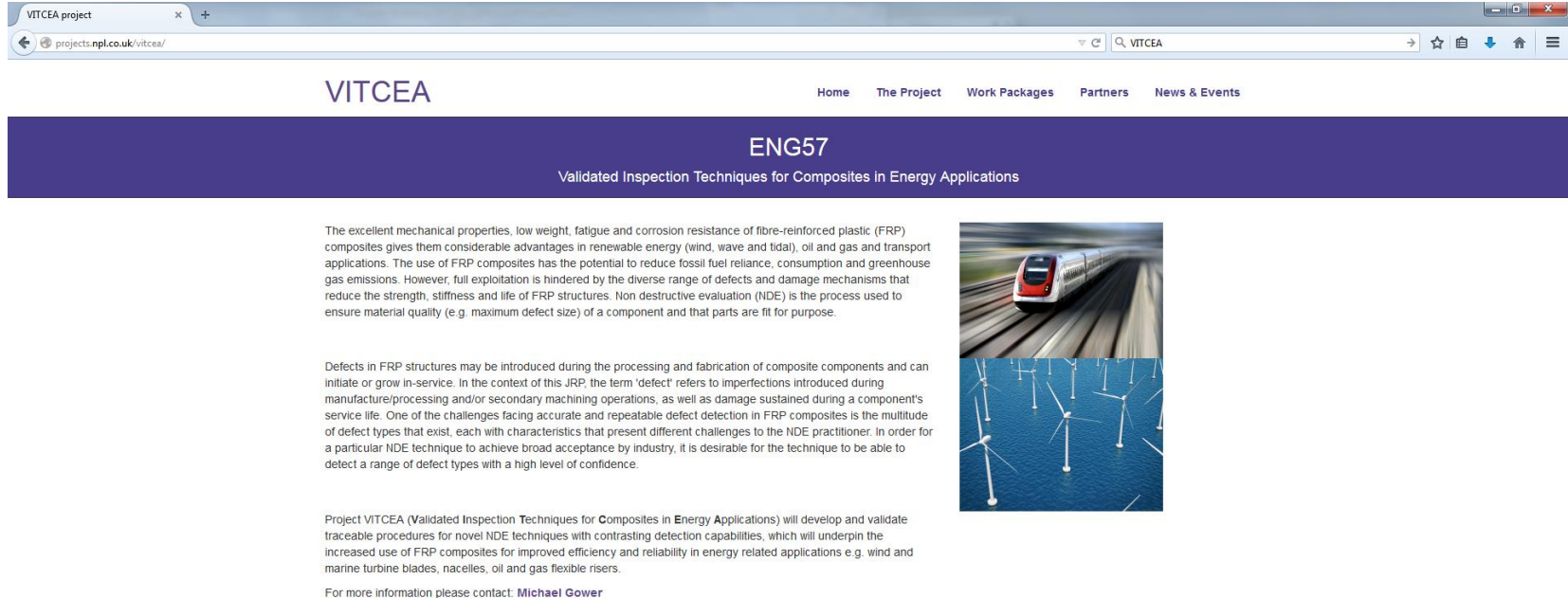


# Validated Inspection Techniques for Composites in Energy Applications (VITCEA)

# Website



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## The Project

### Overall Objective

Project VITCEA will encourage industry adoption and the realisation of promising NDE techniques, such as microwave, active thermography, laser shearography and phased array/air-coupled ultrasonics, thus enabling the increased use of FRPs for energy applications. This will be achieved through the provision of operational procedures based on the comprehensive evaluation and development of each technique for detecting a range of defects typical to FRP composites that are used in wind, wave, tidal, oil and gas and transport sectors.

### Timescale

The VITCEA project runs from July 2014 to June 2017

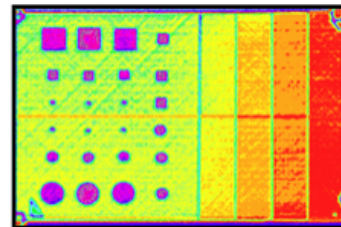
### Project Summary

A summary of the project is available on the [EMRP website](#).

### Key Scientific and Technical Objectives

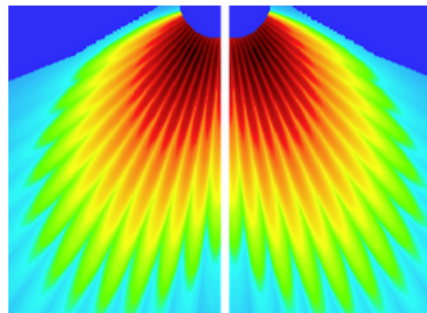
The four main objectives of the JRP are:

- To design and manufacture suitable natural and artificial reference defect artefacts representative of the materials and defects typically found in, and of concern to, the renewable energy (wind, wave, and tidal), oil and gas and transport sectors,
- To develop operational procedures, drafted in the style of CEN and ISO standards, for: microwave; active thermography; laser shearography, and phased array ultrasonic techniques. The specific metrology objectives are to:
  - i. Establish the limits of detection for each NDE technique,
  - ii. Develop analytical techniques for accurately sizing defects for the different NDE techniques. The NDE results will be compared with independent characterisation techniques,
  - iii. Compare the merits of each NDE technique for different defect types found in a broad range of composite material systems using an objective probability of detection (POD) benchmarking framework.
  - iv. Advance the theoretical simulation of the inspection techniques in particular taking into account the intrinsic anisotropic nature of composites and their constituents,
- To evaluate the POD methodology, based on modelling simulations with the aim of reducing the cost and time requirements of intensive experimental POD trials,
- To validate and refine operational procedures via intercomparison exercises and field trials in collaboration with organisations from the renewable energy (wind, wave and tidal), oil and gas and transport sector supply chains. Defect artefacts will be inspected using the developed operational procedures.



### Advancing the state-of-the-art

- Development of novel defect manufacturing methods and production of energy sector specific reference defect artefacts
- Formulation and validation of operational procedures for novel NDI techniques applied to FRPs,
- Development of novel measurement techniques for characterising underpinning material properties
- Development of NDI technique specific data reconstruction and signal processing methods for defect sizing
- Development of predictive models simulating defect detection
- Theoretical POD assessments for FRPs using novel NDI techniques
- Generation of comparative experimental and theoretical POD data



## Work packages

- Work Package 1: Industrial consultation, design and manufacture of defect artefacts
- Work Package 2: Property characterisation of materials used in the production of Reference and Natural Defect Artefacts (RDAs/NDAs)
- Work Package 3: Development and evaluation of scanning NDE techniques (ultrasonics and microwave)
- Work Package 4: Development and evaluation of full-field, non-contact NDE techniques (active thermography and laser shearography)

The aim of this work package is to optimise and validate active thermography and laser-shearography as full-field, fast and non-contact NDE techniques for quantitative testing of FRP structures. The main objective of the application of these methods is the detection and quantitative characterisation of defects based on parameters such as size and depth. Initially, the methods will be evaluated to define the selection of excitation sources, methods of data acquisition and algorithms used for data analysis and visualisation. Subsequently, validation using the RDAs and NDAs from WP1 will be carried out and the possibility of a direct simultaneous application and comparison of active thermography and laser-shearography will be investigated.

The main challenge for WP4 will be the quantitative characterisation of real defects. Real defects are generally not well-defined either in shape, nature or boundaries. In addition, adhesion strength may be highly variable over the delaminated area, thus making quantitative analysis of delamination size difficult. Similarly, fibre misalignment, fibre waviness or deep sub-surface defects may show only weak surface perturbations as the penetration depth of these surface measuring methods is limited, making these types of defect difficult to detect. Another important factor is the detection and quantification of impact damage, where often the larger damage area or splitting appears at the back face of the structure, which is not always accessible. In order to address these challenges, a systematic evaluation of the limits of each NDE method will be required.
- Work Package 5: Intercomparison exercises, field trials and finalisation of operational procedures
- Work Package 6: Creating Impact

## The Project Consortium

The VITCEA consortium brings together the expertise of leading European NMs with extensive capabilities and experience in FRP composites and NDI metrology. The core research to be addressed by project VITCEA will be undertaken by NPL, BAM, PTB and CMI, each with a substantial capability in their respective areas. The project is coordinated by NPL, which has significant experience in managing international research and development projects. The project structure has been arranged carefully to maximise impact and avoid duplication of work.

Of the participating NMs:

- NPL will bring expertise in microwave and full-field strain mapping inspection techniques, as well as innovative dissemination capability in the form of online training (e Learning). NPL will also bring significant experience in the production of Good Practice Guides, drafting of standards (20+ in FRPs) and intercomparison exercises for obtaining precision data.
- BAM will contribute experimental and modelling expertise in phased array and air coupled ultrasonics, and active thermography inspection,
- PTB will bring expertise in thermal and optical property measurements for FRP composites and modelling of microwave propagation in anisotropic materials,
- CMI will bring expertise in the measurement of in-plane and out-of plane thermal properties for FRP composites.

In January 2015 the project will be joined by the Commissariat à l'énergie atomique et aux énergies alternatives (CEA) as an integral REG. CEA will contribute state-of-the-art modelling capability (CIVA software) that will be used to simulate and guide experimental assessment of POD for ultrasonic inspection and enhance the ultrasonic modelling at BAM by addressing the effects of curvature and attenuation in thick FRP components. They will also assist in the calculation of POD curves using experimental and theoretical data for microwave, active thermography and laser shearography techniques.





## News & Events

### Meetings

#### Stakeholder Committee

Date: Ongoing

Nominations are being received by the project coordinator (Michael Gower) for membership of the project stakeholder committee. Nominate yourself or a colleague (one per organisation) to be a member of this group. Membership is voluntary - you receive communications from the project on the status, early drafts of papers and reports that are project outputs and invitations to attend the mid-term meeting and final project meeting (and workshops). Make sure the project outputs are tailored to your own requirements by joining the Stakeholder Committee.

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#### Partner Meeting

Date: 18 February 2015

Location: BAM, Germany

The next VITCEA Partner meeting will be held at BAM, Germany on 18 February 2015.

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#### Project Workshop

Date: 17 February 2015

Location: BAM, Germany

The first of two VITCEA workshops will be held at BAM, Germany on 17 February 2015. All project partners will present the outputs of their work and invited stakeholders will be asked to highlight ongoing needs for further research.

[Workshop Agenda and Details](#) 

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#### Project Kick-off meeting

Date: 29 - 30 July 2014

Location: NPL, Teddington, UK

The first VITCEA project meeting was held at NPL, Teddington, UK, to formally launch the project.

# Future events

- ▶ workshop at the end of the project
- ▶ training courses on selected techniques @BAM, NPL
- ▶ e-Learning modules

# THANK YOU!