



Awel y Môr Offshore Wind Farm

Applicant's Response to the Rule 17 Letter Dated 19.12.2022

Deadline 4

Date: 30 January 2023

Revision: A

Document Reference: 4.5

Application Reference: N/A



REVISION	DATE	STATUS/ REASON FOR ISSUE	AUTHOR	CHECKED BY	APPROVED BY
A	January 2022	Deadline 4	GoBe	RWE	RWE

[Redacted]

RWE Renewables UK Swindon Limited

Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire SN5 6PB
T +44 (0)8456 720 090

[Redacted]

Registered office:
RWE Renewables UK Swindon Limited
Windmill Hill Business Park
Whitehill Way
Swindon

Contents

1	Introduction.....	4
2	The Applicant's Response to the Rule 17 Letter.....	5
	Appendix A: Gwynt y Môr Substation Vibration Assessment	10

Tables

Table 1: The Applicant's response to the questions asked within the Rule 17 letter dated 19 December 2022.	5
---	---

1 Introduction

- 1 On 19 December 2022, Awel y Môr Offshore Wind Farm Limited (the Applicant) received a Rule 17 letter from the Examining Authority (ExA) requesting further information and written comments from the Applicant.
- 2 The Applicant's responses to these questions are tabulated in Table 1 below.

2 The Applicant's Response to the Rule 17 Letter

Table 1: The Applicant's response to the questions asked within the Rule 17 letter dated 19 December 2022.

QUESTION REFERENCE	QUESTION TO	QUESTION	APPLICANT'S RESPONSE
R17Q2.1	The Applicant	<p>Draft Development Consent Order(dDCO) Requirement 15</p> <p>dDCO Requirement 15(1) [REP3-006] states "construction of the onshore works and construction-related traffic movements to or from the site of the relevant Work may take place only between 0700 and 1900 from Monday to Saturday, with no activity on Sundays or bank holidays".</p> <p>Denbighshire County Council (DCC) in its Local Impact Report (LIR) [REP1-056] states that "The Council do not agree to the hours of operation stated in 15 (1)" and "To protect the amenity of occupiers or residential properties which are close to onshore works, the Council consider the hours of works should be restricted to: 8am – 6pm Monday – Friday 8am – 1pm Saturdays No working on Sundays and Bank Holidays".</p> <p>In addition, the ExA notes that similar projects (e.g. East Anglia 2) have limited working hours on Saturdays to between 7am and 1pm.</p> <p>Please provide justification for the working hours proposed</p>	<p>Through discussion with DCC following ISH3 the Applicant has suggested to DCC that a localised reduction in construction working hours to 0800 to 1800 Monday to Friday could be a means of addressing the concerns DCC raises.</p> <p>It is understood that the concern regarding construction working hours relates to the landfall location where residents will have experienced lengthy construction works as a result of the flood defence schemes undertaken by DCC.</p> <p>In response, the Applicant has proposed to reduce the hours during which potentially noisy construction activity would occur to 0800 to 1800 at the landfall. This amendment is included within the outline Code of Construction Practice (REP2-043) as referenced within DCO Requirement 15. An updated version of the outline CoCP is submitted by the Applicant as Document 4.15 of the Applicant's Deadline 4 submission. Such a restriction would still allow construction staff to arrive at site and for any non-noisy tasks (such as undertaking toolbox talks or site administration) to take place from 0700 to 1900.</p> <p>Where continuous periods of construction work, outside of the normal working hours, are required for works such as, but not limited to, trenchless crossing operations, concrete pouring and finishing, and electrical circuit pulling, jointing and testing, delivery and unloading of abnormal loads; these will be agreed in advance with DCC.</p> <p>HDD (or other trenchless crossing works) at the landfall and other major crossing points will require works to take place 24hrs a day. Where continuous 24-hour working is required this will be agreed in advance with DCC through a requirement of the DCO. When the need for 24 hrs working is complete, the Applicant will notify DCC.</p> <p>The Applicant is awaiting a response to this proposal from DCC</p>
R17Q2.2	The Applicant	<p>dDCO Requirement 15</p> <p>dDCO Requirement 15(2) [REP3-006], lists a number of works and/or operations which could take place outside the times specified in 15(1), subject to the</p>	<p>i) The Applicant confirms that Requirement 15 will be updated within the draft DCO (to be submitted at Deadline 5 to make reference to Works 3, 3A, 4, 5, 6, 6A, 7 and 7A (the landfall works).</p>

QUESTION REFERENCE	QUESTION TO	QUESTION	APPLICANT'S RESPONSE
		<p>advance agreement of the relevant planning authority.</p> <p>While DCC in its LIR [REP1-056] “accepts that certain work activities are time sensitive and therefore do not object to out of hours working where necessary”, the Council considers “a notice period of 1 week should be applied”. In addition, the Council considers “criteria 15 (2) (c) ‘for the landfall works’ and (d) ‘for any other time-critical element of the onshore works’ are too vaguely worded” and “the criteria contained in 15 (2) should therefore be more precise and clearly state the construction activities which are necessary to be carried out outside of approval working hours, so that it can be clearly interpreted and enforced”.</p> <p>Please provide justification for the current wording of Requirement 15 (2) [REP3-006] including:</p> <ul style="list-style-type: none"> i. The inclusion and wording proposed for “landfall” and “time-critical elements of the onshore works”; ii. The rationale for including the delivery and unloading of abnormal loads; iii. How the requirement addresses emergency situations; iv. Why “notification” rather than “approval” of continuous 24 hour working with respect to trenchless installation techniques is proposed; and v. Why a notice or completion period is not specified. 	<ul style="list-style-type: none"> ii) With regard to time critical elements, these include, but are not limited to, concrete pours, transformer works, cable pulling, joint bay installation and transition joint bay installation. The rationale for including the delivery and unloading of abnormal loads, such (but not limited to) transformer and cable deliveries, in activities that could take place outside of the times specified in Requirement 15(1), is to allow Abnormal Indivisible Loads (AIlS) to be moved and unloaded outside of periods of heavy traffic flow (i.e. for those that are able to be transported during the night) to minimise disruption to the public. In addition, specific timing restrictions may be imposed by the police or local authority. Should delivery of AIlS, or other construction traffic activities, be required outside of the working hours specified prior notice will be given to DCC before such traffic movements commence. Each delivery will be planned in advance, escorted and managed such that any impacts are minimised. Such arrangements will be procured through standard processes with DCC at the appropriate time. iii) The outline CoCP has been updated (Document 4.15 of the Applicant's Deadline 4 submission) to set out how the Applicant would notify DCC of any out of hours construction works required in response to an emergency situation. DCO Requirement 15 confirms that anything agreed in the CoCP will take precedence over the hours set out in the requirement. iv) ‘Notification’ (rather than approval) has been used as the need for, and the powers to undertake, continuous 24 hour working with respect to trenchless installation techniques is set out in many of the DCO application documents, DCO Requirement and CoCP (Document 4.15 of the Applicant's Deadline 4 submission). Assuming the DCO is granted upon this basis, the principle of undertaking 24hr works will be established and so the Applicant would notify DCC when this is scheduled to take place. As noted in the outline Noise and Vibration Management Plan (NVMP) (REP2-019), local residents considered to be significantly affected by noise from Horizontal Directional Drilling (or other trenchless techniques) works will be kept informed of the likely period during which the work will take place, the times and durations of planned works and the measures that are being taken to avoid unnecessary noise through

QUESTION REFERENCE	QUESTION TO	QUESTION	APPLICANT'S RESPONSE
			<p>measures set out in the Construction Communications Plan (an outline version of this document is provided in Appendix 12 of the CoCP (REP2-049). As noted in the outline NVMP, the Applicant's aim in scheduling and undertaking works will be to control and limit noise and vibration levels, so far as is reasonably practicable and to minimise disturbance to residents and sensitive receptors.</p> <p>v) The CoCP has been updated to include notification of DCC once the need for 24 hr working has ended.</p>
R17Q2.3	The Applicant	<p>dDCO Requirement 18</p> <p>DCC in its LIR [REP1-056] considers that Requirement 18 of the dDCO [REP3-006] does not provide adequate protection to all residential properties in the vicinity of the sub-station and further that requirements need to be included to set out the procedures to be followed should noise complaints be received.</p> <p>The ExA notes from the Applicant's response to the LIR [REP2-004] that the Applicant is amenable in principle to adding further specification to the requirement around procedures for the investigation of complaints, though does not agree with the wording proposed by DCC but considers the current wording in Requirement 18 already provides sufficient protection for all residential properties.</p> <p>Please:</p> <p>a. Explain how the current Requirement provides adequate protection for the occupiers of all residential properties;</p> <p>b. Provide an update on discussions with DCC on agreeing wording for the Requirement with respect to a noise complaints procedure;</p> <p>c. Outline how complaints with respect to vibration will be handled; and</p>	<p>a) The Applicant has updated DCO Requirement 18 in a revised version of the dDCO that will be submitted at Deadline 5 to clarify the Requirement would apply to existing residential properties and any new residential development authorised by the date at which the DCO is granted. The updated text also clarifies that the locations referenced within DCO Requirement 18 are representative locations (e.g. other residential properties on Glascoed Road located to the south west of the proposed substation would be afforded the same protection as for Gwelfryn)</p> <p>b) The Applicant has proposed the following additional DCO Requirement to DCC regarding a noise complaints procedure and awaits DCC's feedback:</p> <p><i>(2) In the event of a complaint to the relevant planning authority relating to noise emissions from the operation of Work No. XXX which may reasonably be expected to result in levels above those allowed by paragraph (1)—</i></p> <p><i>(a) the undertaker must submit a proposed measurement and assessment procedure, based on the guidance and assessment methodology outlined in BS4142:2014, including a proposed measurement methodology and monitoring locations and the timings for the assessment and reporting to the relevant planning authority for approval;</i></p> <p><i>(b) measurements must be undertaken in accordance with the approved procedure by an independent consultant appointed by the undertaker in order to determine compliance or otherwise with paragraph (1).</i></p> <p>c) As noted in ES Volume 3, Chapter 10: Airborne Noise and Vibration (Ref APP-071), the substation does not contain any mechanically moving parts that are</p>

QUESTION REFERENCE	QUESTION TO	QUESTION	APPLICANT'S RESPONSE
		<p>d. Provide an update on any discussions with Memoria Ltd with regard to the issues of noise and disturbance raised in RR-030 and RR-031.</p>	<p>capable of generating a fraction of the energy required to transmit levels of vibration that would be perceptible to residential receptors.</p> <p>The minimum distance to the nearest vibration sensitive receptor from the boundary of the substation footprint is 275 m. For vibration to be perceived over this distance a substantial force would need to be applied which can only be achieved through a very high-energy impact, for example with reference to Table E.1 of BS5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2 the predicted vibration level for percussive piling using a 500 KJ hammer impact would be approximately 0.08 mms-1, which with reference to the thresholds set out in BS5228:2209+A1:2014 : is below the level of perceptibility.</p> <p>As such, the Applicant does not anticipate receiving complaints from residential properties regarding operational vibration from the substation.</p> <p>In support of this position, the Applicant has provided a vibration monitoring report that was undertaken for the Gwynt y Môr substation with reference to receptors on St Asaph Business Park (that were 130m from the Gwynt y Môr substation (See Appendix A of this document)). The report includes measured vibration levels from an operational substation as well as baseline vibration monitoring levels from within the Business Park. The report shows that source term vibration measurements have indicated that, even adjacent to the transformers within a substation, the PPV is unlikely to exceed 0.18 mm/s. Vibration at 275 metres from the substation (the nearest buildings on St Asaph Business Park) would therefore be negligible and will be significantly lower than the measured baseline vibration levels taken from within the Business Park.</p> <p>d) Memoria</p> <p>The Applicant responded to Memoria Ltd at Deadline 1 in document (REP1-001) following its Relevant Representation submissions. As noted in this document, the outcome of the assessments undertaken in respect of noise (Volume 3 Chapter 10 Noise and Vibration (APP-071)) and traffic (Volume 3, Chapter 9, Traffic and Transport (APP-070)) have not predicted any significant impacts on the Denbighshire Memorial Park and Garden.</p> <p>The Applicant has provided an Outline Code of Construction Practice (CoCP) (Document 4.15 of the Applicant's Deadline 4 submission) which contains</p>

QUESTION REFERENCE	QUESTION TO	QUESTION	APPLICANT'S RESPONSE
			<p>Appendix 7 Construction Traffic Management Plan (CTMP) (Document 4.27 of the Applicant's Deadline 4 submission) setting out the principles that will be followed when managing construction traffic during the works to mitigate impacts on local receptors. A final version of the CoCP and CTMP will need to be approved by DCC, prior to construction commencing. The CoCP also contains Appendix 2, Outline Noise and Vibration Management Plan (NVMP) (REP2-020) which sets out mitigation measures that could be deployed to mitigate noise impacts from AyM construction.</p> <p>AyM has also committed to a Construction Communications Plan (Outline CoCP Appendix 12 Outline Construction Communications Plan (REP2-049) which sets out how it will communicate with local residents and businesses during the construction phase. As with the CoCP and CTMP, the NVMP and Communications Plan will need to be revised, based on detailed design and approved by DCC before construction works can commence.</p> <p>The Applicant has had no further engagement with Memoria Ltd.</p>
R17Q2.4	The Applicant	<p>Noise and the Outline Code of Construction Practice (OCoCP)</p> <p>Table 4, Page 42 of Volume 3, Chapter 10 of the Environmental Statement [APP-071] notes that amendments to working hours in specific locations could be agreed with DCC through agreement of the final CoCP. Requirement 15 of the dDCO [REP3-006] appears to suggest this could also be the case. The OCoCP [REP2-043] does not seem to include any reference to this provision.</p> <p>Please update the Outline CoCP to reflect this or provide justification for not doing so.</p>	<p>The outline CoCP (Document 4.15 of the Applicant's Deadline 4 submission) has been updated such that amendments to working hours in specific locations could be agreed with DCC through agreement of the final CoCP. The proposals around construction working hours within the CoCP are also referenced within the outline Noise and Vibration Management Plan (that is Appendix 2 of the overall CoCP suite of documents (REP2-020)) and also the Construction Method Statement (Appendix 1 of the overall CoCP suite of documents (Document 4.14 of the Applicant's Deadline 4 submission)).</p>

Appendix A: Gwynt y Môr Substation Vibration Assessment



SOUTHERN OFFICE
 Phlorum Limited
 Sussex Innovation Centre
 Science Park Square
 Falmer
 East Sussex
 BN1 9SB
 T 01273 7044 49
 F 01273 7044 99
 E info@phlorum.com

NPOWER RENEWABLES

PROPOSED SUBSTATION AT ST ASAPH
DENBIGSHIRE

VIBRATION ASSESSMENT

OCTOBER 2009

	Name
Written By	David Nicholls
Checked By	Glen Parker
Authorised By	Dr Paul Beckett

This report has been prepared for the exclusive use of the commissioning party and may not be reproduced without prior written permission from Phlorum Limited.

All work has been carried out within the terms of the brief using all reasonable skill, care and diligence.

No liability is accepted by Phlorum for the accuracy of data or opinions provided by others in the preparation of this report, or for any use of this report other than for the purpose for which it was produced.



NORTHERN OFFICE Carrington Business Park, Carrington, Manchester M31 4DD T 0161 776 4328 F 0161 775 8995

WESTERN OFFICE Unit 2, Llanwenarth Lodge, Govilon, Abergavenny, Monmouthshire NP7 9SF T 01873 832003

Registered in England and Wales. Registered office: Sussex Innovation Centre, Science Park Square, Falmer, East Sussex BN1 9SB. Reg No. 4967256



This paper comes from sustainable forest stocks approved by the FSC



CONTENTS

PAGE NO

1. Introduction	1
2. Vibration Criteria	2
3. Site Layout and Proposed Construction Activities	4
4. Vibration Monitoring	6
5. Vibration Assessment	8
6. Vibration Monitoring During Construction	11
7. Conclusions	12

Figures

Appendix A – Calculation of Vibration from Vibratory Rollers



SUMMARY

A study has been undertaken in order to assess vibration which would be generated during the construction and operation of the proposed substation at St Asaph.

Vibration monitoring was undertaken at the Qioptiq premises in order to establish existing baseline vibration levels. Vibration monitoring was also undertaken at an existing substation in order to establish source-term vibration levels for the proposed equipment.

Vibration from the proposed construction activities has been calculated using the procedures presented in BS 5228-2:2009.

The assessment has concluded that vibration generated during construction will be lower than existing baseline vibration levels, and will therefore be acceptable. However, vibration monitoring is recommended during phases of construction that could generate significant vibration levels.

The assessment has also concluded that vibration generated by operation of the substation will be insignificant in terms of its effect at the Qioptiq premises.



1. INTRODUCTION

- 1.1 Phlorum Limited has been commissioned by npower renewables to undertake a vibration assessment of the construction and operation of a proposed 132kV substation at St Asaph, Denbighshire, North Wales.
- 1.2 The proposed site is located near to St Asaph Business Park. An existing industrial premises, Qioptiq Limited, is located adjacent to the site and is used to fabricate precision optical instruments. The building closest to the proposed substation houses the process most sensitive to vibration.
- 1.3 Baseline vibration monitoring has been undertaken adjacent to the vibration-sensitive facility in order to establish the existing levels of vibration to which the facility is exposed.
- 1.4 Vibration measurements have also been undertaken at an existing substation facility in order to establish the magnitude of vibration generated by the proposed equipment.
- 1.5 Vibration from construction activities has been predicted, based on the anticipated plant list.
- 1.6 This report presents the vibration assessment that has been undertaken.



2. VIBRATION CRITERIA

Planning Condition No. 23

2.1 Planning permission for the substation was granted on 18 February 2009 (ref 31/2008/1123/PF) subject to a number of Conditions.

2.2 Condition No. 23 related to vibration and stated:

"No development shall commence until the developer has received written approval from the local planning authority for a scheme to manage vibration which may arise in relation to industrial premises in the vicinity of the substation as a result of:

- *Construction works in connection with any parts of the development; and*
- *Operation of the substation*

The submitted scheme shall include details of existing baseline levels of vibration; predicted or modelled levels of vibration from construction and operation; measures which will be implemented to control vibration to acceptable levels; details of how vibration will be monitored during the construction and operational phase of the development; and the timing of the carrying out of the works proposed to control vibration"

Vibration Limits

2.3 It is known that some of the manufacturing processes that take place at the Qioptiq facility are sensitive to vibration. It is understood that the process at Qioptiq with the highest sensitivity to vibration is also the process located closest to the proposed substation. It follows, therefore, that if vibration at this building is acceptable then it will also be acceptable at all other areas of the premises.

2.4 Qioptiq Limited has not been able to provide any vibration limits for the most sensitive process and the magnitude of vibration to which the process may be safely exposed is not known. However, BS 5228 part 2 (2009) suggests that limits as low as 3 $\mu\text{m/s}$ rms velocity may be appropriate. This is equivalent to a peak particle velocity of 0.004 mm/s.

2.5 It is understood that the process currently operates without any disturbance from existing vibration and it follows, therefore, that an appropriate vibration criteria may be to ensure that vibration generated by the construction and operation of the substation should not exceed existing vibration levels at the facility. In practice, this may lead to vibration limits which are more stringent than necessary.



2.6 It has been assumed that the Peak Particle Velocity (PPV) is an appropriate vibration metric to use for assessing the magnitude of vibration at the facility.



3. SITE LAYOUT AND PROPOSED CONSTRUCTION ACTIVITIES

Site Layout

- 3.1 The proposed substation site is located near to St Asaph Business Park, St Asaph, Denbighshire, North Wales and is shown on Figure 1.
- 3.2 The Qioptiq facility is located due north of the proposed substation. The building housing the most sensitive process is circa 130 metres from the closest part of the substation and is also shown on Figure 1.
- 3.3 The building housing the most sensitive manufacturing process has a certain degree of resilience to vibration built in. The manufacturing equipment is mounted on a concrete slab, which sits on resilient material, inside an outer concrete slab. All adjacent plant is mounted on isolating mounts. The vibration transfer function between the "outer" and "inner" slabs is not known.
- 3.4 It is understood that the manufacturing process occurs almost continuously, on a 24-hour basis.

Proposed Substation

- 3.5 The proposed works to the substation comprise the following:
 - installation of 132kV electricity cables;
 - construction of an access road;
 - construction of 132kV Gas Insulated Switchgear (GIS) substation;
 - construction of Static Var Compensation (SVC);
 - construction of a 400kV GIS substation;
 - installation of 132/400kV transformers;
 - installation of one 400kV underground cable circuit;
 - construction of approximately 400m of single circuit 400kV overhead line;
 - construction of a replacement tower on the existing 400kV overhead line; and
 - construction of a sealing end compound.



Construction Methodology

3.6 The following construction plant and activities will be used/undertaken at the site.

- CAT D6 or possibly D8 to carry out topsoil stripping and spreading of stone.
- Bomag 213 self-propelled vibrating roller or towed vibratory 72T roller behind D8. (A deadweight roller could be used if vibration is an issue of concern but would be less preferred).
- 30 ton tracked 360-degree excavator.
- 25 or 30 ton articulated dump trucks.
- Motor scrapers which may be used to carry out the levelling of the substation platform.
- 8 wheel delivery lorries importing fill/stone.
- A SOILMEC R622 Piling Rig with a capability of forming 23m CFA piles (or similar).
- 14 tonne tracked excavators.
- 9 tonne dumpers along with a Bomag 130 roller.
- Standard 8 wheel road wagons for stone deliveries/muck away.
- 25 tonne rough terrain crane.
- 6m³ capacity concrete wagons possibly with a 25m boom concrete pump.
- CAT D6 with Vibromax 651 towed roller or equivalent.
- For the road surfacing a VM132 Single Drum Roller (JCB) or equivalent
- Miscellaneous smaller plant would be used for constructing the roadways and substation compound finishings. These would include concrete trucks; paving machines; Bomag 120 or 130 rollers; 9-ton dumpers; JCB 3CX and 360 excavators both tracked and wheeled of various sizes up to about 20 ton; diesel generator.



4. VIBRATION MONITORING

- 4.1 Two separate vibration surveys have been undertaken as part of this project. Firstly, a baseline vibration survey has been undertaken at the Qioptiq facility in order to establish existing vibration levels. Secondly, vibration monitoring has been undertaken at an existing similar substation in order to determine vibration levels generated by the substation equipment.

Baseline Vibration Survey

- 4.2 In order to assess existing vibration levels at the Qioptiq site, vibration monitoring was undertaken from 13:00 hours on Friday 6 March 2009 to 11:00 hours on Friday 13 March 2009.
- 4.3 A Vibrock V901 seismograph was used to undertake the vibration monitoring. The instrument was located on the "outer" concrete slab within the nearest building, adjacent to the rear door leading inside the manufacturing area. The measurement position is shown on Figure 1.
- 4.4 The sensors of the V901 were rigidly mounted to a heavy plate fitted with spiked feet and the plate was rested directly onto the concrete slab. The X- and Y-axes (in the horizontal plane) were orientated so that the X-axis pointed towards the proposed substation, and the Y-axis was perpendicular to this direction. The Z-axis was in the vertical direction.
- 4.5 The instrument was set to log the PPV every 30 seconds, continuously over the survey period. The measured PPVs are shown in Figures 2 to 9.
- 4.6 The measured PPVs were generally around 0.1 to 0.2 mm/s, but there were peaks up to 2.2 mm/s.

Source-Term Vibration Survey

- 4.7 In order to assess likely vibration from the operation of the proposed substation, vibration monitoring was undertaken at an existing operational substation.
- 4.8 Vibration monitoring was undertaken at the National Grid Legacy Substation, Wrexham Maelor on Friday 13 March 2009.

- 4.9 Vibration measurements were taken at a total of five locations, at various distances from the transformers and the manually switched capacitor bank. The measurement locations are shown on Figure 10.
- 4.10 There are a total of four transformers on the site and these are of a similar size to the transformers proposed for St Asaph (240 mVA). Vibration monitoring was undertaken near two of these transformers. Transformer SGT3 was operating on hot standby during the survey, meaning that the transformer was energised, but off-load. The adjacent transformer, which is older, was operating normally.
- 4.11 A Vibrock V901 seismograph was used to undertake the vibration monitoring. The sensors of the V901 were rigidly mounted to a heavy plate fitted with spiked feet and the plate was rested directly onto the concrete roadway. The X- and Y-axes (in the horizontal plane) are shown on Figure 10. The Z-axis was in the vertical direction.
- 4.12 The instrument was set to log the PPV every 30 seconds, and was positioned at each measurement position for circa 2 minutes. The results of the monitoring are summarised in Table 4.1.

Table 4.1: Results of Source Term Vibration Monitoring

Receptor number	Location	Highest Measured PPV (mm/s)
V1	8 metres from older transformer	0.18
V2	15 metres from older transformer, 20 metres from SGT3	0.18
V3	8 metres from SGT3	0.18
V4	20 metres from SGT3	0.18
V4	4 metres from manually switched capacitor bank	0.18

- 4.13 Table 4.1 shows the measured vibration level to be 0.18 mm/s at all five measurement locations. It is considered that this level actually represents the noise floor of the instrument and that the actual vibration level is likely to be lower. However, in order to provide a worst case, the assessment has been based on the measured level.

5. VIBRATION ASSESSMENT

5.1 Vibration generated by the construction and operation of the substation has been assessed separately and each assessment is detailed below.

Construction Vibration

5.2 The plant that will be used for construction is detailed in Section 3.6. Of this plant, the items that are significant, in terms of vibration are as follows:

- Bomag 213 Vibrating roller or Vibratory 72T roller
- Soilmec R622 Piling Rig
- Bomag 130 roller
- Vibromax 651 towed roller
- VM132 Single Drum Roller or equivalent

5.3 The closest location of the proposed works to the nearest Quiptiq building is 130 metres and, in order to represent a worst-case assessment, this distance has been used in the vibration calculations.

5.4 It is understood that all piling will be undertaken using the Soilmec R622 Piling Rig and that piles will be installed using the continuous flight auger (CFA) method. This method involves using an auger to bore a hole into the ground. Then, as the auger is extracted, concrete is pumped through a hole in the centre of the auger to place concrete into the void. This method of piling generates very little vibration and vibration at 130 metres from the activity will be insignificant.

5.5 It is not currently known whether casings will be used for the piles. However, empirical evidence from BS 5228-2:2009 suggests that vibration at 130 metres from casing installation will be significantly lower than the existing PPVs measured on the outer slab.

5.6 It is also not currently known whether re-bar will be installed into the piles. If it is required, then it will be placed either by the piling rig or by an attendant crane. This operation does not normally generate significant levels of vibration, but care should be taken to ensure that the concrete is sufficiently pliable to push the re-bar into place.

- 5.7 Vibration calculations have been undertaken for the various rollers that will be used using the procedures outlined in Annex E of BS 5228-2:2009. Full calculations are presented in Appendix A.
- 5.8 In order to provide a cautious assessment, the values used in the assessment are those corresponding to 5% probability of predicted values being exceeded. The distance used (130 metres) is slightly higher than the maximum distance for the calculation procedure of 110m and the highest amplitudes (2 mm) are slightly higher than the maximum amplitude for the calculation procedure (1.72mm), but it is considered to be reasonable to extrapolate the equations for these values.
- 5.9 PPVs have been calculated during both the normal operation of the rollers, and also during the startup/rundown period, when vibration levels may be higher.
- 5.10 Calculated PPVs are summarised in Table 5.1. The calculated PPVs refer to the level anticipated in the freefield.

Table 5.1: Calculated PPVs from Vibratory Rollers

	Calculated freefield PPV at Hologram building (mm/s) (5% probability of predicted value being exceeded)	
Roller	Steady State (Normal Operation)	Startup/rundown
Bomag 213	0.5	0.8
Vibratory 72T	Note 1	Note 1
Bomag 120/130	0.1	0.2
Vibromax 651	0.3	0.5
Vibromax VM132	0.5	0.9

Note 1: Details were not available for the 72T roller, but vibration from it is not anticipated to exceed that from the other types of roller.

- 5.11 The calculated PPVs shown in Table 5.1 correspond to free-field levels. There will be a transfer function between these freefield levels and the levels on the “outer” slab. There will also be a second transfer function between the “outer” and “inner” slab.



- 5.12 These transfer functions are not known, and so it is not possible to calculate the PPV on the outer slab or the inner slab. However, the transfer function from the freefield to the outer slab will certainly be below unity and the anticipated PPV on the outer slab will therefore be below 0.9 mm/s during operation of all the rollers assessed.
- 5.13 Anticipated PPVs on the outer slab are therefore lower than those measured during the baseline vibration survey and, therefore, should not interfere with the manufacturing process. However, it is recommended that some vibration monitoring be undertaken during periods when vibratory rollers are used and when piling is carried out. This monitoring is discussed in Section 6.
- 5.14 In order to minimise the magnitude of vibration generated by the construction works, the following mitigation measures should be adopted as good practice:
- care should be taken in the placement of heavy loads to avoid dropping;
 - access roads should be maintained to ensure there are no step changes in the road surface; and
 - where aggregate and other material is placed, it should be placed from the minimum height possible.

Operational Vibration

- 5.15 The transformers are to be mounted on anti-vibration mounts, which are designed to protect the transformers from excessive movement, in addition to minimising the transmission of vibration into the ground.
- 5.16 Source term vibration measurements have indicated that, even adjacent to the transformers, the PPV is unlikely to exceed 0.18 mm/s.
- 5.17 Vibration at 130 metres from the transformers will therefore be negligible and will be significantly lower than the measured baseline vibration at the nearest Qioptiq building.
- 5.18 It is concluded, therefore, that vibration from the operation of the substation will be insignificant in terms of its effect at the Qioptiq premises.



6. VIBRATION MONITORING DURING CONSTRUCTION

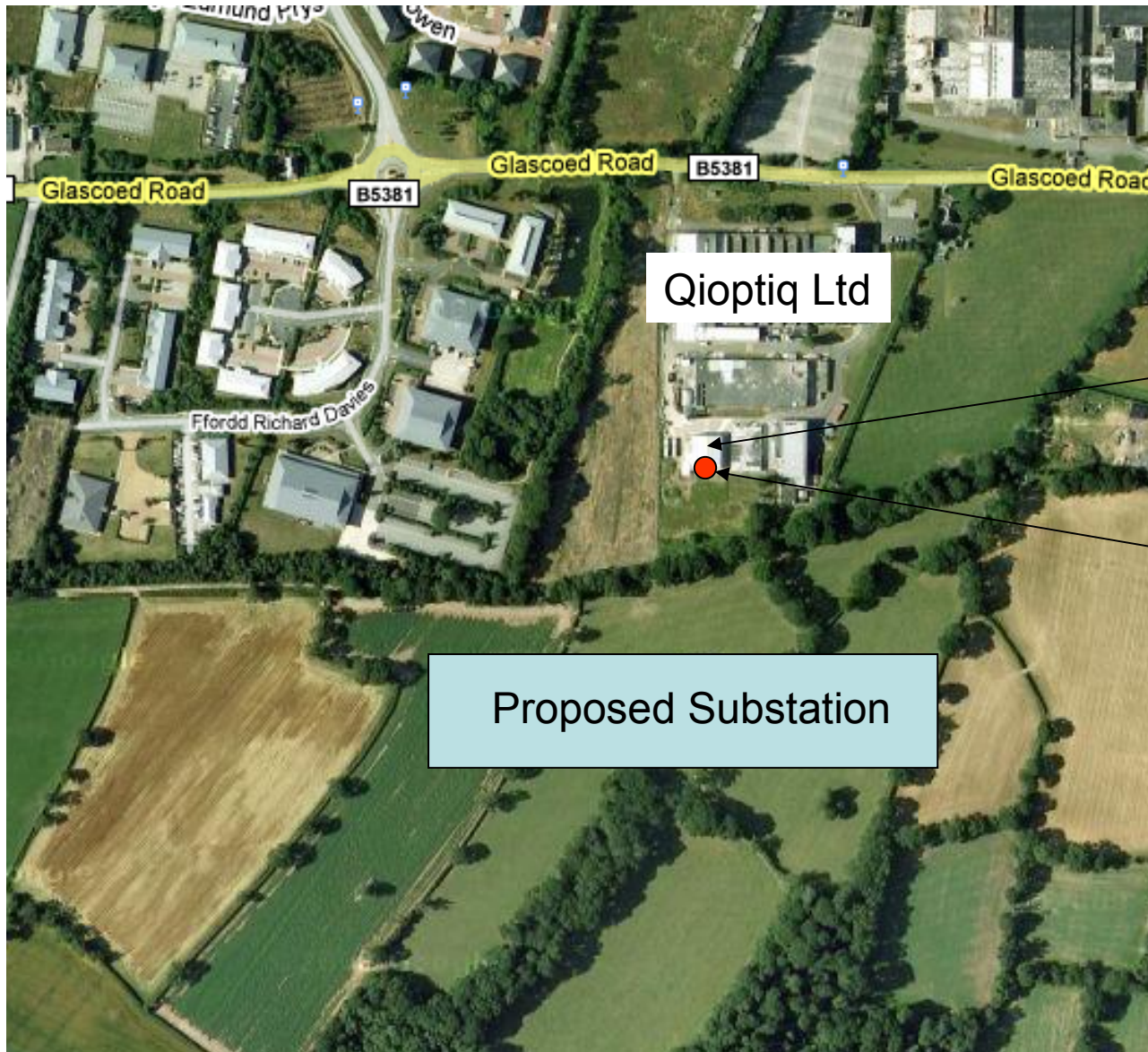
- 6.1 The assessment of vibration from the construction phase of the project has indicated that vibration will be below the existing baseline levels at the nearest building.
- 6.2 However, it is recommended that vibration monitoring be undertaken during phases of the construction when significant vibration could be generated. Specifically these relate to periods when vibratory rollers are used and when piling is being carried out.
- 6.3 The purpose of the measurements will be twofold. Firstly, they will validate the vibration predictions presented in this report. Secondly, in the event that there is suspicion that vibration may have affected any manufacturing process at Qioptiq, they may be used to determine whether the construction activities were in fact responsible.
- 6.4 It is recommended that vibration monitoring is undertaken simultaneously at two locations, as follows:
- Location 1: On the outer slab, at the same location used in this assessment; and
 - Location 2: On the southern boundary of the Qioptiq premises, close to where the works are being undertaken.
- 6.5 The adoption of these two locations will therefore allow any potential disturbance to any manufacturing process to be investigated. It will allow confirmation that a high level of vibration occurred, that the source of this vibration was external to the building, and also that the source was located on the Project Construction area.
- 6.6 These monitors should be fitted with communication so that in the event of levels of vibration being experienced on the building slab exceeding that measured in the baseline studies, notification is made to the Gwynt y Mor Offshore Wind Farm's construction site manager and Qioptiq's site manager. This will allow very fast response to identify possible cause of the vibration. The monitor at the site boundary will be able to 'correlate' with the monitor on the building slab to confirm if the vibration incident recorded at the building has its source on the construction site. In the event of a vibration incident occurring contrary to the anticipation from this study, this will immediately identify an incident and allow its source to be traced so that remedial action can be taken.



7. CONCLUSIONS

- 7.1 The results of the vibration assessment demonstrate that vibration levels anticipated during the construction phase of the Project should be below existing vibration levels at the nearest Qioptiq building. Construction vibration is therefore considered to be acceptable, but it is recommended that vibration monitoring be carried out during piling activities and the use of vibratory rollers.
- 7.2 Operational vibration from the substation is considered to insignificant in terms of its effect at the Qioptiq premises.
- 7.3 It is concluded, therefore, that vibration generated by the construction and operation of the proposed substation will be acceptable and will not affect the operation of the Qioptiq premises.
- 7.4 Condition 23 to the grant of planning permission for the substation (see Section 2 above) requires a scheme to manage vibration which may arise from construction or operation of the substation. This report includes the appropriate details to form a scheme which would discharge the planning condition, subject to appropriate monitoring being undertaken during construction activities which may generate significant vibration levels.
- 7.5 The assessment has considered the manufacturing processes at the Qioptiq facility that are known to be potentially sensitive to vibration. There are other occupied office and commercial buildings to the north of the proposed substation site which are not known to be particularly sensitive to vibration. The results of the study demonstrate that no adverse effects are anticipated to arise on these other premises as a result of vibration from construction or operation of the substation.

Figures



Qioptiq building
closest to proposed
substation

Vibration
Monitoring location

Proposed Substation



Phlorum Limited, The Sussex Innovation Centre,
Science Park Square, Falmer, East Sussex,
BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
Web: [REDACTED]
Email: info@phlorum.com

Title: **Site Layout and Vibration Monitoring Location**

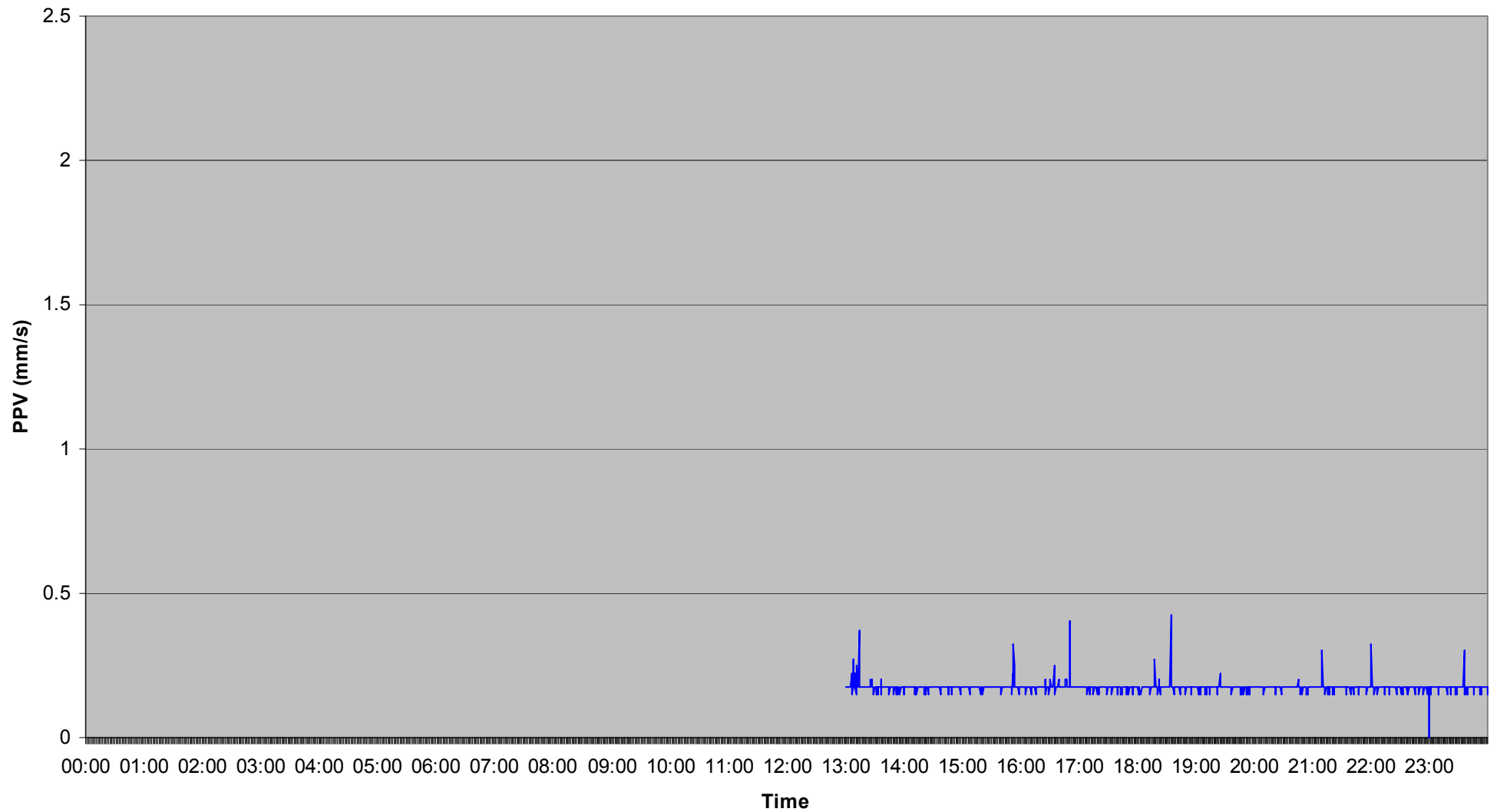
Figure No: **1**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Phlorum Limited, The Sussex Innovation Centre,
 Science Park Square, Falmer, East Sussex,
 BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
 Web: [REDACTED]
 Email: info@phlorum.com

Title: **St Asaph: Vibration Monitoring Results, Friday 6 March 2009**

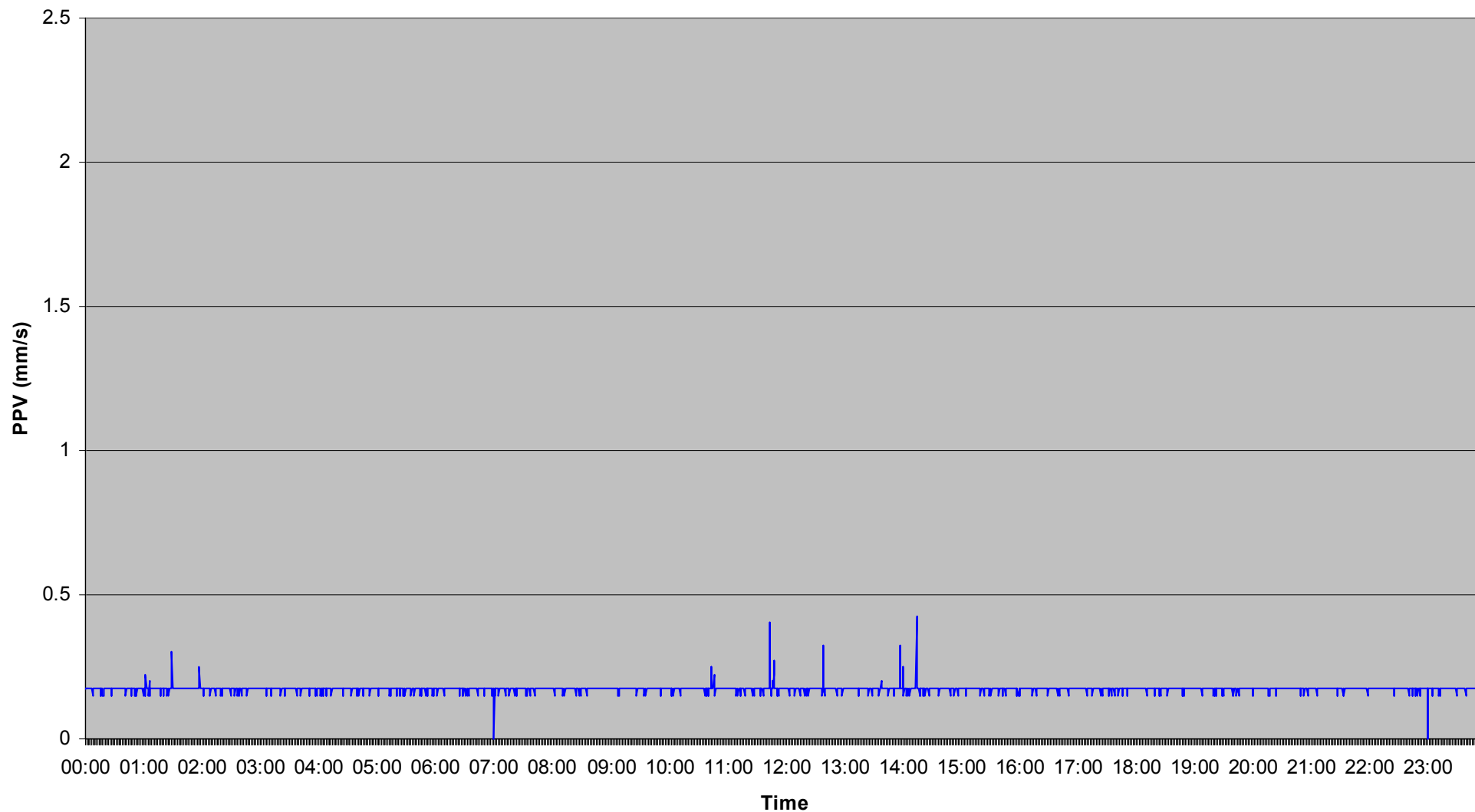
Figure No: **2**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Phlorum Limited, The Sussex Innovation Centre,
 Science Park Square, Falmer, East Sussex,
 BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
 Web: [REDACTED]
 Email: info@phlorum.com

Title: **St Asaph: Vibration Monitoring Results, Saturday 7 March 2009**

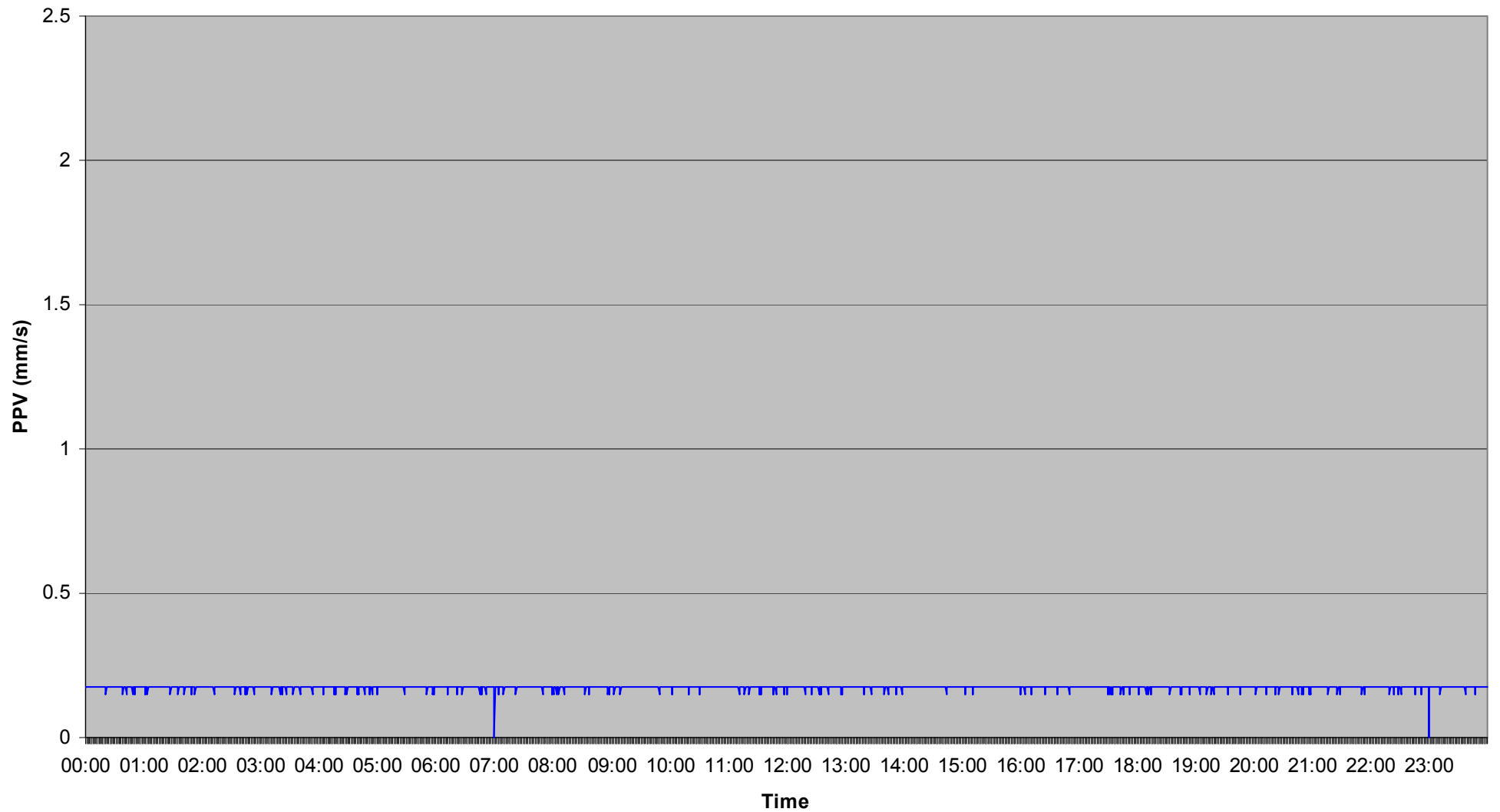
Figure No: **3**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Phlorum Limited, The Sussex Innovation Centre,
 Science Park Square, Falmer, East Sussex,
 BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
 Web: [REDACTED]
 Email: info@phlorum.com

Title: **St Asaph: Vibration Monitoring Results, Sunday 8 March 2009**

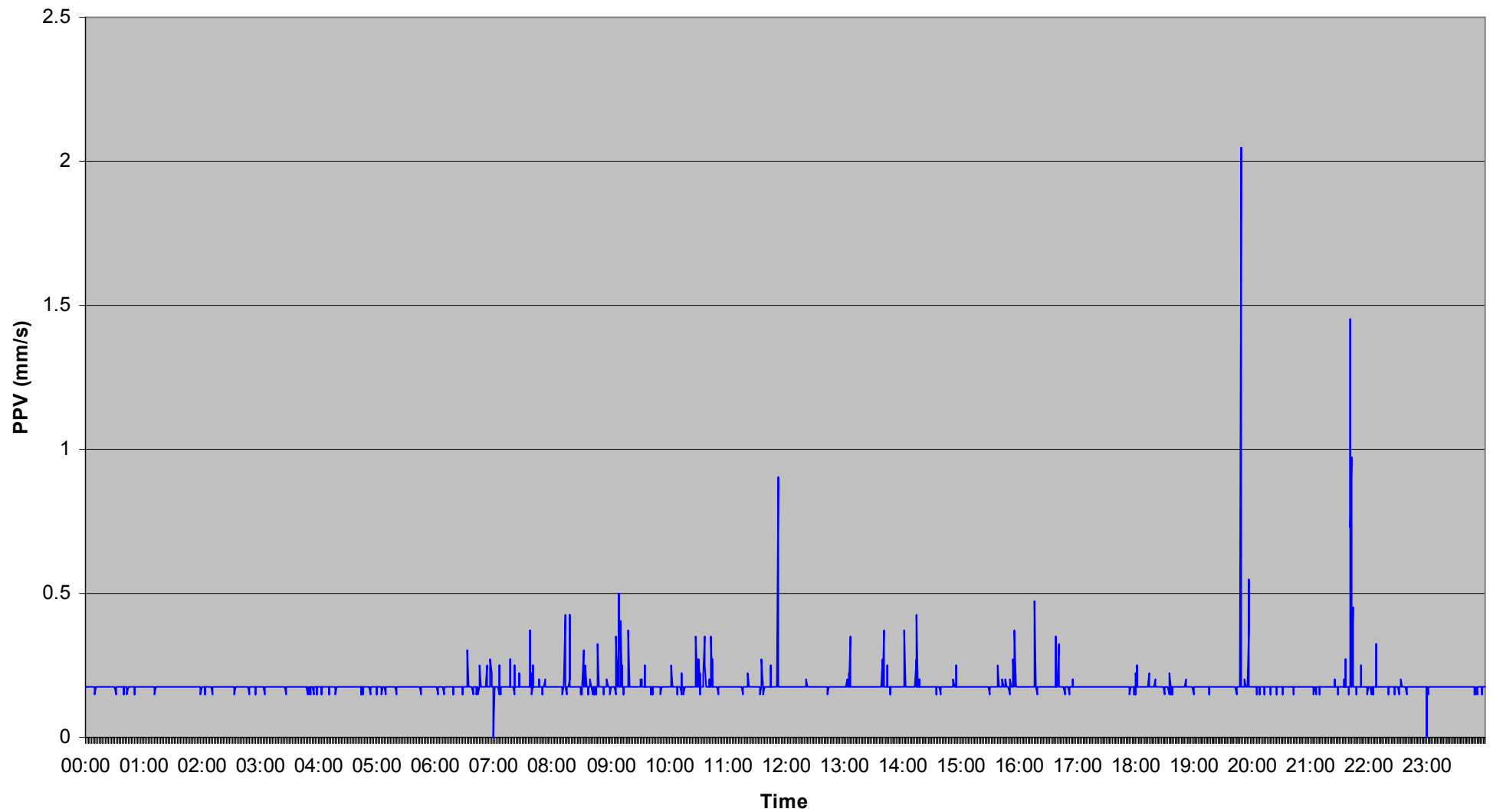
Figure No: **4**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Phlorum Limited, The Sussex Innovation Centre,
 Science Park Square, Falmer, East Sussex,
 BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
 Web: [REDACTED]
 Email: info@phlorum.com

Title: **St Asaph: Vibration Monitoring Results, Monday 9 March 2009**

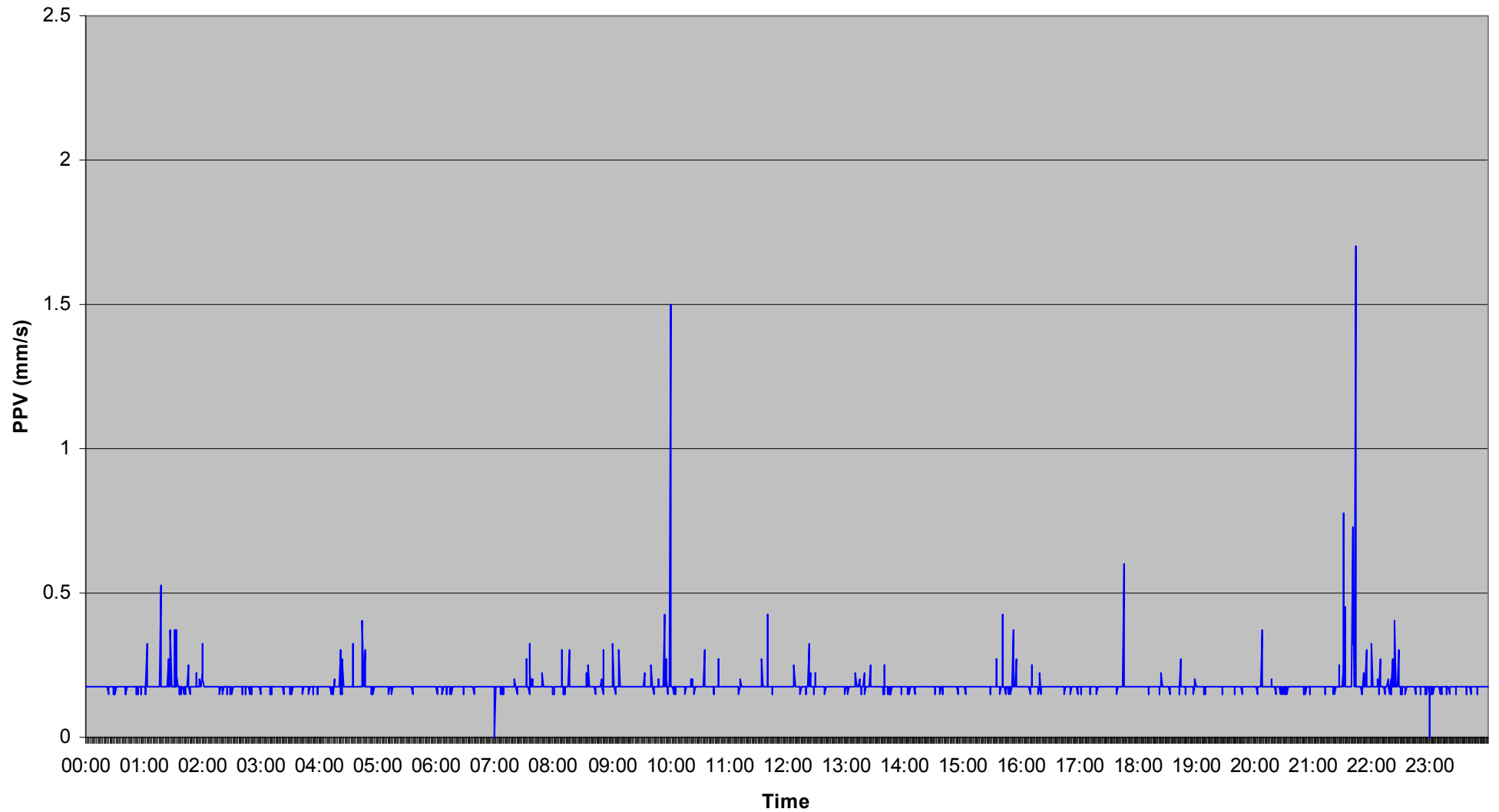
Figure No: **5**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Phlorum Limited, The Sussex Innovation Centre,
Science Park Square, Falmer, East Sussex,
BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
Web: [REDACTED]
Email: info@phlorum.com

Title: **St Asaph: Vibration Monitoring Results, Tuesday 10 March 2009**

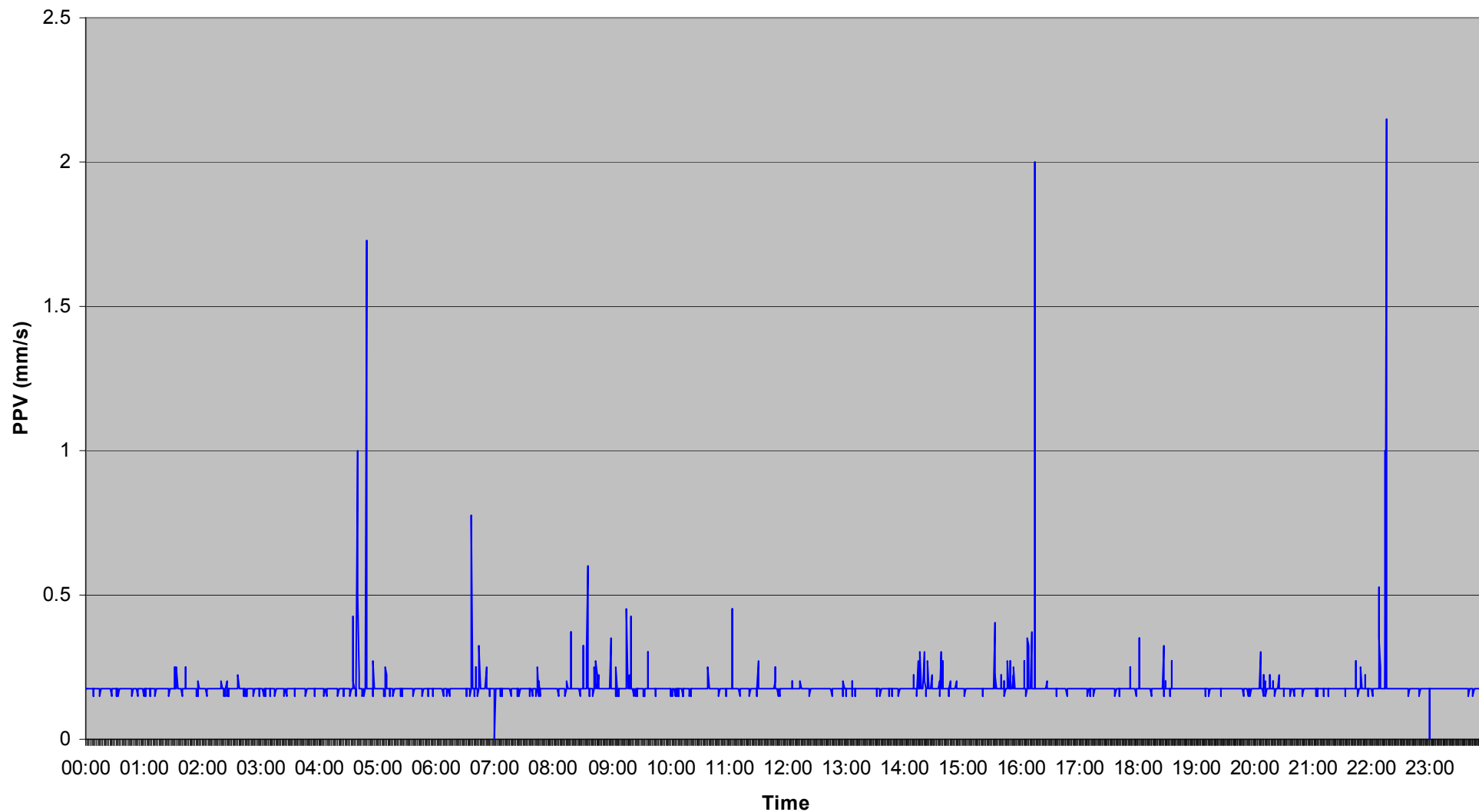
Figure No: **6**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Phlorum Limited, The Sussex Innovation Centre,
 Science Park Square, Falmer, East Sussex,
 BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
 Web: [REDACTED]
 Email: info@phlorum.com

Title: **St Asaph: Vibration Monitoring Results, Wednesday 11 March 09**

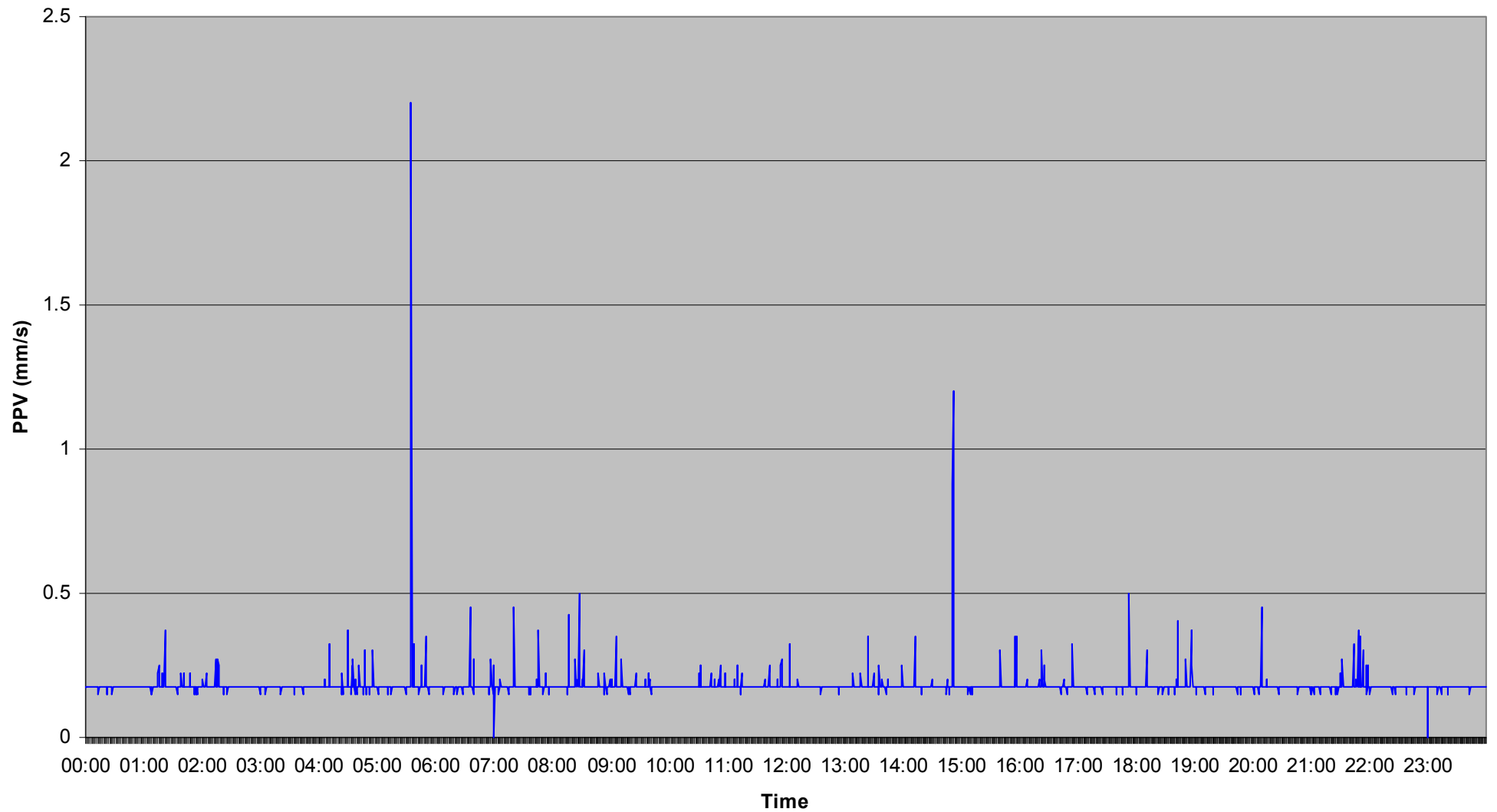
Figure No: **7**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Phlorum Limited, The Sussex Innovation Centre,
 Science Park Square, Falmer, East Sussex,
 BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
 Web: [REDACTED]
 Email: info@phlorum.com

Title: **St Asaph: Vibration Monitoring Results, Thursday 12 March 2009**

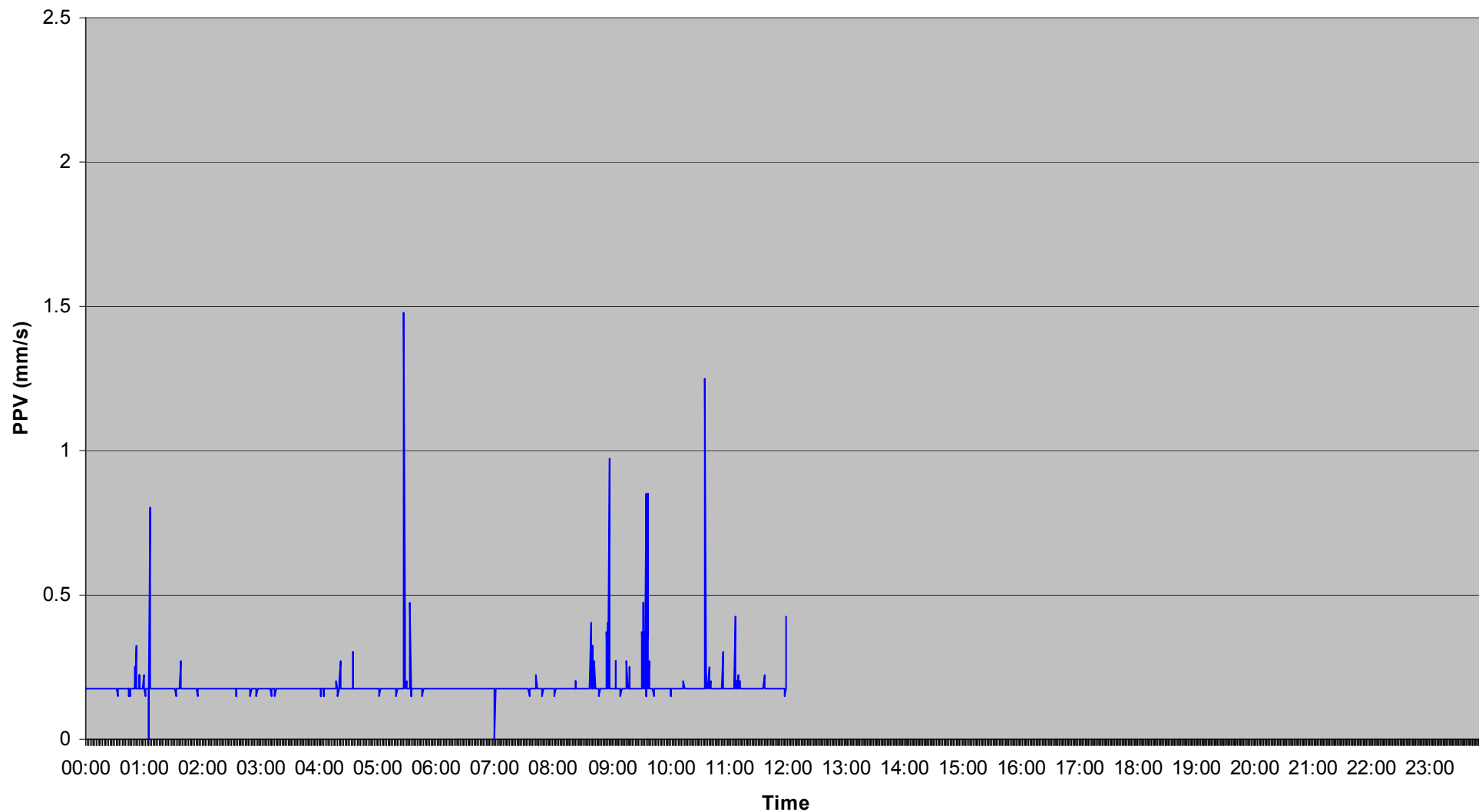
Figure No: **8**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Phlorum Limited, The Sussex Innovation Centre,
 Science Park Square, Falmer, East Sussex,
 BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
 Web: [REDACTED]
 Email: info@phlorum.com

Title: **St Asaph: Vibration Monitoring Results, Friday 13 March 2009**

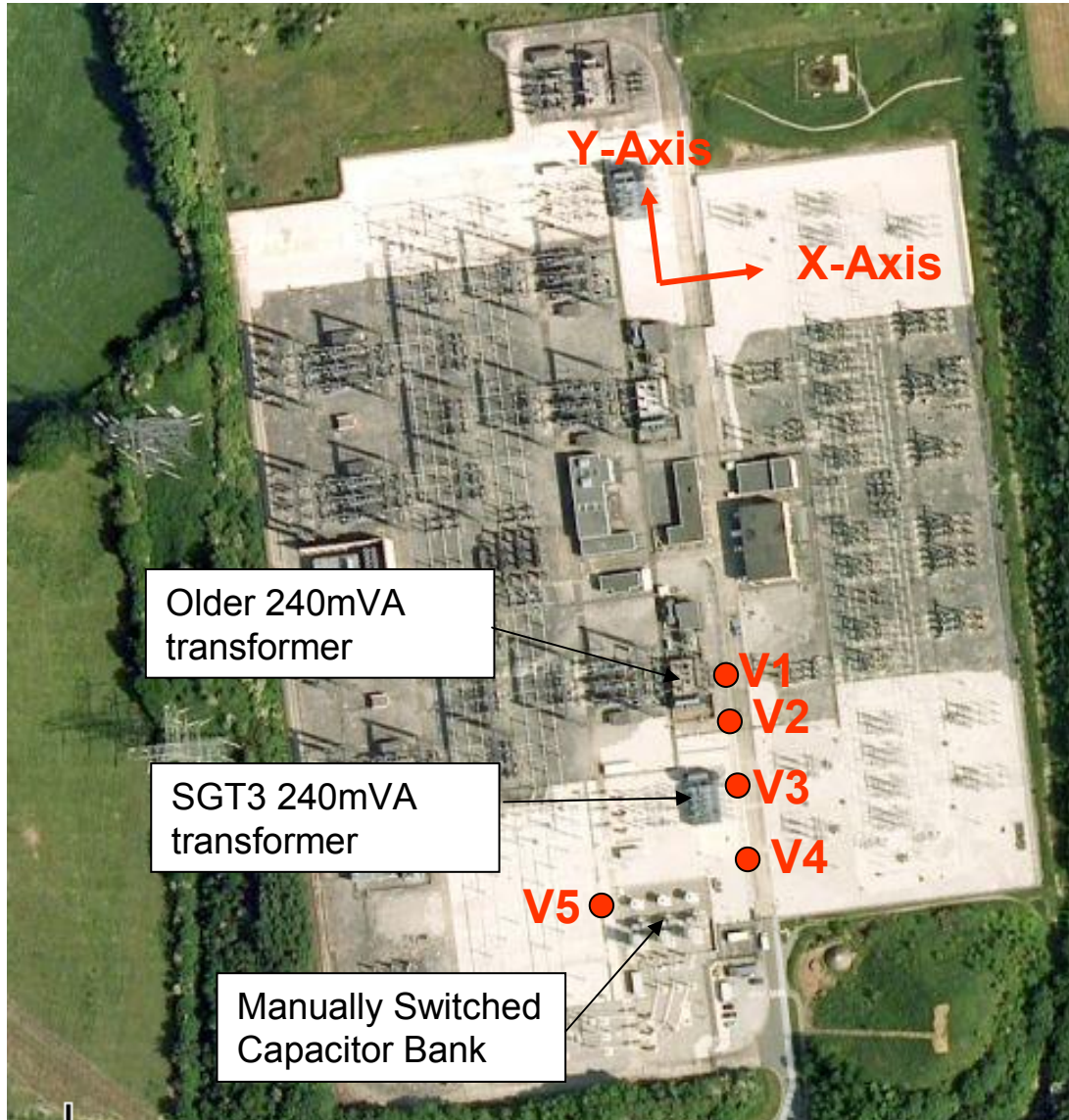
Figure No: **9**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB



Key:

● V1 Vibration Monitoring Location



Phlorum Limited, The Sussex Innovation Centre,
Science Park Square, Falmer, East Sussex,
BN1 9SB.

Tel: +44(0)1273 7044 49 Fax: 01273 7044 99
Web: [REDACTED]
Email: info@phlorum.com

Title: **Vibration Monitoring Locations at Legacy Substation**

Figure No: **10**

File: /jobnos/3741_S/figures.ppt

Date: 08 April 2009

Created by: DJN

Checked by: PB

Appendix A

Calculation of Vibration from Vibratory Rollers

Appendix A: Calculation of Vibration from Vibratory Rollers

Roller Specifications						Calculated PPV (freefield) (mm/s)							
Type	No. of drums	Amplitude (mm)	Distance (m)	Roller drum width (m)	Frequency (Hz)	Steady State (Ks)			Startup/rundown (Kt)				
	n _d	A	X	L _d		Equation excluding scaling factor	75	143	276	Equation excluding scaling factor	65	106	177
							50%	33.30%	5%		50%	33.30%	5%
Bomag 213	1	1.9	130	2.13	30/36	0.00172	0.1	0.2	0.5	0.00458	0.3	0.5	0.8
Vibratory 72T			130			0.00000	0.0	0.0	0.0	0.00000	0.0	0.0	0.0
Bomag 120/130	2	0.51	130	1.2	70	0.00034	0.0	0.0	0.1	0.00091	0.1	0.1	0.2
Vibromax 651	1	1.35	130	2.1	40	0.00103	0.1	0.1	0.3	0.00274	0.2	0.3	0.5
VM132 Single Drum roller	1	2	130	2.1	29/36	0.00186	0.1	0.3	0.5	0.00495	0.3	0.5	0.9





RWE Renewables UK Swindon Limited

Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire SN5 6PB
T +44 (0)8456 720 090

Registered office:
RWE Renewables UK Swindon Limited
Windmill Hill Business Park
Whitehill Way
Swindon