Improved Statistical Ratings for Distribution Overhead Lines (Phase 2)

Quarterly Report; September 2016

Date: 12 September 2016

Version History

Date	Version	Author(s)	Notes
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Final Approval

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EA Technology Limited, Capenhurst Technology Park, Capenhurst, Chester, CH1 6ES;
Tel: 0151 339 4181 Fax: 0151 347 2404
http://www.eatechnology.com
Registered in England number 2566313

Summary

This third Quarterly report for the Improved Statistical Ratings for Distribution Overhead Lines (Phase 2) project at the Western Power Distribution (WPD) Stoke site provides an update of operation since the last Quarterly Report published in June 2016.

The Overhead Line (OHL) conductor test-rig has been formally operational since January 4th 2016, and in a predominantly stable condition throughout the first six months of operation with only a small number of issues arising. Where any issues arose, they have been addressed swiftly by the EA Technology project team, with support and guidance from Project Sponsor, Sven Hoffmann, in order to maintain the stable operation of the rig.

However, a major incident occurred at the test rig site, WPD Stoke at 19.14hrs on Friday 3rd June 2016. During this incident, a critical piece of operational equipment (Power Factor Correction Unit) suffered a catastrophic failure and as a result a brief, localised, self-extinguishing fire developed within the test rig porta-cabin.

Further details of the fire fault incident and the associated reparation process are provided in the Project Summary Activity Log section of this report.

Contents

Appendices

1. Project Activity List

The table below illustrates the current status of the activities aligned with Key Deliverables of this project which attempt to ensure continued, uninterrupted operation and timely completion:

Activity / Project Deliverable		Item Description	Status
1	Test-rig Running and Maintenance	Operation and Management Plan	Complete. However, this is a "live" working document: therefore, the appropriate reviews, amendments and additions are made as the project evolves.
		Decommission Plan	Started but incomplete.
2	Data Entry Checking and Validation	Data Collection and Validation Method Statement	Complete
3	Data Collection and Validation	Data Download Tool	Complete
4	Data Analysis	Data Analysis Method Statement	In Progress
		Data Analysis Tool; OHRAT & OHTEMP Functionality	In Progress
		Data Analysis Tool; C-T Curve Production Capability	In Progress
		Data Analysis Tool; Ability to incorporate LDC	In Progress
		Validation of CIGRE Methodology	In Progress
5	Year One	Year One Data Collection Completion	Not Started
		Year One Interim Report	Not Started
6	Year Two	Year Two Data Collection Completion	Not Started
		Year Two Interim Report	Not Started
		Update ACE104 and ENA ER P27	Not Started
		Decommission Test-rig	Not Started
7	Integrated Software Tool	Specification Developed	Not Started
		"Beta"/Test version of software released	Not Started
		Final Release of Software	Not Started
8	Project Conclusion	Final Project Report Complete	Not Started

1.1 Test-rig Running and Maintenance

A "live" Test-rig Operation and Management Plan (TOMP) has been developed by the EA Technology project team to ensure the successful operation and optimal evolution of the Overhead Line (OHL) rig at Western Power Distribution (WPD) Stoke. The current version of the TOMP comprises a list of all items that need consideration aligned with:

- Appropriate OHL rig spares, suppliers and delivery lead times.
- Performance feedback monitoring mechanism.
- External component performance support.
- Scheduled EA Technology review meetings.
- Appropriate level of approval.
- Appropriate resources to perform each task
- Appropriate Risk Assessments & Method Statements (RAMS).

Additional documents were produced during the development of the TOMP, and include:

- Outstanding Task List for the Test-rig.
- Reactive Maintenance Strategy.
- Maintenance Inspection Check-sheet.
- Calendar of Scheduled Events

The **Outstanding Task List for the Test-rig** provides a contemporary record of the ongoing project management status that enables prioritisation and forward planning of tasks. An extract of current "live" tasks is shown in Appendix I.

The **Reactive Maintenance Strategy** was formed to minimize down-time and enable efficient response and deployment of resources (Shown in Appendix III).

The **Maintenance Inspection Check-sheet** was composed to ensure that a suite of preventative maintenance activities was performed during site visits to improve rig performance and component service-life longevity (Shown in Appendix IV).

The **Calendar of Scheduled Events** was produced, and is coupled with the electronic calendar of the Test-rig Manager, in order to ensure timely planning and execution of significant development or operational activities (Shown in Appendix V).

EA Technology has made a significant number of scheduled and reactive visits to the Test-rig site since commencement of data collection in order to progress task completion and improve rig performance.

Remote monitoring systems, including web-cams, sensory threshold alarms and remote isolation apparatus, have been incorporated into the test-rig control system and continue to assist the EA Technology project team in trying to prevent component failure and mitigate unnecessary down-time.

All activities to date have facilitated improvements in the quality of the test-rig management processes, documentation and performance.

1.2 Data Entry Checking and Validation

A specific **Data Collection and Validation Method Statement** has been produced and is available to view separately to this quarterly report. An automated data validation method is now in place. However, manual data validation is still being carried out in parallel.

Since commencement of this project phase, the data is being downloaded and processed daily. Additional monthly tasks are also being carried out as the overall operation of the data logger is more reliable and consistent. Details of these additional tasks are stated within the **Data Collection and Validation Method Statement.**

A spreadsheet has been created to enable checking of daily data, and validates the "sanity" of the data collected each day. The raw data is imported into a "checkdata" file which prepares Graphs displaying a number of parameters. These parameters include:

- Behaviour of thermocouples
- Wind variation
- Power supply behaviour (graph of voltages to highlight any trips)
- Solar radiation
- Overall rig operation

Automated data validation software is in place which processes daily automatic data downloads and validates data accuracy. Any data variation from set parameters is notified to project team via email.

1.3 Data Collection Download Tool

The EA Technology Software Team commenced the initial development stage to automate the data checking for this particular aspect of the project during week commencing 7th March 2016. This was completed in June 2016 and performs automated daily checks including:

- Number of data points collected
- Comparison of key measurement parameters with pre-defined acceptable values to detect faulty measurement equipment or unexpected conditions (usually by comparison with minimum, maximum, mean and standard deviation over a day's measurement).
- Comparison of key rig operation parameters with pre-defined acceptable values including voltage, current and temperature to detect unexpected operating conditions

The output of the data collection tool is reported in a number of ways:

- Automated emailing to key staff to report unexpected conditions
- Saving of check results for manual inspection and visualisation. This allows identification of trends which is not possible by software alone
- Saving checked data as separate Excel and csv files for data analysis

2. Project Summary Activity Log

The Overhead Line conductor test-rig has been formally operational since January 4th 2016, and had been in a predominantly stable condition throughout the initial six-month period of operation with only a small number of issues arising since initial "switch-on". Where any operational issues had arisen, they have been addressed swiftly by the EA Technology project team, with support and guidance from Project Sponsor, Sven Hoffmann, in order to maintain the stable operation of the rig.

However, a major incident occurred at the test rig site, WPD Stoke at 19.14hrs on Friday 3rd June 2016. During this incident, a Power Factor Correction Unit suffered a catastrophic failure and a brief, localised, self-extinguishing fire developed within the porta-cabin. No personnel were on site at the time of the fire, hence there were no personal injuries and there was no operational or reputational impact to WPD from the resultant fire damage. The fire alarm panel and test-rig monitoring equipment inside the porta-cabin ensured that the automatic trip protection operated appropriately.

Temperature data downloaded at the time of the fire incident is shown below;

- At 19:13h on Friday 3rd June 2016 hut temperatures (Thut1 & Thut2) were 32°C and falling.
- 19:14h Thut1 at 29.4°C but Thut2 measured 43.5°C; test-rig supply tripped automatically.
- 19:17h Thut1 at 41.2°C, Thut2 at 126.8°C.
- 19:20h Thut1 at 57.9°C, Thut2 at 52.3°C and both falling.

Fortunately, the fire was contained to the immediate area of the faulted equipment, although the rig porta-cabin suffered extensive smoke damage (see photographic images below). Whilst the amount of smoke damage from the resultant fire was extensive, the outcome from the fire was not catastrophic and was considered recoverable. Approximately two months of operating time has been lost due to this fire incident (June 3rd to 5th August), although it is worth noting that an immense amount of hard work and dedication by the EA Technology project team, meant that the test rig essentially became operational again on the 5th August 2016. This resulted in approximately two months of data not being collected during the fire reparation process. A full Fire Incident Fault Report is included in Appendix I of this quarterly report.

EA Technology project staff visited the test-rig site on numerous occasions during the fire reparation stage to perform clean-up operations and repairs to various items of equipment within the porta-cabin. A number of components were removed and transported back to EA Technology's workshops at Capenhurst, for intensive cleaning and testing. The power supply units underwent their first manufacturer's servicing during this period. The Power Factor Correction Unit enclosure has been modified from the original specification and is now contained within two bespoke ventilated metal enclosures, with higher rated components. A number of other precautionary measures have also been instigated for preventing a reoccurrence of a similar fire incident.

Prior to the fire incident and following the subsequent reparation process the test-rig monitoring data logger (DT-85 Datataker) had been exhibiting brief intermittent operational lapses. Consequently, short "pockets" of data had been uncollectable. The ongoing management of the Data Logger issue has been dealt with as a priority by the team, resulting in multiple software amendments, episodes of hardware testing and component replacement, all assisted by the equipment manufacturer and UK distributor (Grant Instruments and OMNI, respectively).

EA Technology staff have attended the test site on numerous occasions since the 5th August to reset the logger and progress fault-finding locally whilst assisted remotely from Capenhurst. The issues with the Data Logger appear to have been resolved following installation of a new IP Power switch installed on 8th September 2016. At time of publication of this quarterly report, the OHL test-rig is fully operational and the data logger and all ancillary devices appear to be in a stable condition.

Further details of the fire fault and data logger reparation process are shown in the table below.

Figure 1 General view inside Porta-cabin 7th June 2016

Figure 2 Fire damaged Power Factor Correction Unit 7th June 2016

Figure 3 Porta-cabin following reparation work 5th August 2016

Figure 4 New/repaired test rig components 5th August 2016

A post fire fault/Data logger timeline of activity is illustrated in the table below;

Date	Personnel	Action	
03/06/16	N/A	Fire occurs within test rig porta-cabin at WPD Stoke at 19.14	
07/06/16	PT/JDC	Post-fire visit to assess damage and commence clean-up operation.	-
13/06/16	All	Post fault project meeting held at EA to establish best course of action	
22/06/16	PT/NJH	Site visit to continue various reparation tasks	-
23/06/16	PT/NJH	Site visit to continue various reparation tasks	-
30/06/16	SG	Take PSUs to REO	-
05/07/16	PT/RG	Site visit to continue various reparation tasks	-
06/07/16	PT/JK	Site visit to continue various reparation tasks	-
06/07/16	REO	Inspection and Service of all 5 PSUs	
15/07/16	AJ Electrics	Complete the replacement of Fire Alarm smoke detector and perform Fixed Electrical Installation Inspection (Retest was originally due: 06/03/16)	-
18/07/16	PT/JDC/JK	Commence testing of PSUs, IT 1 & 4 and all new ancillary control modules at Capenhurst	
w/c 25/07/16	PT/JDC/JK	Transport all equipment to Stoke and re-commission.	-
w/c 01/08/16	PT/JDC	Final re-commissioning tasks performed (2nd & 4th Aug). Rig fully re-commissioned and logging data as of COP 04/08/16.	-
8/08/16	NJH	Restart Datataker logger at Stoke	-
10/08/16	NJH	Restart Datataker logger at Stoke	-
15/08/16	MPB/NJH	Restart Datataker logger at Stoke w/ tele-assistance from OMNI: OMNI claim that the internal main battery is the most likely cause of the fault. I discussed issue w/ Steve (Omni) on phone…. Awaiting response.	-
17/08/16	NJH	Restart Datataker logger at Stoke	
22/08/16	PT	Received pre-programmed DT85 from Omni. Went to Stoke and replaced 'suspect' unit. Replacement unit logger appears susceptible to the same fault as the 'suspect' DT85. Discussed w/ Omni and Mark (Grant Instruments). Andy and Mark (GI) will scrutinise programme line-by-line during next 2 days. Comms w/ DT85 intermittent/unreliable, therefore, the PSUs to the OHL rigs were not energised.	-
26/08/16	PT	Solo visit to Stoke at request of OMNI. Rebooted 'loan' logger successfully. Andy Omni remotely cleared the existing program completely and all old data from logger. He suspects that: • The existing program may have been causing stoppage of the command screen • The latest firmware version may have also contributed to problem	

		Andy then loaded new modified program and monitored for an hour or so. Andy (OMNI) is going to: • Discuss the issues again with Datataker/Mark (Grant Instruments) today • Monitor the logger remotely during the next 2-3 days (There is no bank holiday next week in Scotland). As the comms w/ DT85 were intermittent/unreliable the PSUs to the OHL rigs were not energised.	
03/09/16	RA	• Reboot logger • Install new Ethernet s/w • Confirm all LAN/comms cabling between Ethernet s/w, logger, wifi and PC • Install temp. DC supply feeding Squirrel to test supply voltage stability • Photograph all connections for records	
08/09/16	MB	• Installed a new power supply adapter to the Datataker DT85-3 logger. • Installed the new internet based Power Cycle Box to the Data logger, to restart in case it crashes • Checked and confirmed the operation of the power cycle box • Turned the rig power supplies back on. • Ramiz A confirmed access to logger remotely.	
09/09/16	MB	• Logger has run without problem since yesterday's installation of IP Switch/ Power Cycle Box (PCB), and replacement of logger power supply.	
Personnel involved in site reparation process above		MB; Mark Bertinat RA; Ramiz Ahmed PT; Pete Thompson JDC; John Crabtree JK; Josh Kane NJH; Nick Hiorns (all above from EA Technology) REO; Steve Hughes (REO is an original manufacturer of high quality power equipment, including electronic controllers, components and electrical regulators) AJ Electrics; Electrical Installation Test and Inspection company OMNI; Andy Philpott/Steve Duncan (Omni Instruments Ltd. specialises in providing measurement and data acquisition products)	

In order to prevent recurrence of the recent fire fault incident, the rig monitoring and control equipment has been re-designed to reduce the likelihood of overheating:

- Two control transformers have replaced the original single unit; each running well below their maximum rating.
- Plastic component enclosures have been replaced with metallic alternatives.
- Air flow and powered ventilation has been increased significantly, and steel flooring sections positioned beneath the majority of rig-control equipment.

The power factor correction unit consisted of a transformer to step up the rig voltage (from about 10V) to drive conventional metal can power factor correction capacitors, with a fuse on the low voltage side. The capacitors have an overpressure disconnect function and were not fused. The components were all within their ratings, and the enclosure was in a cooling forced air flow from an adjacent fan. It appears probable that the transformer overheated and failed, as no capacitor had self-disconnected. The single unit has been replaced with a pair of metal, ventilated units with a higher margin from operating to nominal ratings and separate fuses on transformer windings. The post-injection PFC is only used on the 500A circuit to reduce current drawn from the highest loaded injection transformer towards that on the other circuits. All circuits have pre-injection PFC capacitors to reduce current load on the motorised variacs.

Conductor thermocouples have continued to work effectively since the OHL rig went live in January 2016 and as stated in previous quarterly reports, one thermocouple suspected of malfunction had been replaced as a precaution. To date, this has been the only issue associated with thermocouple performance.

The automatic daily data download procedure had been working well prior to the fire incident, with automated data checking in place. It is hoped that now the test rig is operational following the fire incident, the overall performance will be settled and the project team can continue updating the parameters that need to be monitored for reliable operation.

A back-up independent alarm and automatic trip system, incorporating an Eltek Squirrel data logger, has been installed in addition to the primary automated alarm function hard-wired into the DT-85 Datataker logging system.

All ambient sensors (i.e.: temperature, wind, sunshine, rainfall) are noted as continuing to work well.

Modification of OHTEMP to incorporate new CIGRE equations continues to progress (OHTEMP2).

A summary of the most significant issues attended to since data collection commencement was collated and is shown below:

Start Date	Issue Description	Date Resolved	Action and Consequence
23/12/15	Porta-cabin reached 30ºC during pre-start and project rig running operation.	24/12/15, 21/01/16	Ventilation methods improved including installation of additional 16" cooling fan adjacent to injection transformers, thermostatic controllers for existing extractor fans and two new floor vents.
04/01/16	Formal start of Project Phase 2 and operation of the OHL rig	04/01/16	N/A
19/01/16	Integrity of certain thermo-couples giving cause for concern	21/01/16	Thermocouple THUT1 behind PSU4 repositioned
19/01/16	Omni advised updating the logger's "firmware" to resolve potential reset instability.	10/02/2016	Complete. Changes in logger configuration and overall issues fixed. Logger operation stable
29/01/16	Minor mistakes discovered in the Logger Channels file	29/01/16	Updated version; logger channel 12a is now consistent with the current CONFIG and checkdata programs.
01/02/2016	Squirrel Logger Installed	10/02/2016	Backup Trip Alarm and Relay installed to complement existing logger trip circuit.
02/02/16	Logger stopped at 07.14am	03/02/16	Manually restarted: 26hrs of data lost.
05/02/01	Logger stopped at 20.35pm	06/02/16	Manually restarted: 14hrs of data lost.
10/02/16	Logger firmware updated	10/02/16	Fix firmware bugs, improved operational stability.
14/02/16	Logger stopped at 15.20pm	14/02/16	Manually restarted: 43hrs of data lost. Configuration issues resulting from logger firmware update. Fixed.
16/02/16	Power supply unit (PSU) 3 had ceased automatic regulation, consequently, the output voltage and current were tracking the line input	24/02/16	A repair was carried out by modifying the micro-switch assembly of the maximum limit switch. Modification rectified fault and method was approved by the manufacturer.
19/02/16	Conductor 14A peaked at 80degC at 08.00. It was noted there was no wind and low sun	ongoing	Monitoring of this situation, but nothing to report since this temperature excursion.

Start Date	Issue Description	Date Resolved	Action and Consequence
19/02/2016	Distributed thermocouples on 14A very variable e.g. 50 – 53 – 50 while TC15 reading 49	ongoing	Monitoring of this situation on regular basis
24/02/16	Successful modification of PSU 3 replicated in PSU 1, 2 and 4 following recent malfunction of PSU 3	24/02/16	Checked operation of motor to confirm symptoms were the same as PSU 3 and made mods on PSU 4. It was decided to perform mods on PSUs 1 and 2 also.
24/02/16	Logger reformatted	24/02/16	Logger reloaded with saved configuration to try and alleviate unexplained stoppages
24/02/16	One of thermocouple trio on 14A (rig1, circuit 4, Ash) reading low (-3K).	24/02/16	Replaced Thermocouple 13 with spare and now operating without incident.
4/3/16	Conductor current transducer correction factors rechecked – TCF4 found to be significantly lower than previously thought – now similar to TCF1-3.	8/3/16	Altered correction factors in checkdata (rather than altering logger config, so logger data are consistent)
22/3/16	Solarimeters sol1 & sol2 found to be reversed on logger	22/3/16	Added correction factors in checkdata (rather than altering logger config, so logger data are consistent)
5/5/16	Logger malfunctioned – lost a line of data	18/5/16	Ongoing discussions with DataTaker
8/5/16	Hut ambient temperature hit 40 degC – rig cut out	10/5/16	Additional ventilation added in hut and rig restarted
3/6/16	Power Factor Correction Unit failure and resultant fire	05/08/16	Significant reparation program (detailed earlier in this report)
16/08/16	Data issues with OMNI Logger	08/09/16	- Installed a new power supply adapter to the Datataker DT85-3 logger. - Installed the new internet based Power Cycle Box to the Data logger Rig restarted successfully and now fully operational

Appendix I Fire Incident Safety Report

Incident Safety Report Form

Incident Reference Number UK 16-17 08

Name of Person Reporting the Incident Richard Wood	**Contact Number** 2387
Business / Department HV5-9s / Asset Diagnosis	**Site** Capenhurst
Date and Time of Incident 03/06/2016 at 19:14hrs	**Location of Incident** Test Rig at WPD, Stoke

Incident Description

A fire occurred in the portacabin housing the OHL Conductor Temperature Monitoring Test Rig at WPD, Stoke.
The exact cause of the fire is not known but the most likely cause is thought to have been that the power factor correction unit overheated and set its plastic enclosure on fire.
It should be noted that the transformer was not running at its full rating and its enclosure had vents in it and there was a cooling fan over it. The transformer had been running continuously for about six months.

Root Cause; D4 – (Potential) Inadequate design	**Incident Potential;** 7 – Property damage

Learning / Actions to Prevent a Recurrence

A meeting was held on 13th June 2016 (attendees : Richard Wood, John Crabtree, Peter Thompson, Mark Bertinat, Greg Watson) to discuss;

- How to inform interested parties
- Cleaning up the portacabin
- Testing and inspection of equipment and circuits
- Replacement of damaged equipment and circuits.

In order to prevent a recurrence, the rig will be re-designed. Two transformers will be used instead of one, each running below their rating, to reduce the likelihood of overheating. The plastic enclosures will be replaced with metal ones, with vents. Measures will also be taken to improve air flow around the rig and prevent heat damage to flooring materials.

Health and Safety Adviser	**Print Name** Greg Watson	**Signature**	**Date**
Director Responsible for Safety	**Print Name** Anne McIntosh	**Signature**	**Date**

Accident / Incident Prime Cause List.

All causation factors should be considered in this order - no more than two should be assigned.

A. FAILURE TO ESTABLISH A SAFE SYSTEM OF WORK (SSOW).

1. Requirement not recognised.
2. Requirements recognised, but not put into place.
3. Inadequate consideration of the SSOW requirement.
4. Change taken place which had not been incorporated into the SSOW.

B. FAILURE TO FOLLOW A SAFE SYSTEM OF WORK (SSOW).

1. Did not know of the SSOW.
2. Did not understand the SSOW.
3. Understood the SSOW, but did not follow it.

C. FAILURE TO MAINTAIN A SAFE PLACE OF WORK (SPOW).

1. Requirement not recognised.
2. Requirement recognised, but no action taken.
3. Inadequate arrangements to maintain a SPOW.
4. Change taken place from original arrangements.

D. FAILURE OF EQUIPMENT OR MAINTENANCE SYSTEMS.

1. Inadequate maintenance requirements.
2. Inspections not carried out to specifications.
3. Wrong equipment for job.
4. Inadequate design and / or construction.
5. Wilful or accidental damage.

E. OTHER HUMAN FACTORS.

1. Inattention.
2. Distraction.
3. Rushing.
4. Illness.

F. OTHER CAUSES.

NOTE : - A to D to be fully considered before E and F.

Categories of Potential.

Consider the categories below. In your view, did the incident, however minor, have the potential to result in one of those listed? If so, enter the relevant category in the box provided. If not, enter 0.

1. Fatality
2. Major Injury
3. Over Seven Day Injury
4. Over Three Day Injury
5. Minor Injury
6. Notification to External Authorities.
7. Major Property Damage.
8. Environmental Impact.
9. Public / Media Attention.

Appendix 1

T7919 OHL Conductor Temperature Monitoring Test-rig at WPD Stoke

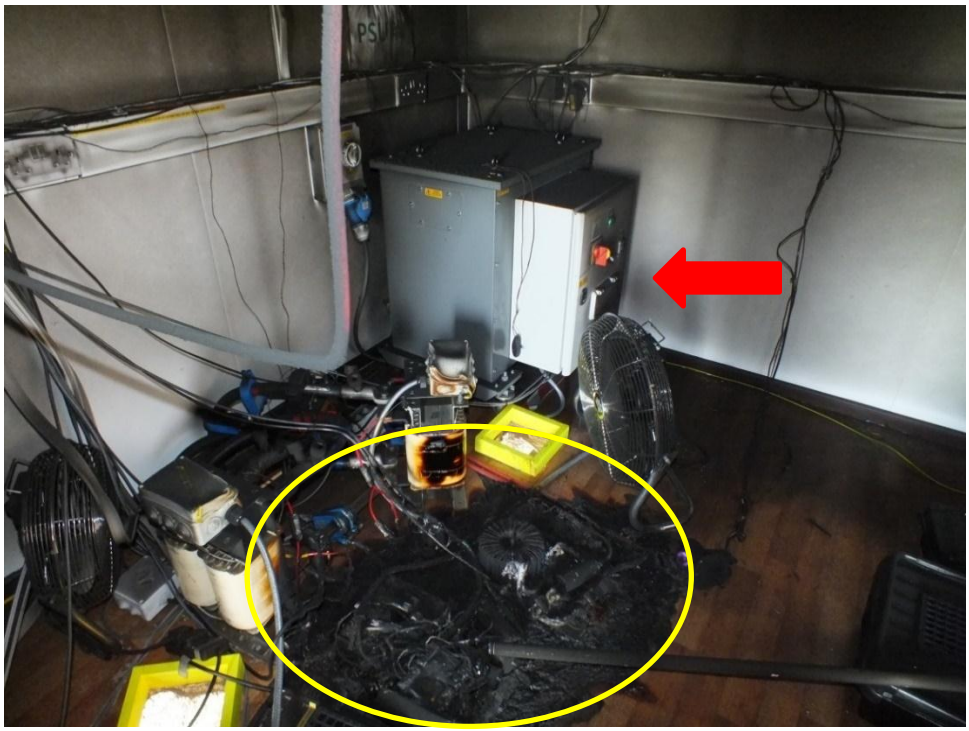

Figure 1 Location of fire within porta-cabin. Power supply unit (PSU) 4 indicated by red arrow.

Figure 2 Charred components co-incidental with origin of fire. Injection transformers 1 and 4 indicated by appropriate green numerals

The fire had originated within the rig 4 post injection transformer power factor correction enclosures that was positioned at floor level adjacent to injection transformers 1 and 4. Charred flooring material was localised co-incidental with the failure which covered a surface area of approximately 70cm x 70cm (**Error! Reference source not found.** and Figure 2).

- The most significant evidence of secondary thermal damage within the porta-cabin was as follows:
    - External surfaces of injection transformers 1 and 4 and associated termination boxes
    - Current and voltage transducers (CTs and VTs), associated LV cabling, thermo-couples, etc.
    - Webcams
    - Wall mounted cable trunking for fire alarm cabling and ceiling mounted smoke sensor
    - Ceiling mounted fluorescent light fitting(s)
    - Floor standing fan(s)
    - Wall mounted extractor fans and associated cabling, trunking, switches, etc.
    - Wall mounted file holder
    - Fire alarm sounder
    - Domestic 6-way RCD protected consumer unit
- There were significant levels of carbon deposits within the plug-top ports of all 240V 13A sockets that caused instant tripping to RCD protection when tried during commencement of initial clean-up operation.

Review of records:

It was previously recorded that the Fire Alarm sounder was enabled and the smoke-sensor-operated electricity supply trip had been tested for functionality on 24/02/2016 and had passed.

Reparation Actions:

The actions planned initially were:

- The fire extinguishers held within the porta-cabin were covered in soot deposits and should be inspected or replaced.
- All test-rig power supply control components should be installed within metal enclosures with vents in lids and bases.
- All test-rig power supply control components, including injection transformers, associated cabling, VTs, CTs, etc. should be positioned on top of a steel grill platform raised approx. 6” above the floor in order to improve air flow and prevent heat damage to floor materials.
- Additional vents should be cut into the flooring to improve air flow.

Appendix II EA Technology Outstanding Task List for Test-rig

Task List A	Outstanding Tasks at / for Test-site, Stoke	Last updated: 08/09/16
Priority	**Person Responsible**	**Problem/Action/Event/Comment**	**Comment or Est'd time (hrs)**
	JDC/MPB/RA (AW)	Integrate 'High Temperature Warning" notification into Datataker system to act as a pre-cursor alert to 'Over-temp Tripping Event'. Identification of TC that will be used to trigger warning is still TBC.	(18/05/16) Determined by JDC & MPB that: Datalogger Warning @ 38ºC [MPB] & Trip @ 42ºC [RA]; Squirrel Trip at 43ºC [AW]
	Team	Consider implication(s) of dry grass-cuttings entering cabin through vent holes in floor	
	RA	Identify/source UPS for PC & Modem and plan installation	Ongoing **[1.0hr]** PT discuss w/ RA
	RA/NH	Identify/source remote isolation for logger and install during next visit	Ongoing **[0.5hr]** PT discuss w/ RA
	NH/GPC/MPB/RW	With assistance from WPD MEWP, reassemble 2 TCs on Rig 1 CCT 4 (Ash) due to measurement inaccuracy and check all TCs on Rig 1 CCT 4 (Ash) conductor are correctly identified (Discuss w/ MPB first). RW: Liaise w/ WPD for MEWP access. Activity to be performed during next visit.	Job folders, PPE, SATNAV, Sunnies, Maint. Insp Checksheet, Fire Equipt Checksheet, Hand-tools, 110V Tx, ext'n leads, hot air gun, gloves **[1.5hr for 2 people]**
	PT/GPC/NH	Amend component/circuit identification labelling on CU and PSUs so that consistent and appropriate: PT to review and advise.	Dyno printer and Dyno tape **[0.5hr]**
	RA	Set up email (~~text~~) alert for 'Rig-tripped' alarm; recipients to be PT & RW (plus RA & MPB if they so desire)	
	RA/PT	Details for iPhone App Webcam viewing	Ongoing

Task List A	Outstanding Tasks at / for Test-site, Stoke	Last updated: 08/09/16	
	All	Monitoring of site Web-Cams during staff visits	
	JDC/MPB	Consider remote resetting function for PSU variac. **JDC to discuss w/ REO**	
	JDC/MPB	Consider installation of isolator switch for each PSU o/p to Inj. Txs following **JDC discussions w/ REO**.	
	JDC/MPB/RA	Investigate present inability to (i) access logger remotely and (ii) perform remote tripping function of test-rig. Possibly caused by most recent firmware update. RA to discuss w/ OMNI (presently on leave). Resources at test-site may be required to assist.	**?**
	TBC	1. Adjust PSU auto control current settings after calibration factors have been properly determined by JDC and MPB. 2. Complete new Maintenance Inspection Check-sheet 3. Disco' wall heater if AJ Electrics didn't do during their recent test.	
Medium priority	NH	~~Update electronic spares list showing items currently held at Stoke and forward to PT~~. ~~NH to update spares list during next visit~~. (Organise appropriate identification and storage for spares)	**[0.5hr]**
	JDC/MPB	Ongoing review of Datataker & Squirrel over-current/over-temp thresholds Current settings (04/08/16): • Datataker: PSUs set at 80ºC; THUTs set at 40ºC. • Squirrel: PSU 1-3 currents set at >10%; PSU 4 >5%; THUTs 43ºC	
	Team	Review performance feedback loop (Frequency of meetings, sensor threshold alarms, trigger recipients, webcam review, etc.)	
	MPB	Monitor ambient temperature within auxiliary pole cabinets. Consider installation of localised heating if ambient temp. =<0ºC. Specification for Digirail Modules TBC by OMNI	
	JDC/MPB	Confirm how close the PSUs are running to their limits during warmer seasons. (MPB to liaise w/ JDC)	
	PT	Re-review and finalize Safety Documentation (Currently appropriate to Reparation/commissioning stage 20/07/16; revisit at later date)	
	PT	Complete outstanding tasks on Fire RA. (inc. send docs to WPD). NOTE: These tasks do not render the RA dysfunctional. Progressed ~~10~~27/02/16. ~~Fire Safety Doco presented to Blah for printing printed and ready for WPD~~. Only outstanding item in	~~Awaiting confirmation of postage recipient from WPD 10/03/16~~. Fire Safety File ~~posted to WPD c/o~~

Task List A	Outstanding Tasks at / for Test-site, Stoke	Last updated: 08/09/16	
		the Fire RA is Main Isolation Warning Notices: currently on order w/ RS.	received and instated at reception by Mandi Kaur ~~12/03/16~~ 14/03/16.
	PT	Identify & source spares required for Stoke. Review team spares list. ~~PT set up workable document in job folder: all team to add to list appropriately.~~	
	PT	Source “Main Isolation Point” signage on Electricity meter cubicle and “E-Stop only for 32A radial circuits” signage (ARCO). Adhere labels in appropriate locations.	On order from RS 09/03/16…. Discontinued!
	PT	Confirm grass maintenance for 2017 and schedule w/ Hortech	
	RW/PT	1 page PR document for WPD (A. Pickering to approve all pics)	
	PT/RW	Opening ceremony for EATL/WPD/Suppliers/DNOs/STP members	

Appendix III Reactive Maintenance Strategy

Reactive Maintenance Strategy

Last updated: 8/01/2016

Class of emergency

	Emergency	Questionable	Non-emergency
1	Threat to safety and health of people	Vandalism?	Power outage
2	Threat to rig safety and/or functionality	Foreign objects within compound…	
		…close to or touching test-rig components	…remote from test-rig components
3	Threat to WPD operations	OHL conductor falling/fallen down	Other?
4	Trespassers within compound	OHL pole crossarm falling/ fallen down	
5		Fencing/gate failure	

Actions available

A	Do nothing except record details of communication
B	Remotely interrogate webcams
C	Confirm receipt of 'Rig-tripped' text alert
D	Contact WPD reception, security or Electricity Supplier
E	Liaise with resource informatively
F	Contact emergency services informatively at an appropriate point in time
G	Isolate power to rig remotely

Resources available

		Resource	Contact Details (7am-10pm)	
1	EATL	Project Manager	Richard Wood	0151 347 2387 07854 401802
2		Test-rig Manager	Peter Thompson	0151 347 2402 077183 40551
3		Data Manager	Ramiz Ahmed	0151 347 2333 07891 236893
4		Electrical Engineering Guidance	John Crabtree	0151 347 2337 (O) 07841 492595 (W) 07704 572786 (P) 01244 328961 (H)
5		Test-rig design (Primary contact)	Mark Bertinat	0151 347 2391 07817 909797
6		Test-rig design (Secondary contact- ONLY during normal working hours)	Alan Ward	0151 347 2349 (ONLY during normal working hours)
7		OHL Design	Richard Wood	0151 347 2387 07854 401802

Note: We currently foresee that the only cause for immediate attendance to the Test-site outside of normal working hours would be if the Emergency Services and/or WPD were to insist that we do so.

H	Contact emergency services immediately
I	Liaise with and deploy resource at an appropriate time
J	Liaise with and deploy resource immediately

8		Health & Safety Advisor	Greg Watson	0151 347 2256
9		Technical Engineers	Ralph Eyre-Walker	0151 347 2375 07894 392833
10	WPD	Test-rig design	Sven Hoffmann	
11		OHL Team	Shane Degg	07989 700472
12		Network Connection Team		
13		Stoke Depot Security	Nigel Morris	01782 403706
14	Electrical Contractor	AJ Electrics (Local to Test-site)	Chris Huxley	01782 205814 07718 027814
15	Data loggers	OMNI (0845 9000 601)	Andy Philpott	07595 120791
16			Steve Duncan	07908 753933
17	PSUs	REO	Steve Hughes	01588 673411
18	ITs	Birmingham Transformers	Mark Waidson	0121 764 5600
19	Npower	Commercial Premises Supplies	Ed Davies	0800 912 7723
20	Grounds Maintenance	Hortech Grounds Maintenance	John Shufflebotham	01782 416653 07866 704854
21			Peter Tilley	01782 416653 07896 832637
22	Porta-cabin	Concept Cabins	Darren Trinder	07733 763864

Appendix IV Maintenance Inspection Check-sheet

Task List D	**Maintenance Inspection Check-sheet**	Version update: 26/01/16	**Maintenance Inspection completion date:**

Description:

The Maintenance Inspection Check-sheet is a guide for the routine maintenance tasks associated with the OHL Test-rig. A new document should be printed prior to visiting site and completed during each inspection.
The completed documents should be returned to the Test-rig Manager and stored at EA Technology's head-office, Capenhurst.

Module		Component		Action	Frequency	HR	Equipment required	Initials	Comments
1	Test-rig control & monitoring equipment (Indoor)	A	Weld cables	Visual assessment[1] and comparative sweep across the four supplies w/ FLIR	Each visit[2]	TE	FLIR/iPhone FLIR		
				Torque check of terminated lugs (44Nm) and bolted terminations	During quarterly scheduled inspection ONLY when Test-rig is isolated	TE	Calibrated torque wrench, adaptors. Work Instruction including specified torque		
		B	Injection Transformers	Visual assessment as 1A	Each visit	TE	FLIR/iPhone FLIR		

[1] 'Visual assessment' refers to the observational process of assessing the mechanical condition of each component associated with the stated item, where practicable and safe to do so, by employing an appropriate level of manual handling, tooling, interference and/or component movement in order to assess the actual condition of component materials, assemblies, fixings, and/or wirings without causing unnecessary or irreversible disturbance that could render the components vulnerable to failure or dysfunctional operation. All noteworthy observations, reparatory works, pro-active maintenance actions or considerations must be recorded and communicated to the appropriate responsible person in a timely manner for means of traceability and in order that any subsequent actions can be planned accordingly.
[2] 'Each visit' refers to visits that are >2weeks apart or those directly following severe weather occurrences.

				Check tightness of bolted terminations	During quarterly scheduled inspection ONLY when Test-rig is isolated	TE	Calibrated torques wrench, socket set and spanners		
		C	PSUs (x5)	Visual assessment as 1A	Each visit	TE	FLIR/iPhone FLIR		
				6 monthly OEM Service inspection	Scheduled w/ REO	Any	REO require Min 2 week notice. (If fully disco'd: 4 units in 8 hours, w/ reconnection by EATL staff)		
		D	PSU control / measuring equipment	Visual assessment of cables, components and terminations Check only for signs of damage or overheating	Each visit	TE	FLIR/iPhone FLIR		
				PAT checks	Scheduled w/ FMS	FMS/ DC/ NJH	PAT Instrument		
		E	Porta-cabin thermo-couples	Visual assessment. Check in place and undamaged, and readings are similar	Each visit	TE			
		F	Data Logger, CEM units, PC / laptop	Visual assessment. Check in place and undamaged, w/ no disconnected wires.	Each visit	TE			
				PAT checks	Scheduled w/ FMS	FMS/ DC/ NJH	PAT Instrument		
		G	E-stop & Fire alarm circuit	Functional assessment and test of local operation and detectors	6 months	TE	?		

				Functional assessment and test of remote operation	6 months	TE	?		
		H	32A Radial circuits and consumer unit	Visual assessment of PSU isolators, sockets and extension cables (incl. mechanical switch operation)	Each visit. Switched operational checks ONLY when convenient	TE	FLIR/iPhone FLIR		
		I	Office furniture	Visual assessment of chair functionality and table legs	Each visit	TE			
2	Test-rig control & monitoring equipment (Outdoor)	A	OHL Thermo-couples	Visual assessment of self-amalgamating tape, and cable insulation material localised to ducted elbows at height and all glanded entry ports.	From ground level each visit.	TE	OHL_PGP[3] / Genie boom/ UAV		
					Review remotely using webcam.				
		B	2D Anemometer	Visual assessment of anemometer sensor head and overall cable insulation material, specifically at all glanded entry ports.	From ground level each visit.	TE	OHL_PGP / Genie boom/ UAV		
					Review remotely using webcam.				
		C	3D Anemometer	Visual assessment of anemometer sensor head and overall cable insulation material, specifically at all glanded entry ports.	From ground level each visit.	TE	OHL_PGP / Genie boom/ UAV		
					Review remotely using webcam.	Any			

[3] 'OHL_PGP' is the OHL fibreglass poles with a GoPro Camera attached at the upper end

		D	Rain Tipping bucket	Visual assessment of functionality and overall cable insulation material, specifically at all glanded entry ports. Cleaning only if required.	Each visit.	TE			
		E	Solar meters	Visual assessment of sensor head and overall cable insulation material, specifically at all glanded entry ports.	Visual assessment and clean each visit.	TE			
		F	Ambient temp probes and radiation shields	Visual assessment of assembly and overall cable insulation material, specifically at all glanded entry ports.	From ground level each visit.	TE	OHL_PGP / Genie boom/ UAV		
					Review remotely using webcam.	Any			
		G	Auxiliary Cabinets	Check condition and functionality of cabinet, door, seals, mountings & panel keys, and identify any evidence of moisture ingress.	Only external inspection performed EVERY visit; detailed checks performed maximum fortnightly visit	TE			
		H	Ducting & trunking	Visual assessment of material, joints and all cable entry ports. Ensure duct seals are functional. Check that there is no pooled water present within, or evidence of rodent activity.	Only external inspection performed EVERY visit; detailed checks performed maximum fortnightly visit	TE			

3	Porta-cabin	A	Fixtures, fittings, windows, door locks & cable entry ports	Confirm condition, functionality, seals and security. Identify any evidence of moisture ingress. Assess functionality/ integrity of cable entry ports and vermin barriers. Assess vermin traps.	Only external inspection performed EVERY visit; detailed checks performed maximum fortnightly visit	TE			
		B	2-step platform	Visual assessment	3 months	TE	FMS		
		C	Entrance steps	Visual assessment	Each visit	TE			
		D	Fire extinguisher	Quarterly inspection	3 months	TE	FMS		
		E	General	Housekeeping	Each visit	All			
4	OHL	A	OHL conductors and fittings	Visual assessment	From ground level each visit.	TE	FLIR/iPhone FLIR OHL_PGP / Genie boom/ UAV		
					Review remotely using webcam.				
		B	Poles, cross-arms and stay-wires	Visual assessment	From ground level each visit.	TE	OHL_PGP / Genie boom/ UAV		
					Review remotely using webcam.				
5	Electricity supply	A	WPD cabling supply to Test-site	No control measures available					
		B	Contract w/ Electricity Supplier (Npower)	Assess actual usage against estimated. Current contract expires: 14/02/17	Review of most appropriate contract	Any		PT	

		C	Cut-out / meter cubicle	Check condition and functionality of cabinet, door, seals, mountings & panel key, and identify any evidence of moisture ingress.	Only external inspection performed EVERY visit; detailed checks performed maximum fortnightly visit	TE			
		D	Internal electrical installation	RCCD test	Quarterly ONLY when possible	TE			
				Annual Test & Inspection	Annual	AJ Electrics		PT	
		E	Earthing	Confirm condition and security of cable and terminations	Only external inspection performed EVERY visit; detailed checks performed maximum fortnightly visit	TE	Hand tools		
6	Fencing/ Gates	A	Fencing & gates	Visual assessment of fixings	Each visit	Any			
		B	Padlock / keys	Confirm functionality	Each visit	TE			
7	Test-site	A	Signage	Visual assessment of condition & fixings	Each visit	Any	Hand tools Cable-ties		
		B	Safety walkway	Visual assessment	Each visit	Any			
		C	Grass maintenance	Ensure maintenance contract works are performed to WPD expectations	Confirm w/ WPD	TE	Maintenance contract		
		D	General house-keeping	Collection & disposal of wind-blown debris/ refuse	Each visit	All			

Appendix V Calendar of Scheduled Project Events

Calendar of Scheduled Events 2016/17		Last updated: 08/09/16		Index page Contact List
Date	**Person Responsible**	**Problem/Action/Event/Comment**	**Target Completion Date**	**Results**
04/01/2016	MPB	Test data gathering commenced	-	-
25/01/2016	PT	Renewed Electricity Supply Contract w/ Npower (Expires: 14/02/16)	01/02/16	Complete
21/01/2016	NJH/RA/GDC	Visit to Stoke to continue w/ commissioning tasks (Poss. perform 1st Visual Inspection?)	-	Visit performed: outstanding tasks and first inspection partially complete
03/02/16	NH/RA	Logger stopped at 07.14am 02/02/16. Manually restarted: 26hrs of data lost.		
04/02/16	IH	Visit to Test-rig to retrieve Squirrel Logger; passed to AW for repair	-	
06/02/16	NH/RA	Logger stopped at 20.35pm 05/02/01. Manually restarted: 14hrs of data lost.	-	
10/02/16	NH/RA/GPC	Logger firmware updated 10/02/16. Fix firmware bugs, improved operational stability. Continued w/ commissioning tasks (Completed 1st Visual Inspection)	-	
14/02/16	NH/RA	Logger stopped at 15.20pm 14/02/16. Manually restarted: 43hrs of data lost. Configuration issues resulting from logger firmware update. Fixed. Swapped thermocouples. RA on Camera Monitor	-	
16/02/16	-	PSU3 Variac stopped moving	-	
24/02/2016	JDC/NJH	Visit to Stoke to investigate PSU3 Variac issue plus continue w/ commissioning tasks (Complete 1st Visual Inspection?)	24/02/2016	Mods made to proximity switches by JDC
10/05/16	NJH	Nick visited site to reset rig after Cabin over-temp trip (>40ºC) had operated on Sunday. No email alerts had been received. Squirrel alarm still not functional. Only noticed by MPB after he returned to work on Tuesday. U/S 12" fan brought back to Capo.	-	Nick performed other tasks whilst on site.

Calendar of Scheduled Events 2016/17		Last updated: 08/09/16		Index page Contact List
1/05/2016	PT	Schedule 6mth maint. inspection of PSUs w/ REO and EATL resources/visit. Ensure they check the mods JDC made to all PSUs incl. spare. EM sent to REO by PT 240516	1/06/2016	REO to visit site on 06/07/16
07/06/16	PT/JDC	Post-fire visit to assess damage and commence clean-up.	-	Team meeting arranged for 13/06/16
22/06/16	PT/NJH	Site visit to continue reparation tasks	-	
23/06/16	PT/NJH	Site visit to continue reparation tasks	-	Team meeting arranged for 20/06/16
30/06/16	SG	Take PSUs to REO	-	Team meeting arranged for 30/06/16
05/07/16	PT/RG	Site visit to continue reparation tasks	-	
06/07/16	PT/JK	Site visit to continue reparation tasks	-	
06/07/16	REO	Inspection and Service of all 5 PSUs (See update EM from Steve Hughes 11/07/16)		Team meeting arranged for 14/07/16
15/07/16	AJ Electrics	Complete the replacement of Fire Alarm smoke detector and perform Fixed Electrical Installation Inspection (Retest was originally due: 06/03/16)	-	
18/07/16	PT/JDC/JK	Commence testing of PSUs, IT 1 & 4 and all new ancillary control modules at Capenhurst		
w/c 25/07/16	PT/JDC/JK	Transport all equipment to Stoke and re-commission.	-	
w/c 01/08/16	PT/JDC	Final re-commissioning tasks performed (2nd & 4th Aug). Rig fully re-commissioned and logging data as of COP 04/08/16.	-	
8/08/16	NJH	Restart Datataker logger at Stoke	-	
10/08/16	NJH	Restart Datataker logger at Stoke	-	
15/08/16	MPB/NJH	Restart Datataker logger at Stoke w/ tele-assistance from OMNI: OMNI claim that the internal main battery is the most likely cause of the fault. I discussed issue w/ Steve (Omni) on phone…. Awaiting response.	-	
17/08/16	NJH	Restart Datataker logger at Stoke		

Calendar of Scheduled Events 2016/17		Last updated: 08/09/16		Index page Contact List
22/08/16	PT	Received pre-programmed DT85 from Omni. Went to Stoke and replaced 'suspect' unit. Replacement unit logger appears susceptible to the same fault as the 'suspect' DT85. Discussed w/ Omni and Mark (Grant Instruments). Andy and Mark (GI) will scrutinise programme line-by-line during next 2 days. Comms w/ DT85 intermittent/unreliable, therefore, the PSUs to the OHL rigs were not energised.	-	
26/08/16	PT	Solo visit to Stoke at request of OMNI. Rebooted 'loan' logger successfully. Andy Omni remotely cleared the existing program completely and all old data from logger. He suspects that: • The existing program may have been causing stoppage of the command screen • The latest firmware version may have also contributed to problem He then loaded new modified program and monitored for an hour or so. Andy is going to: • Discuss the issues again with Datataker/Mark (Grant Instruments) today • Monitor the logger remotely during the next 2-3 days (There is no bank holiday next week in Scotland). As the comms w/ DT85 were intermittent/unreliable the PSUs to the OHL rigs were not energised.		
03/09/16	RA	Solo visit to Stoke on way to London: • Reboot logger • Install new Ethernet s/w • Confirm all LAN/comms cabling between Ethernet s/w, logger, wifi and PC • Install temp. DC supply feeding Squirrel to test supply voltage stability • Photograph all connections for records		
08/09/16	MPB	Solo visit to Stoke: • Installed a new power supply adapter to the Datataker DT85-3 logger. • Installed the new internet based Power Cycle Box to the Data logger, to restart in case it crashes • Checked and confirmed the operation of the power cycle box • Turned the rig power supplies back on.		

Calendar of Scheduled Events 2016/17		Last updated: 08/09/16		Index page Contact List
		• Ramiz A confirmed access to logger remotely. • Richard Ash changed the settings of the internet router to only allow EA Technology IP address to connect to the logger (reducing external interference). This does not affect the cameras (still accessible via iPhone app). • The rig is now back on and operational…….		
XX XX XX	TBC	Visit Test-rig to: 1. Adjust PSU auto control current settings after calibration factors have been properly determined by JDC and MPB. 2. Complete new Maintenance Inspection Check-sheet 3. Disco' wall heater if AJ Electrics didn't do during their recent test.	-	
1/10/2016	PT	Schedule 6mth maint. inspection of PSUs: REO stated (24/06/16) that they will provide spares and a Work Instruction (WI) in order that EATL can perform the next inspection(s)	1/11/2016	
1/01/2017 (TBC)	PT/REO/TE	6mth maint. inspection of PSUs by EATL/REO		
1/05/2017	PT	Schedule 6mth maint. inspection of PSUs by EATL/REO	1/06/2016	
1/07/2017 (TBC)	PT/REO/TE	6mth maint. inspection of PSUs by EATL/REO		
Nov 2016	PT	Prepare Site Decommission Method Statement	Dec 2016	
Jan 2017	PT	Confirm Electricity Supply Contract renewal w/ Npower (Expires: 14/02/17)	01/02/17	
Jan 2018		Stop gathering test data		
Mar 2018	PT	Decommission Test-rig and Site	June 2018	
July 2018	MPB	Produce Final Report		
July 2018		Site Lease Expires		

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Main reception: +44(0) 151 339 4181
EA Technology, Capenhurst Technology Park,
Capenhurst, Chester, CH1 6ES, United Kingdom

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Main reception: +44(0) 151 339 4181
EA Technology, Capenhurst Technology Park,
Capenhurst, Chester, CH1 6ES, United Kingdom