



Improved Statistical Ratings for Distribution Overhead Lines (Phase 2)


Quarterly Report; December 2016

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Date	Version	Author(s)	Notes
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Final Approval

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Summary

This fourth 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 September 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 until the equipment fire within the site portacabin on June 3rd 2016 (which has since been resolved). 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.

Since the test rig was re-commissioned on 5th August 2016 following the major incident reported in the September 2016 Quarterly Report regarding the fire within the portacabin at the test rig site at WPD Stoke, 19.14hrs on Friday 3rd June 2016, the rig has remained generally operational and stable, with only minor missing data operations. The continued stable operation of the test rig following the June 2016 fire incident can be attributed to improvements to various equipment within the portacabin, coupled with the hard work and dedication of the EA Technology project team.

Contents

1.	Project Activity List	1
1.1	Test-rig Running and Maintenance.....	2
1.2	Data Entry Checking and Validation.....	3
1.3	Data Collection Validation* Tool (*previously Data Collection Download Tool).....	3
2.	Project Summary Activity Log.....	4

Appendices

Appendix I	EA Technology Outstanding Task List for Test-rig
Appendix II	Reactive Maintenance Strategy
Appendix III	Maintenance Inspection Check-sheet
Appendix IV	Calendar of Scheduled Project Events

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	In Progress
		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 0.

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

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 III).

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 IV).

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**.

Automated data validation software is now in place which processes daily automatic data downloads and validates the integrity of the raw data. Parameters that show up any malfunctioning of either the datalogger or instrumentation are evaluated each day and any variation from set values is notified to members of the project team via email. The daily values of the integrity parameters (which are a mixture of daily totals, daily averages and daily max or min values) are automatically recorded as a row in a monthly output table (one row per day), which features conditional colouring based on how close to a parameter is to its set value. This provides a visual monthly record of the data gathering process. Further details of this Data Collection Validation Tool are given below in Section 1.3

The validated raw data for each day are automatically imported into the data-checking spreadsheet autocheckdat, which processes them to produce a minute-by-minute graphical record of the most important measured and derived parameters:

- Conductor temperatures
- Ambient temperatures (indoor and outdoor)
- Power supply temperatures
- Conductor currents
- Power supply voltages
- Wind speed and direction at line height
- Wind attack angle
- Solar radiation on a horizontal surface
- Rainfall

1.3 Data Collection Validation* Tool (*previously Data Collection Download Tool)

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

- Number of 1-minute logs missing from daily dataset (full complement = 1440);
- Number of 1-minute logs in daily dataset with one or more missing 15-second scans (logger scans most channels every 15s and logs average every minute);
- 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.

As detailed in the September 2016 quarterly report, 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. This near catastrophic incident had a massive impact on the first year rig operation and left a significant gap in the test rig data collection throughout the 2016 summer period.

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 30°C 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 thermocouples 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	24/02/16	A repair was carried out by modifying the micro-switch assembly of the maximum limit switch. Modification rectified

Start Date	Issue Description	Date Resolved	Action and Consequence
	output voltage and current were tracking the line input		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.
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) Rig returned to operation.
16/08/16	Reliability problems with datalogger - Omni (supplier) unable to fix	08/09/16	Installed new power supply adapter to Datataker logger. Installed new internet-based Power Cycle Box to datalogger Rig restarted successfully and now fully operational

Start Date	Issue Description	Date Resolved	Action and Consequence
13-Sep-16	WindSonic (Anemometer 2) readings dubious	22-Sep-16	WindSonic power supply reconnected – problem solved.
22-Sep-16	Commissioning fine-tuning	22/09/16	Adjusted PSU auto-control current settings in line with revised calibration factors. Repaired cable termination fault at power supply to Windmaster.
22-Sep-16		7-Nov-16	Data collection perfect (7 weeks)
07-Nov-16	Electricity supplier (Npower) required isolation of test rig to replace faulty electricity meter. EATL maintenance inspection.Omni requested return of 12V power supply (on-loan)	7-Nov-16	De-energised test-rig temporarily and accompanied Npower. Replaced 12V Omni power supply with 24V unit (Omni). Filled in rodent hole near electricity meter-box cable duct. Lubricated porta-cabin entrance door plate, locking mechanism & hinges. Inspected Test-rig control equipment using FLIR cam. Completed new Maintenance Inspection Check-sheet. Missed 18 logs.
10-Nov-16	Rig 1 current falling with Thut (-0.5% for -10K, 18°C to 8°C.	2-Dec-16	Fitted thermostats on extract fans. Thut controlled at ~18°C
15-Nov-16	Logger missed single 1-min log plus single 15s scan	?	Contacted Omni
28-Nov-16	Logger missed 4 x 1-min logs plus 16 x 15s scans	?	Be on lookout for other instances
7-Dec-16	Logger missed single 1-min log plus single 15s scan	?	Be on lookout for other instances
09-Dec-16	WindMaster (Anemometer 1) U,V & W all dropped to minus 45m/s for 1 hour (power loss?)	?	Be on lookout for other instances
10-Dec-16	Spike in 22H1 spread of 4.1K (>3K for 4 mins)	?	Be on lookout for other instances

Appendix I EA Technology Outstanding Task List for Test-rig

Task List A	Outstanding Tasks at / for Test-site, Stoke		Last updated: 13/12/16
Priority	Person Responsible	Problem/Action/Event/Comment	Comment or Est'd time (hrs)
	RA	Identify/source UPS for PC & Modem and plan installation.	Ongoing PT discuss w/ RA
	TBC	Ongoing PAT test of equipment onsite.	
	RA	Set up email (text) alert for 'Rig-tripped' alarm; recipients to be PT & RW (plus RA & MPB if they so desire)	
	All	Monitoring of site Web-Cams during staff visits.	
	JDC/MPB	Ongoing review of Datataker & Squirrel over-current / over-temp thresholds Current settings (04/08/16): <ul style="list-style-type: none"> Datataker: PSUs set at 80°C; THUTs set at 40°C. Squirrel: PSU 1-3 currents set at >10%; PSU 4 >5%; THUTs 43°C 	
	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. =<0°C. 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	Identify & source spares required for Stoke. Review team spares list.	Ongoing consideration
	PT	Confirm grass maintenance for 2017 and schedule w/ Hortech	
	RW/PT	1page PR document for WPD (A. Pickering to approve all pics)	
	PT/RW	Site visit for EATL/WPD/Suppliers/DNOs/Project Sponsors	

Appendix II Reactive Maintenance Strategy

Reactive Maintenance Strategy							Last updated:		8/01/2016	
Class of emergency				Actions available		Resources available				
	Emergency	Questionable	Non-emergency			Resource		Contact Details (7am-10pm)		
1	Threat to safety and health of people	Vandalism?	Power outage	A	Do nothing except record details of communication	1	EATL	Project Manager	Richard Wood	0151 347 2387 07854 401802
2	Threat to rig safety and/or functionality	Foreign objects within compound...		B	Remotely interrogate webcams	2		Test-rig Manager	Peter Thompson	0151 347 2402 077183 40551
		...close to or touching test-rig components	...remote from test-rig components							
3	Threat to WPD operations	OHL conductor falling/fallen down	Other?	C	Confirm receipt of 'Rig-tripped' text alert	3		Data Manager	Ramiz Ahmed	0151 347 2333 07891 236893
4	Trespassers within compound	OHL pole crossarm falling/ fallen down		D	Contact WPD reception, security or Electricity Supplier	4		Electrical Engineering Guidance	John Crabtree	0151 347 2337 (O) 07841 492595 (W) 07704 572786 (P) 01244 328961 (H)
5		Fencing/gate failure		E	Liaise with resource informatively	5		Test-rig design (Primary contact)	Mark Bertinat	0151 347 2391 07817 909797
				F	Contact emergency services informatively at an appropriate point in time	6		Test-rig design (Secondary contact- ONLY during normal working hours)	Alan Ward	0151 347 2349 (ONLY during normal working hours)
				G	Isolate power to rig remotely	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 III Maintenance Inspection Check-sheet

Task List D		Maintenance Inspection Check-sheet			Version update: 26/01/16	Maintenance Inspection completion date:		
<p>Description:</p> <p>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.</p>								
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			
		Check tightness of bolted terminations	During quarterly scheduled inspection ONLY when Test-rig is isolated	TE	Calibrated torques wrench, socket set and spanners			

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, proactive 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.

		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 IV Calendar of Scheduled Project Events

Calendar of Scheduled Events 2016/17			Last updated: 08/11/16	
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 1 st 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 1 st 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 1 st 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 (>40°C) 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.
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

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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 (2 nd & 4 th 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		

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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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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. • 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). 		

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		<ul style="list-style-type: none"> The rig is now back on and operational..... 		
22/09/16	JDC/MPB	Visited Test-rig: <ol style="list-style-type: none"> Adjusted PSU auto control current settings after calibration factors have been properly determined by JDC and MPB. Taped up PS cable plug to DT85 to ensure connection is sound Collected spare loan DT85 Logger (and grommet) Repaired cable termination fault at power supply to Windmaster 	-	
07/11/16	NJH	Visited Test-rig to: <ol style="list-style-type: none"> De-energised test-rig and accompanied NPower whilst they replaced faulty electricity meter. Then re-energised test-rig. Collected green DT85 connectors to return to Omni. Installed new 24V supply to DT85⁴ (See notes in "Outstanding tasks"). Filled in rodent hole nr electricity meter box cable duct (hockey-stick). Lubricated porta-cabin entrance door plate, locking mechanism & hinges. Inspected all Test-rig control equipment located in porta-cabin using FLIR cam. Completed new Maintenance Inspection Check-sheet. 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. MPB stated not necessary w/c 31/10/16. Used wall heater whilst onsite; seemed ok. 	-	Complete
02/01/2017	PT	Schedule 6mth maint. inspection of PSUs: REO stated (on 24/06/16) that they will provide spares and a Work Instruction (WI) in order that EATL can perform the next inspection(s). Maintenance date reflects re-energisation of rig c08/09/16	1/03/2017	
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	
1/03/2017 (TBC)	PT/REO/TE	6mth maint. inspection of PSUs by EATL/REO		
1/07/2017	PT	Schedule 6mth maint. inspection of PSUs by EATL/REO	1/09/2016	
1/09/2017 (TBC)	PT/REO/TE	6mth maint. inspection of PSUs by EATL/REO		

⁴ Re-install DT85 internal-battery-link upon arrival at site in order to charge internal battery for 1h duration prior to replacing suspect 12V power supply with new 24V power supply. Ensure to remove internal-battery-link from DT85 once new 24V PS is installed.

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Jan 2018		Stop gathering test data		
Mar 2018	PT	Decommission Test-rig and Site	June 2018	
July 2018	MPB	Produce Final Report		

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