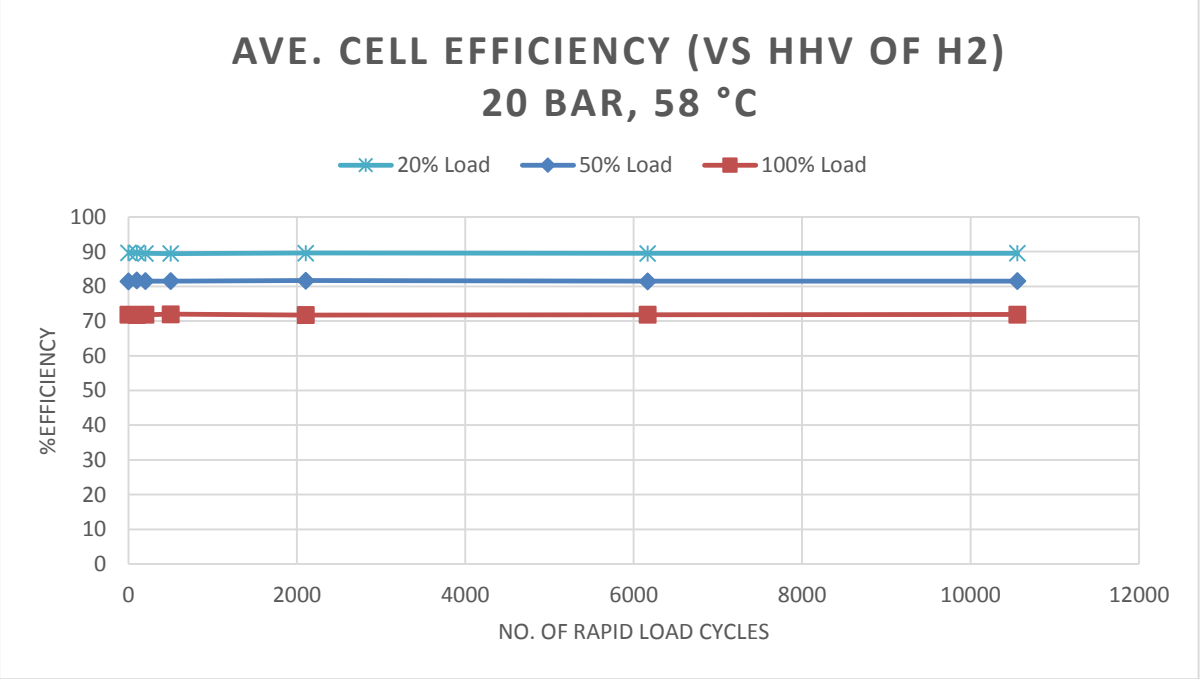
A 400 hour constant running test was carried out (shut down caused by lab issues) where a voltage decrease was measured. Higher current density was also achieved

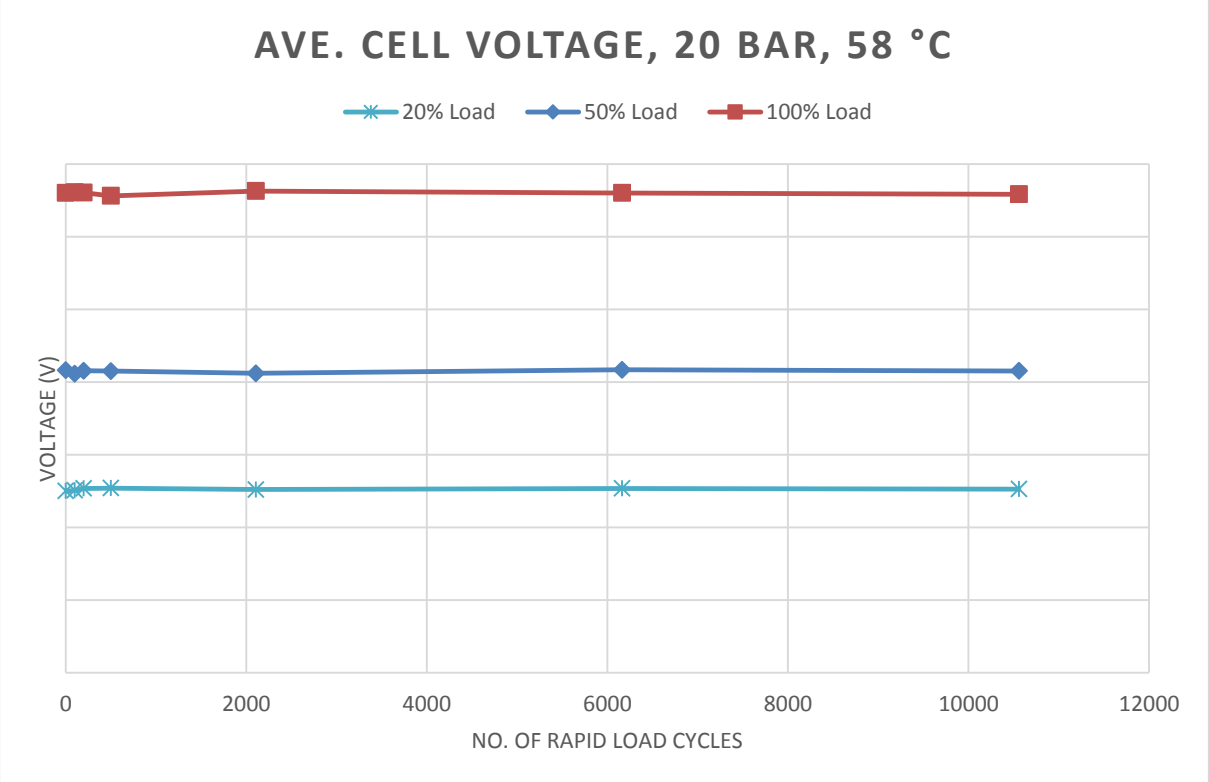


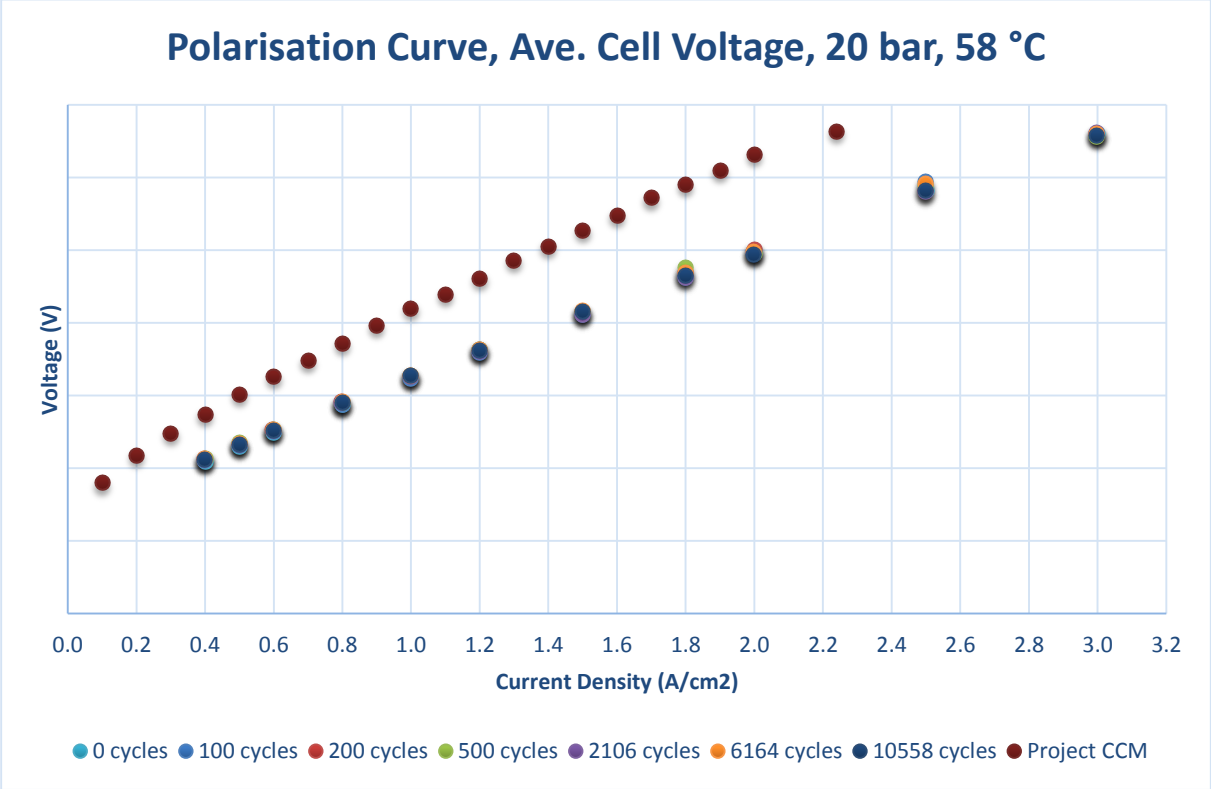


7. Data Gathered (ITM CCMs) – Rapid cycling

As part of ITMs on going lab testing a (commercially sensitive) cyclic accelerated stress test has been developed. Data from other testing has proven that system membrane degradation can be observed from this testing.







8. Conclusion

The system successfully completed all tests without issue. When compared to existing ITM technology (commercially available LEP systems) the results were comparable. The goal of 1.8 A/cm² was passed with most data collected at 2 A/cm²

Further testing with ITM CCMs has shown that the platform responds in the same manner as ITMs commercially available CCMS and that MegaStack is capable of exceeding its current density targets.