

## II.A. Tank Testing

### Purpose of Tank Testing

Tank testing is performed to obtain high quality data for a proposed device under a controlled environment. Estimates of final performance may also be obtained against a selection of idealised sea conditions. Tank Testing includes small scale through larger scale model testing including preliminary analysis of power takeoff.

### Objectives of Tank Testing

Tank testing, typically carried out early in the development programme, has the following objectives:

- A. Characterise the performance by investigating the behaviour of the device under controlled conditions in order to confirm device operation and calibrate analytical models and software;
- B. To investigate the impact of different configurations, dimensions and other component changes on device performance and survivability. This earlier stage testing leads to a better understanding of the critical parameters influencing device performance and identifies parametric sensitivities within analytical models;
- C. To establish an early indication of the technical feasibility of the concept with respect to the behaviour of the device, energy conversion capabilities and identification of any potential 'show-stoppers';
- D. Following small scale testing, the screening of the different configurations and the improved simulation tools leads to focusing the main studies on the larger scale models to allow for the behaviour of the energy converter to be modelled more accurately, while still in a controllable environment and with reduced costs. Some parameter sensitivity studies are possible.

### Reporting from Tank Testing

Reporting from Tank Testing will cover three areas:

- i) Scope of the test
- ii) Report on the test
- iii) Post test evaluation

The Tank Testing scope needs to be clearly defined by a test specification that should define the following:

1. The areas of uncertainty and novelty that are to be addressed during the test;
2. The tests to be performed, including the range of hydrodynamic excitation, the model physical and control parameters and any modifications to the model, and the goal of the tests with respect to elucidating model performance and behaviour;
3. Required minimum qualification of tank testing to satisfy the range of

tests to be performed, compatible with the model scale and objectives of the test;

4. Reporting requirements, i.e. content and parameters to be reported;
5. Required Certification of Tank Test;
6. Requirements for traceability of results, storage of results and integrity of data.

The Tank Test reporting should:

1. Define the objectives of the test, how the objectives have been achieved considering the scope of the test, a
2. Describe the implications of the model scale effects used regarding the objectives of the test;
3. Define the roles of the device developer, test tank facility and any independent third party if involved
4. Describe the test carried out including: model characteristics, facilities, sea states / flow conditions implemented and the reasons for their selection, equipment used for measurements and the data processing and presentation techniques adopted and associated inaccuracy, description of the parameters to be monitored and the reasons for their selection, recommendations for next steps;
5. Define the status of the product development, for instance first trial prototype, pre-commercial pilot, commercial qualification, etc;
6. Report the target of the tests, for instance first trial, preliminary result, result for R&D only, data to be made commercially available;
7. Define the conditions under which data was monitored. These should:
  - a. Reflect the setup and settings of the measurement during the tank tests and limitations (directionality, parameters not tested);
  - b. Consider the parameters influencing the initial assessment of power capture performance identified in this protocol. In the case that any parameter is not relevant to the application, justification should be provided on its use and the principles listed above applied.

Post Tank Testing Evaluation / Reporting:

1. Report on the device performance data
2. Comparison with model predictions

The results of the Tank Test should be compared to the predictions of the analytical model and reporting on the differences and recommended modifications / calibration of the analytical model should be discussed and reported. Further tests and recommendations regarding improvements and possible modifications on the configuration of the device should be considered.

It is possible that some concepts may need to deviate from the best practices given here. However, the deviations should be documented and should be in compliance with the principles given above.

## Contents of Protocol

### 1.Specification

- (i) Determining appropriate model scale
- (ii) Assessing physical scaling effects
- (iii) Determining an appropriate test matrix for assessing performance
- (iv) Specifying regimes for extreme conditions

### 2.Measurement

- (v) Provide a rationale for the type, number and duration of the measurements;
- (vi) Establish at what point in the power conversion chain measurement of power production should be ideally performed, and the consequences/measures to be taken if it is performed elsewhere;
- (vii) Describe the provisions for data archiving to ensure traceability and repeatability;
- (viii) Provide guidance on data quality assurance procedures data.

### 3.Analysis and presentation of results

- (ix) Recommend appropriate techniques for data processing including the generation of summary statistics and estimates of uncertainty;

### 4.Power performance

- (x) Recommend a procedure for displaying the performance of the device
- (xi) Provide equitable methodology for assessment of performance at the primary interface.
- (xii) Recommend procedures for determining the optimal loading condition under a range of test conditions.
- (xiii) Provide guidance on the normalisation of power performance assessments.

### 5.Model Verification

- (xiv) Provide procedures for verifying mathematical models.

### 6.Exclusions

This protocol will not provide guidance on physical power take-off system performance

## Principles

1. The selection of device scale and wave and flow conditions to be emulated within the test programme should be compatible with the capabilities of the test tank facility and correlate to realistic operating

conditions.

2. The tests must be documented to a level of detail that allows traceability of the results, identification of any limitations on a statistical basis, and quality of data capture and processing and/or any other aspect to be discussed including any impact on the conclusions of the tests and recommendations.
3. The level of detail, complexity and reporting is expected to increase as the scale of the model is increased. In some cases, the aspects investigated are expected to shift from parametric evaluation and performance improvement to definitions of system survivability, power generation, and interaction of power take-off with the structural / hydrodynamic response.
4. Tank testing results leading to the definition of mathematical models which can be used to dimension the different system components of a device must be independently verified.
5. Measurements should be sufficient to allow for calibration / verification of mathematical models in order to ensure that such models are also able to predict, within a reasonable level of certainty, the power production for different metocean conditions and site characteristics from those investigated. The levels of accuracy need to be stated and considered in the final calculation of power production.
6. The main parameters investigated for power production measurements are to be identified and described. Sensitivity tests should be considered to cope with uncertainty on tank test measurements, power take-off settings and the influence of different power take-off systems.
7. Any extrapolation of results should be clearly identified and will need to be based on trends manifested during measurements and levels of accuracy evaluated, and included in the conclusions and recommendations derived from such tests.
8. Reference should be made to any limitations on the measurement or data processing techniques or conditions investigated that may affect the overall power production calculations.
9. An independent party should be allowed to monitor any tests for which the purpose is certification.