Improved Statistical Ratings for Distribution Overhead Lines (Phase 2)

Quarterly Report; June 2016

Date: 23 June 2016

Version History

Date	Version	Author(s)	Notes
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Final Approval

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Summary

This second 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 previously published Quarterly Report in March 2016.

The Overhead Line conductor test-rig has been formally operational since January 4th 2016, and has been in a predominantly stable condition with only a small number of issues arising during in its first six months of operation. Where any issues have 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 at WPD Stoke at 19.14hrs on Friday 3rd June 2016. During this incident, a critical piece of operational equipment suffered a catastrophic failure and a subsequent fire developed. The fire was contained to the faulted equipment, although the site portacabin suffered extensive smoke damage. Hence, since the time of this fault, the entire overhead powerline test rig has not been in operation and as a result, no data has been collected. Emergency repairs by the EA Technology project team are ongoing to address this situation, with the primary focus being on returning the overhead line test rig to an operational state as soon as possible.

A full investigation of this significant incident is ongoing and a full fault report will be published in the Appendices of the next formal quarterly report due in September 2016.

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1. Project Activity List

The table below illustrates the current status of the activities aligned with Key Deliverables of this project which 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 II).

The **Maintenance Inspection Check-sheet** was composed to ensure that a suite of preventative maintenance activities were 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.**

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

Following publication of the first project Quarterly report in March 2016, a very small number of minor operational incidents have arisen at the test rig site. It is worth noting that all of the issues recorded have been attended to and rectified as a matter of urgency by the EA Technology project team, to ensure the test-rig has been maintained in an operational state with minimal "downtime".

However, at the time of writing this report, the test-rig is no longer operational due to suspected component failure of a critical piece of equipment inside the site portacabin, which caused a minor fire resulting in extensive smoke damage to cabin interior and all associated equipment. The incident happened at approximately 19.14hrs on 3rd June 2016. 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 item of equipment which catastrophically failed was the Power Factor Correction Unit. The fire alarm panel inside the portacabin indicated that everything operated as was expected and all safety devices, trip switches etc. operated accordingly.

A thorough investigation is under way and a formal report will be included in the Appendices of the next Quarterly report due in September 2016.

In the meantime, EA Technology project staff have visited the site on several occasions since the incident on the 3rd June to carry out clean-up operations and repairs. A number of components have been removed from the test rig portacabin and transported back to EA Technology's workshops at Capenhurst, for intensive cleaning and testing. Work is already underway to ensure the replacement Power Factor Correction Unit is modified from the original specification and contained within a ventilated metal enclosure. A number of other precautionary measures are also being investigated for suitability for preventing a reoccurrence of this incident, including potential fire protection pads for siting of critical equipment.

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

The power supplies have continued to work well overall, despite an initial incident where one unit developed a fault that resulted in one of the four circuits producing invalid data for several days. A minor modification carried out by EA Technology staff corrected the fault, and as previously reported, similar modifications were carried out to the three other power supplies as a precaution.

The data logger had originally been of concern regarding its reliability due to it originally being delivered with very out-of-date firmware. The manufacturer has since released several updates to fix a number of operational issues. It has been in a functional state since the issue of the last quarterly report and EA Technology personnel continue to routinely monitor its performance.

The automatic daily data download procedure is working well, and automated data checking is in place. As the overall rig operation has settled, the project team have been updating the parameters that need to be monitored for reliable operation.

A back-up independent alarm 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 checkdat (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 checkdat (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	Ongoing	Ongoing investigation. Suspension of data collection

Appendix I EA Technology Outstanding Task List for Test-rig

	Outstanding Tasks at / for Test-site, Stoke		Last updated: 24/05/16
Priority	**EA Person Responsible**	**Problem/Action/Event/Comment**	**Comment or Est'd time (hrs)**
High	PT/GPC	Re-install Squirrel logger and switch protection box at Stoke AW to alter threshold on Squirrel at Capenhurst to 43ºC: Re-install when ready. To be completed during 2-day 'REO' visit?	AW examined & identified fault 08/03/16, then discussed w/ JDC: Squirrel Logger (AW to alter threshold) to be repaired by Eltek and New transistor s/w module to be designed by JDC and built by AW.
	PT	Fixed Electrical Installation Inspection by AJ Electrics	
	PT	Schedule REO site visit and co-ordinate resources and tasks. [Assess wear on brushes; EA rep w/ eng'g experience onsite to shadow REO].	
	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]
	RA	Identify/source UPS for PC & Modem and plan installation	Ongoing
	RA/NH	Identify/source remote isolation for logger and install during next visit	Ongoing
	GPC/MPB/JDC	Calibration check of currents using clip-on ammeter and JDC's DVM	Ongoing at Capenhurst:

	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.	Hand-tools, 110V Tx, ext'n leads, hot air gun, gloves
	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
	PT/GPC	Replace TPS2 (FKA: IT2) TC during next site visit (TC48). Note RA replaced w/ new one BUT it needs to be verified that it is the correct one during the next visit (See MPB if necessary)	(18/05/16 MPB to check historic data and confirm necessity)
	RA	Set up email (~~text~~) alert for 'Rig-tripped' alarm; recipients to be PT & RW (plus RA & MPB if they so desire)	
	GPC	Confirm thermostats for extract fans are appropriately wired: Test functionality of both w/ hot air gun during next visit.	hot air gun, gloves
	RA/PT	Details for iPhone App Webcam viewing	Ongoing
	All	Monitoring of site Web-Cams during staff visits	Job folders, PPE, SATNAV, Sunnies, Maint. Insp Checksheet, Fire Equipt Checksheet,
	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/PT	Determine reparatory tasks to be performed by REO on the PSU Variac issue. Issue raised by PT during visit scheduling EM w/ REO 23/05/16.	
	PT/GPC	Complete installation of reflective cladding to auxiliary pole cabinets in order to prevent overheating. [Sheeting cut to size and left in p-cabin as rain stopped play during last visit (10/05/16)]	

	PT	Replace failed Fantronix cooling fan (Fan failed 090516, now at Capo) and position on rig side that only has 2. One rig only has 2 fans at present. PT completed online Returns form 24/05/16.	Date, Type, Order#: 090115 1x12" 109879; 140115 3x12" 111310; 120116 1x16" 200839; 140116 1x16" 201312; 020316 1x16" 213441
	JDC/PT/RW	Discuss failed Fantronix cooling fan and their reliability. Only 6mths running; inability to source same types; One rig only has 2 fans at present.	
	PT/GPC	Install 'tell-tale' strips to floor fans (in order that functionality can be checked via webcams)	
	PT/GPC	Install 2 additional extractor fans of 400m^3/hr type adjacent to existing extractor fans: (PT EM VMc to order by CCC 23/05/16) [Each panel has a framework around its perimeter, and again around windows. Please fit them lower than 150mm below the ceiling from the inside].	Jigsaw, batten detector, mastic, ladders/platform, sheeting, cabling, PPE glasses, extension lead
	PT/GPC	Identify and label the 3 TCs that are taped onto side of PSU 4 [They should be THUT1, Squirrel Ch1 and Squirrel Ch2]. Then, reposition Squirrel Ch2 up to same height as THUT2.	
	MPB/GPC	Test Solarimeter o/p voltage using DVM at Datataker and compare w/ measurement stated on logger. (Discuss task w/ MPB beforehand)	
Medium priority	MPB/GPC	Confirm Solarimeter identification. (Discuss task w/ MPB beforehand)	
	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.	
	RW/JDC	Source clip-on ammeter that can measure >500A with accuracy tolerance ≤1% (Re. 500A circuit possibly running at 515A) RW: Discuss w/ Fluke and arrange test-kit/Fluke rep. to visit site at same time as EATL resources next visit. EATL resource to assist Fluke rep or perform measurement.	
	NH	Organise appropriate identification and storage for spares	
	PT	Discuss Air-con unit for cabin (6-10kW) poss. 15mth rental: 7x EMs sent; 3 responses so far = £1716 to £2261 (+VAT). *** Duct aircon o/p to IT4 ***.	Ongoing

	JDC/MPB	Review Datataker & Squirrel over-current/over-temp thresholds (Currently PSUs set at 80ºC; THUTs set at 40ºC).	
	Team	Review performance feedback loop (Frequency of meetings, sensory threshold alarms, trigger recipients, webcam review, etc.)	
	MPB	Monitor ambient temperature within auxiliary pole cabinets. Install 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 running operation, revisit when time permits)	
	PT	Complete outstanding tasks on Fire RA. (inc. send docs to WPD). NOTE: These tasks do not render the RA dysfunctional. Progressed 27/02/16. Only outstanding item in the Fire RA is Main Isolation Warning Notices: currently on order w/ RS.	Fire Safety File received and instated at reception by Mandi Kaur 14/03/16.
	PT	Identify & source spares required for Stoke. Review team spares list.	
	PT/NH/GPC	Source “Main Isolation Point” signage on Electricity meter cubicle and “E-Stop only for 32A radial circuits” signage (ARCO). Adhere labels to outside surface of Outdoor Electrical Cabinet	On order from RS 09/03/16.
	PT	Schedule visit to Lucideon (ST4 7LQ): Re. Instron test alternatives	
	PT	Confirm grass maintenance contractors and schedule w/ Hortech (email sent to Peter Tilley 10/02/16)	
	RW/PT	1 page PR document for WPD (A. Pickering to approve all pics)	
Low priority	RA/MPB/PT	Confirm requirement for ambient heating in Auxiliary Pole Cabinets	
	PT/RW	Opening ceremony for EATL/WPD/Suppliers/DNOs/STP members	
To be completed	PT/GPC	Re-install Squirrel logger and switch protection box at Stoke AW to alter threshold on Squirrel at Capo to 43ºC: Re-install when ready.	AW examined & identified fault 08/03/16,

during 2-day ‘REO’ visit			then discussed w/ JDC: Squirrel Logger (AW to alter threshold) to be repaired by Eltek and New transistor s/w module to be designed by JDC and built by AW.

Appendix II 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 III Maintenance Inspection Check-sheet

Task List D	Maintenance Inspection Check-sheet	Version update: 26/01/15	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: 14/02/16	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 2016-18	Last updated:			09/06/16
Date	**EA Person Responsible**	**Problem/Action/Event/Comment**	**Target Completion Date**	**Results**
04/01/2016	MPB	Test data gathering commenced	-	Ongoing
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
10/02/2016 (TBC)	NJH/RA/GDC	Visit to Stoke to continue w/ commissioning tasks (Complete 1st Visual Inspection)	-	Visit performed: outstanding tasks and first inspection progressed
04/02/16	IH	Visit to Test-rig to retrieve Squirrel Logger; passed to AW for repair	-	
14/02/16	NJH/RA	Nick to Visit Stoke to Restart logger and Swap 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.
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. (More details to follow)	-	Team meeting planned for 13/06/16

Calendar of Scheduled Events 2016-18		Last updated:		09/06/16
XX/XX/2016	PT	Schedule Annual Fixed Electrical Installation Inspection w/ AJ Electrics and EATL resources/visit. Note: ONLY Recommended not Mandatory, see http://www.electricalsafetyfirst.org.uk/guides-and-advice/frequently-asked-questions/	Retest was due: 06/03/16	
XX/XX/2016	JDC/PT	Determine reparatory tasks to be performed by REO on the PSU Variac issue		
XX/06/2016 (TBC)	PT/GPC Day 1 PT/REO Day 2	6mth maint. inspection of PSUs by REO (currently being scheduled as part of post fire reparation schedule)	June 2016	To be advised in next quarterly report
1/10/2016	PT	Schedule 6mth maint. inspection of PSUs w/ REO and EATL resources/visit	1/11/2016	
1/01/2017 (TBC)	PT/REO/TE	6mth maint. inspection of PSUs by 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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