Executive Committee

Tasks and structure of the 30th ITTC technical committees and groups

1. STRUCTURE OF TECHNICAL COMMITTEES

The structure of the technical committees includes six General Committees, five Specialist Committees and one Group.

1.1 General Committees

- Resistance and Propulsion
- Manoeuvring
- Seakeeping
- Ocean Engineering
- Stability in Waves
- Full Scale Performance

1.2 Specialist Committees

- Cavitation and Noise
- Ocean Renewable Energy
- Ice
- Wind Powered Ships
- Combined CFD/EFD Methods

1.3 Groups

- Quality Systems Group

2. TERMS OF REFERENCE FOR THE GENERAL AND SPECIALIST TECHNICAL COMMITTEES AND GROUPS

2.1 General Committees

Each General Committee will be responsible for a general subject area. It will review the state-of-the-art, identify the need for research and development, and carry out longer term studies with broad impact.

Each General Committee will submit a report on the results of its work to the Full Conference. The conclusions and the recommendations of the General Committee report should be structured as follows:

1. General technical conclusions
2. Recommendations to the Full Conference, which require actions such as, e.g., adopting ITTC procedures.

In addition, each General Committee shall submit proposals for future work of the General Committee and identification of tasks, which may be appropriate for Specialist Committees. These proposals shall be submitted to the Advisory Council which will compile the proposals and present them to the Full Conference.

2.2 Specialist Committees

The ITTC Advisory Council will propose Specialist Committees. Each Specialist Committee will be responsible for studying a specific technical problem. The Specialist Committees will be appointed for a limited duration. It is expected that they will complete their tasks within maximum two ITTC periods (6 years). They shall interact closely with the appropriate General Committees.

Each Specialist Committee will present a final report on the results of its work to the Full Conference and interim reports on progress if the duration of the committee spans more than one Conference. The conclusions and the recommendations of the Specialist Committee report should be structured as follows:

1. General technical conclusions
2. Recommendations to the Full Conference, which require actions such as, e.g., adopting ITTC procedures.

In addition, each Specialist Committee shall submit proposals for future work and identification of tasks, which may be appropriate for Specialist Committees. These proposals shall be submitted to the Advisory Council which will compile the proposals and present them to the Full Conference.

2.3 Groups

Groups may be established from time to time by the Executive Committee to carry out specific tasks for the Conference, which are generally not technical issues.

Each Group will present a final report on the results of its work to the Full Conference. The conclusions and the recommendations of the Group report should be structured as follows:

1. General conclusions
2. Recommendations to the Full Conference, which require actions such as, e.g., adopting ITTC procedures.

In addition, each Group shall submit proposals for future work and identification of tasks, which may be appropriate for General and Specialist Committees. These proposals shall be submitted to the Advisory Council which will compile the proposals and present them to the Full Conference.

3. MECHANISM FOR IDENTIFYING NEW SPECIALIST TECHNICAL COMMITTEES

As part of their Terms of Reference, the General Committees shall consider the need for new tasks and include appropriate proposals in their technical reports. If the Advisory Council identifies a need for a new Specialist Committee when it reviews the draft recommendations of the General Committees, the Advisory Council will prepare and agree on a statement of the technical aims and objectives for the work of the Specialist Committee.

Independent of the proposals of the General Committees, the Advisory Council will keep the requirement for Specialist Committees under continuous review.

When the Advisory Council has agreed on the need for a new Specialist Committee, the draft statement of technical aims and objectives will be presented to the Executive Committee for endorsement. If the Executive Committee approves the formation of a new Specialist Committee, it will present the proposal to the Full Conference for approval.

4. TASKS OF THE TECHNICAL COMMITTEES AND GROUPS OF THE 30TH ITTC

4.1 General Terms of reference

1. All committees shall observe the Terms of Reference and general obligations. The committees are expected to perform all the tasks defined in this document. However, should a committee be unable to do this, it shall consult the Advisory Council with regard to reduction of the work.
2. All committees shall identify areas of mutual interest with other committees and the concerned committees shall establish active co-operation/liaison in these areas
3. All committees shall endeavour to identify benchmark data and submit these to the ITTC Secretary for inclusion in the benchmark data repository on the ITTC website. Each committee shall appoint a member responsible for this.
4. In their work, the committees shall follow the guidelines given in ITTC Recommended Procedure 1.0-03, General Guideline for the Activities of Technical Committees, Liaison with the Executive Committee and Advisory Council.
5. All committees shall monitor and propose possible application of combined CFD/EFD methods and liaise with the SC on Combined CFD/EFD Methods.
6. Committee reports to the Conference should be structured in line with the terms of reference of the committee and in accordance with Recommended Procedure 4.2.3-01-02, Guidelines for Preparation of Committee and Group Reports.

4.2 Requirements to new and revised Recommended Procedures and Guidelines

An important part of the work of the committees will be to establish Recommended Procedures and Guidelines to help the ITTC member organizations maintain their institutional credibility with regard to quality assurance of products and services such as predictions and evaluations, and quality assurance of designs. The committees will develop detailed plans in accordance with these Terms of Reference and their work should be directed towards the techniques and the understanding of physical and numerical modelling as a means of predicting full-scale behaviour. While maintaining an awareness of progress, fundamental theoretical studies and fundamental aspects of numerical fluid computation should be covered by other fora. Recommended Procedures and Guidelines shall contain only techniques which are applicable in commercial practice.

In the preparation of new or revision of existing Recommended Procedures and Guidelines, the committees shall observe the following:

1. Committees that have a task to review ITTC Recommended Procedures shall identify and report any proposed changes in their first annual report to the Advisory Council. The changes approved by the Advisory Council shall be implemented in the second year and the draft revised procedure submitted to the Advisory Council for comment.
2. Committees that have a task to write new procedures or guidelines shall submit an outline of these with their first annual report to the Advisory Council. The outline shall be reviewed by the Advisory Council and comments made to the committees. The draft new procedures or guidelines shall be prepared during the second year and submitted to the Advisory Council for review.
3. New and revised draft procedures shall subsequently be updated, incorporating the comments made by the Advisory Council, and in February of the third year of the period be submitted to the Advisory Council for final review and approval. Following AC review, the committee will have three weeks to make the final adjustments to the procedure and resubmit them to the AC. After approval by the AC, the Quality Systems Group shall perform a formal check of the procedures.
4. Procedures and Guidelines must be in the format defined in the ITTC Recommended Procedure 4.2.3-01-03 “Work Instruction for Formatting ITTC Recommended Procedures”, and they will be included in the ITTC Quality Manual. Symbols and terminology must be in accordance with those used in the current version of the ITTC Symbols and Terminology List. If necessary, new symbols, complying with ISO 80000-1, should be proposed in collaboration with the Quality Systems Group. Recommended Procedure 4.2.3-01-03 contains a template, which shall be used for all new procedures and guidelines.
5. When a committee is given the task to write a new procedure or guideline or revise an existing procedure or guideline, the committee shall ensure that symbols and terminology as well as the contents of this procedure or guideline is consistent with any other procedure or guideline, which may deal with a related matter.
6. If relevant, procedures and guidelines shall specifically describe the deliverable to the customer for the described test.
7. All new and revised procedures shall, as far as feasible, include a procedure for uncertainty analysis. All procedures for uncertainty analysis in experiments shall follow ITTC Procedure 7.5-02-01-01 “Guide to the Expression of Uncertainty in Experimental Hydrodynamics” and JCGM 100:2008 “Evaluation of measurement data – Guide to the expression of uncertainty in measurement”, also known as the GUM. All existing procedures on uncertainty analysis,

that for other reasons are going to be updated, shall also be updated to follow this standard. The Quality Systems Group will assist the committees with regard to uncertainty analysis.

8. All revisions to ITTC Procedures shall be updated referring to the ITTC Procedures from the latest ITTC Register. The latest ITTC procedures shall be included in the References of the revised procedure. Revisions for the 30th ITTC shall be updated with the ITTC Procedures from the Register for the 29th ITTC.

4.3 Terms of Reference for the General Committees

Resistance and Propulsion Committee

1. Update the state-of-the-art for predicting the performance of different ship concepts emphasizing developments since the 2021 ITTC Full Conference. The committee report should include sections on:

A) The potential impact of new technological developments on the ITTC, including, for example new types of hull and propeller coatings, propulsors, rudders.
B) New experimental techniques and extrapolation methods.
C) New benchmark data.
D) The practical applications of computational methods to performance predictions and scaling.
E) The need for R&D for improving methods of model experiments, numerical modelling and full-scale measurements.

2. Review ITTC Recommended Procedures relevant to resistance and propulsion, and

A) identify any requirements for changes in the light of current practice, and, if approved by the Advisory Council, update them,
B) identify the need for new procedures and outline the purpose and contents of these.

3. Rewrite procedure 7.5-02-03-01.2, Uncertainty Analysis, Example for Propulsion Test (old procedure deleted 2021), complying with current ITTC guidelines for uncertainty analysis. Include a worked example complying with current ITTC procedures for propulsion tests. Cooperate closely with the Quality Systems Group
4. Rewrite procedure 7.5-02-03-02.2, Uncertainty Analysis, Example for Open Water Test (old procedure deleted 2021), complying with current ITTC guidelines for uncertainty analysis. Include a worked example complying with current ITTC procedures for open water tests. Cooperate closely with the Quality Systems Group.
5. Update procedure 7.5-02-05-03.3, Uncertainty Analysis, Example for Water Jet Propulsion Test, complying with current ITTC guidelines for uncertainty analysis. Include a worked example complying with current ITTC procedures for water jet propulsion tests. Cooperate closely with the Quality Systems Group.
6. Conduct a benchmark study focusing on the effect of Re at model scale and scaling methods for full scale prediction. CFD calculations would be run at a range of Re at model scale and full scale, along with open-water model tests at a range of Re. The study could use two propellers that were provided for the previous benchmark study run by the 28th ITTC.
7. Investigate the issue of laminar effects in self-propulsion test of propeller with low blade area.

A) Conduct a survey how ITTC members tackle this issue, and which scaling method they use for low blade area propellers.
B) Investigate the sufficiency of conduction two open water tests at different Reynolds numbers for full scale extrapolation.
C) Review literature on the subject.
D) Suggest modification to recommended procedures.

8. Investigate the issue of extrapolation of model tests with ducted propellers to full scale according to different Re-numbers. Identify the need and change relevant procedures if necessary.
9. Update Load variation test method in 7.5–02-03–01.4 "1978 ITTC Performance Prediction Method"

A) Review of Load Variation Test method taking into consideration a wider range of resistance and develop a new method if necessary.
B) Review the effectiveness of shallow water effects in Load Variation Test method and develop of a new method if necessary.

10. Monitor the experience of ITTC members using CFD-based form factors and, if necessary, update the Recommended Procedures accordingly. This includes the correlation with sea trial data, numerical friction line, how to handle a submerged transom, the possibility to handle separation in model scale by deriving model and full scale form factors. Continue the comparative studies on CFD methods for form factor derivation.
11. Investigate the requirements for testing and numerical evaluation of high-speed marine vessels. Address the need of updating the relevant procedures.
12. Investigate the use of CFD methods in scaling of model test results for a more precise speed-power prediction. The issues with high priority are:

A) propeller open water scaling
B) difference in Reynolds number at self-propulsion and open water test, laminar effect in self-propulsion test
C) effective wake scaling
D) scaling of immersed transoms
E) energy saving devices

13. Investigate the measurement and prediction methods for breaking waves.
14. Investigate scaling of sinkage and trim in deep water, as well as their effect on the form factor.
15. Investigate the scale effects of ships advancing through shallow/restricted waters, in particular scaling of sinkage.
16. Monitor the developments in hull and propeller model manufacturing. Investigate the advances in additive manufacturing techniques and novel materials. Investigate the use of 3D scanning techniques to validate the model geometry in view of updating the procedures.
17. Develop guidelines for model testing of coatings; in particular, skin friction reducing and air lubrication systems, including scaling laws.
18. Review CFD methods for roughness effects and recommend best practice; in particular, in terms of wall resolved as well as wall function methods.
19. Identify the necessity of guidelines for CFD methods, model tests and scaling for energy saving devices.
20. Investigate the issue of powering and resistance for slower speed submerged vehicles due to the resurgence of UUV (Unmanned Underwater Vehicle) and AUV (Autonomous Underwater Vehicle). The UUV's and AUV's can be plagued by the added drag of appendages, sensors and add-ons. They can have much greater impact on performance (% wise) than typical submerged vehicles (torpedo/subs) since UUV's and AUV's typically operate at much slower speeds. The community would benefit with a better correction for Cf than the flat plate curve. Identify the need and, if necessary, update the procedures to better handle transition issues that would be present in these lower Re submerged vehicles.

Manoeuvring Committee

1. Update the state-of-the-art for predicting the manoeuvring behaviour of ships, emphasizing developments since the 2021 ITTC Conference. The committee report should include sections on:

A) the potential impact of new technological developments on the ITTC, such as unmanned ship and autonomous navigation
B) new experiment techniques and extrapolation methods
C) the practical applications of computational methods to manoeuvring predictions and scaling, including CFD methods
D) the need for R&D for improving methods of model experiments, numerical modelling and full-scale measurements

2. During the first year, review ITTC Recommended Procedures relevant to manoeuvring, and

A) identify any requirements for changes in the light of current practice and, if approved by the Advisory Council, update them,
B) identify the need for new procedures and outline the purpose and contents of these.

3. Update procedure 7.5-02-06-05 "Uncertainty Analysis for Free Running Model Tests" complying with current ITTC guidelines for uncertainty analysis. Cooperate closely with the Quality Systems Group.
4. Survey the state of the art of the development of autonomous navigation technology such as the application of artificial intelligence schemes, and investigate potential impact to ITTC, including the impact to autopilot of full-scale ships.
5. Update 7.5-02-06-02, Captive Model Test, particularly with specific attention to the treatment of amplitudes, frequencies and inertial coefficients and to have a single integrated example for uncertainty analysis, based on the SIMMAN results.
6. Update 7.5-02-06-03 Validation of Manoeuvring Simulation Models, reflecting the outcome of SIMMAN and any other new developments.
7. Continue the work with underwater vehicles towards and complete the guidelines, extending to submarines and ROV's, if possible.
8. Update the guidelines proposed by Special Committee on Manoeuvring in Waves of the 29th term, collaborating with the Seakeeping Committee.
9. Support and collaborate with SIMMAN group for post processing and analysis of the submitted results and collect the benchmark data for the validation of numerical methods of ship manoeuvring, including the wave-induced forces and moments in waves.
10. For the minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions, validate the Level 2 – Simplified Assessment Method of the 2013 Interim Guidelines (MEPC.1/Circ.850) by enhanced and comprehensive methods, and review the Level 3 – minimum power assessment of the Draft Amendments to Guidelines (MEPC.1/Circ.850).
11. Collect benchmark data for

A) underwater vehicles
B) inland navigation
C) model-scale vessels with a documented full-scale variant

12. Survey the captive test in waves and collect the data of the hydrodynamic forces acting on the ship in waves, which can be used for the validation and application of simulation tools, including

A) Oblique towing test data in waves
B) Circular motion test data in waves
C) PMM test data in waves
D) Rudder force data in waves when ship is moving straight ahead

13. Considering the effect of novel devices and clean fuel technology on available installed power, investigate its implications on manoeuvrability in wind and waves

Seakeeping Committee

Note: The Seakeeping Committee is primarily concerned with the behaviour of ships underway in waves. The Ocean Engineering Committee covers moored and dynamically positioned ships. For the 30th ITTC, the modelling and simulation of waves, wind and

current is the primary responsibility of the Ocean Engineering Committee, with the cooperation of the Seakeeping and the Stability in Waves Committees.

1. Update the state-of-the-art for predicting the behaviour of ships in waves, emphasizing developments since the 2021 ITTC Conference. The committee report should include sections on:

A) the potential impact of new technological developments on the ITTC
B) new experiment techniques and extrapolation methods
C) new benchmark data
D) the practical applications of numerical simulation to seakeeping predictions and correlation to full scale
E) the need for R&D for improving methods of model experiments, numerical modelling and full-scale measurements.

2. Review ITTC Recommended Procedures relevant to seakeeping procedures, and

A) identify any requirements for changes in the light of current practice, and, if approved by the Advisory Council, update them,
B) identify the need for new procedures and outline the purpose and contents of these.

3. Create a new guideline on verification and validation of the CFD methods for seakeeping analysis. For example, finite-volume-based methods and particle methods which solve RANS and LES, for seakeeping procedures, collaborating with the Specialist Committee on Combined CFD/EFD Methods and taking existing procedures for verification and validation of CFD methods into account.
4. Considering Procedure 7.5-02-07-02.8, Calculation of the Weather Factor fw, investigate the functionality of the procedure when applied to ships smaller than 150m in length, and provide any method to improve the current procedure for small ships.
5. Investigate if there is any practical problem in the application of MEPC.1/Circ.850/ Rev.2 for minimum power requirement, and develop a new ITTC guideline, if needed.
6. Develop a guideline for wind loads for ships, collaborating with the committees related to this issue, particularly the Ocean Engineering Committee, the SC on Renewable Ocean Energy, Manoeuvring Committee and the Full-Scale Performance Committee.
7. Organize a benchmark experimental campaign, including the added resistance measurement in oblique seas and different loading conditions, and the characterization of the uncertainty in the measurement of added resistance.
8. Survey the state of the art for the acquisition and analysis in on-board and/or real-time seakeeping data, and investigate the need of ITTC activities, including future issues related to autonomous vessels.
9. Collaborate with Manoeuvring Committee for the development of guidelines related to manoeuvring in waves.

Ocean Engineering Committee

Note: The Ocean Engineering Committee covers moored and dynamically positioned ships and floating structures. For the 30th ITTC, the modelling and simulation of waves, wind and current is the primary responsibility of the Ocean Engineering Committee with the cooperation of the Seakeeping and the Stability in Waves Committees.

1. Update the state-of-the-art for predicting the behaviour of bottom founded or stationary floating structures, including moored and dynamically positioned ships, emphasizing developments since the 2021 ITTC Conference. The committee report should include sections on:

A) the potential impact of new technological developments on the ITTC
B) new experimental techniques and extrapolation methods
C) new benchmark data

D) the practical applications of computational methods for prediction and scaling
E) the need for R&D for improving methods of model experiments, numerical modelling and full-scale measurements.

2. Review ITTC Recommended Procedures relevant to ocean engineering, including CFD procedures, and

A) identify any requirements for changes in the light of current practice, and, if approved by the Advisory Council, update them,
B) identify the need for new procedures and outline the purpose and contents of these.

3. Review and identify areas of concern in modelling and simulation of waves, wind and currents. In particular:

A) report on methods to generate extreme wave packets for studying responses to extreme waves in a towing tank. Examine the effects of wave breaking and statistics of occurrence on the wave spectrum, its spectral shape, extreme wave generation, and the role of wind-wave interaction on wave breaking occurrence.
B) investigate the influence of the vertical wind profile on the aerodynamic loads experienced by platforms and other offshore objects. Develop a standard vertical wind profile for model testing purposes and methods for modeling it both numerically and experimentally.
C) Continue work on using a small controllable fan to mimic forces developed during a floating offshore wind turbine test due to the turbine itself. Expand the work on Software-in-the-Loop (SiL) systems for modeling wind turbine loads to be used as a general tool to model many types of wind loads. For example, wind loads on a ship during a maneuvering in waves test. Liaise with the SC on Ocean Renewable Energy and the Seakeeping Committee.
D) develop specifications for a benchmark test program for wind loads and their influence on the motions of floating structures. Compare wind loads developed using SiL to model the wind loads versus using fans to produce an actual model scale wind. Among other data, repeatability, and consistency between the methods and between different facilities should be reported. The benchmark study may also include CFD comparisons.
E) report on state-of-the-art for wave-current interactions. In particular, the role played in terms of the generation of extreme waves.

4. Review the state-of-the-art in offshore aquaculture systems since the 2021 report of the Ocean Engineering committee including large volume closed containment systems, extreme wave environments, and modelling of entire systems.
5. The benchmark tests with the square cylinders are complete. However, it is recommended that, owing to the complicated wave-column interactions, more experimental and CFD studies should be considered for four-column cases with different configurations and more extreme waves such as focused waves. In addition, local wave impact loads on the columns are also critical and deserve further in-depth studies.
6. The work on the CFD benchmark study of two-bodies in close proximity shall be continued. Smaller gaps need to be studied and the procedure for 2-body model tests shall be updated based on the CFD benchmark study.
7. Investigate extraction methods of nodules from the seabed. Develop a guideline for testing Nodule Mining Machines in a towing tank including their riser systems.
8. Investigate testing methods to characterise the influence of changing bottom bathymetry and coastline for tankers at offloading terminals.

Stability in Waves Committee

Note: The Stability in Waves Committee covers the stability of intact and damaged ships in waves. For the 30th ITTC, the modelling and simulation of waves, wind and current is the

primary responsibility of the Ocean Engineering Committee with the cooperation of the Seakeeping and the Stability in Waves Committees.

1. Update the state-of-the-art for evaluating the stability of ships in adverse weather conditions, emphasizing developments since the 2021 ITTC conference. The committee report should include sections on:

A) the potential impact of new technological developments on the ITTC
B) new experimental techniques
C) new benchmark data
D) the practical applications of computational methods to prediction
E) the need for R&D for improving methods of model experiments, numerical modelling.

2. Review ITTC Recommended Procedures relevant to stability, including CFD procedures, and

A) identify any requirements for changes in the light of current practice, and, if approved by the Advisory Council, update them,
B) identify the need for new procedures and outline the purpose and contents of these.

3. Update ITTC Procedure 7.5-02-01-08, Single Significant Amplitude and Confidence Intervals for Stochastic Processes when new information becomes available.
4. Develop new ITTC recommended procedures in support of direct stability assessment within 2nd generation IMO intact stability criteria:
5. Avoiding self-repeating effect in time-domain numerical simulation of ship motions,
6. Procedure of Estimation of Frequency of Random Events by Direct Counting,
7. Statistical Validation of Extrapolation Methods for Time Domain Numerical Simulation of Ship Motions
8. Develop a new procedure, Computational procedure for instantaneous GZ curve during time-domain numerical simulation in irregular waves.
9. Investigate the current state of the art on flooding dynamics of damaged ship in waves, including EFD and CFD.
10. Continue the identification of benchmark data for validation of stability-in-waves predictions.

Full-Scale Ship Performance Committee

1. Update the state-of-the-art for investigation of full-scale ship performance, emphasizing developments since the 2021 ITTC Conference. The committee report should include sections on:

A) the potential impact of new technological developments on the ITTC
B) new measuring techniques
C) new benchmark data
D) the practical applications of numerical simulation to full-scale ship performance
E) the need for R&D for improving methods of full-scale measurements and numerical modelling.

2. Review ITTC Recommended Procedures relevant to full-scale performance, and

A) identify any requirements for changes in the light of current practice, and, if approved by the Advisory Council, update them,
B) identify the need for new procedures and outline the purpose and contents of these.

3. Address issues related to hull and propeller surface roughness such as:

A) Definition of roughness properties
B) Components of roughness
C) Measurement of roughness
D) Effects of roughness on in-service performance including filtering and analysis methods for evaluating hull and propeller performance separately
E) Roughness usage in performance prediction and cross effects with correlation

4. Provide technical support to ISO and IMO in further development of approaches to in-service performance monitoring (e.g. ISO19030)
5. Address the following aspects of the analysis of speed/power sea trial results:

A) Initiate and conduct speed trials on commercial ships on deep and shallow water to further validate Raven method.
B) More validation of wave-added resistance method, in particular SNNM, covering all wave encounter angles based on a set of significant ship parameters including the short-term estimation of wave-added resistance in irregular waves.
C) Investigate the influence of drift, rudder action, short wave and wave height on wave-added resistance.
D) Investigate the influence of water depth on the hull-propeller interaction (thrust deduction, relative rotative efficiency)
E) Explore and monitor new developments in instrumentation and measurement equipment relevant for sea trials and in-service performance assessment (e.g. wind, waves, thrust, speed through water)

6. Study accuracy of CFD for shallow water applications – cooperate with CFD/EFD Committee
7. Update the speed/power sea trial procedures 7.5-04-01-01.1 where appropriate, in particular:

A) complement it by a procedure for the correction of yawing (caused by wind) and rudder angle
B) wind averaging method to correctly reflect the wind effect in double run (true wind vector in each run).

8. Support ISO in updating ISO15016 in compliance with 7.5-04-01-01.1
9. Update guideline for determination of model-ship correlation factors, including shallow water and draft dependency (in cooperation with AC Working Group)
10. Update guideline on CFD-based wind coefficient; in particular, re-assess database of wind resistance coefficients and update it according to the new procedure for non-dimensionalising.
11. Continue to monitor the development of relevant techniques for ship energy saving and identify the needs to complement the present EEDI framework in response to the adoption of alternative fuels and the receptivity of innovative technologies. Consider, if necessary, a complementary metric to EEDI to represent power savings.
12. Collect full scale data obtained through relevant benchmark tests on the effect of energy saving methods (ESM). Use the full scale data for validating the effect of ESM. Develop a guideline to conduct in-service performance evaluation for ESM. Full-scale data showing the benefits of ALDR (Air Layer Drag Reduction) would be of particular interest.
13. Consider the hydrodynamic aspect of design for Smart Ship and Unmanned Surface Vehicles as the smart ship technology for cargo or passenger transportation is one of the emerging technologies in maritime industry. Explore the suitability of the traditional design spiral for the smart ship and USVs. Identify the need for new or modified procedures of experiment and simulation for performance evaluation in this particular field.

4.4 Terms of Reference for Specialist Committees

Specialist Committee on Ocean Renewable Energy

The following list of tasks is rather ambitious. Based on the expertise of the committee members, the specialist committee should review the TOR and decide what can be accomplished and is more relevant from a practical point of view in a three-year period.

1. An official type A liaison has been established with the International Electro

Technical Commission (IEC), TC114 and TC 88 technical committees in order to:

A) Verify, integrate, and remove conflicts of actual ITTC procedures and guidelines for testing marine current turbines and wave energy devices with the IEC guidelines
B) Monitor and contribute to the discussion within the IEC for the definition of standards and protocols for testing ocean energy devices.

2. Review testing techniques for deployment (transportation, installation), operations, and maintenance of marine renewable energy devices.
3. Review testing techniques for multipurpose platforms (e.g. combinations of WEC/OWT/Current Turbines/Solar/Aquaculture)
4. Continue reporting on full scale installations

A) Type of device
B) Problems in installation
C) Success of energy extraction
D) Survivability
E) Investigate and report on the correlation between the model-scale predictions and full-scale results.

5. Wave Energy Converters (WEC)

A) Monitor and report on new concepts for WEC's
B) Review and report on the progress made on the modelling of arrays. Update and extend array section of the guideline for numerical modelling of WEC's.
C) Continue to monitor developments in PTO modelling both for physical and numerical prediction of power capture. Discuss different PTO control strategies for power optimisation and survivability modes.
D) Develop a guideline for numerical and experimental survival testing of WEC's
E) Assess level of support for a benchmark study of comparisons between numerical computations and physical testing of WEC's. If there is sufficient interest, develop specifications for the benchmark study.

6. Current Turbines

A) Obtain and analyze benchmark data for current turbines from IEC.
B) Continue to monitor developments in physical and numerical techniques for prediction of performance of current turbines.
C) Assess support and if sufficient interest, develop specifications for a benchmark study of a horizontal axis turbine (for instance the 3-blade DoE turbine).
D) Review and report the techniques used for CFD modelling of current turbines. This should include the use of combined EFD/CFD techniques for scaling and blockage corrections and methodologies for replicating environmental conditions.
E) Investigate effects and reproduction at model scale of inflow turbulence and unsteadiness to the turbine including the effects of waves.
F) Review and report on the progress made on the modelling of arrays, elaborating on wake interactions and impact on performance
G) Investigate and develop blockage corrections for testing current turbines in water channels.

7. Offshore Wind Turbines

A) Continue monitoring and report on the developments in full-scale installations of floating offshore wind turbines.
B) Report on possible full-scale measurement data availability and address how these data can be utilized for validation of simulation tools and evaluation of scaling effects from model scale tests.
C) Continue monitoring and report on the development in model testing methodology for offshore wind turbines.
D) Review and report on recent developments of physical wind field modelling in open space with application for wave tank testing of floating offshore wind turbines, including

modelling of turbulence and the measuring and documentation of the wind field.

E) Investigate the influence of the vertical wind profile on the operation and efficiency of offshore wind turbines
F) Liaise with the Ocean Engineering Committee regarding their work on SiL and a small controllable fan to model the loads due to an operating wind turbine.
G) Review and report on the development of numerical offshore wind farm modelling.
H) Monitor and report on recent research related to model tests of bottom-fixed offshore wind turbines including modelling the influence of structural stiffness and soil stiffness.
I) Report on other existing regulations related to model tests of offshore wind turbines (e.g. IEC, classification societies, DoE) and update procedures/guidelines as appropriate.
J) Continue monitoring the developments in model testing methodology with respect to Froude/Reynolds scaling issues and incorporating control system strategies.

Specialist Committee on Cavitation and Noise

1. Review and update the current guidelines on model and full scale noise measurement and review and update the existing procedures on cavitation; provide recommendations for new guidelines / procedures, if any.
2. Review the state of the art on cavitation model testing (cavitation appearance, hull pressure fluctuation, thrust break down, cavitation erosion) with a focus on ways to reproduce the scaling effects on ship wakes. Conduct an Uncertainty Analysis on the full-scale prediction of all the cavitation parameters (cavitation appearance, hull pressure fluctuation, thrust break down, cavitation erosion).
3. Review the current CFD method for cavitation extent and hull pressure fluctuation prediction and especially on the use of a dummy model (defined by using CFD calculation) on propellers / pods / other types. Liaise with the Specialist Committee on CFD/EFD Combined methods. Provide recommendation for a new guideline on how to proceed for the dummy model definition.
4. Review the currently available CFD benchmark data, including the on-going projects, such as JORES, and investigate the feasibility to establish ITTC benchmark database.
5. Review new measurement techniques used for cavitation model testing and full-scale trials (optical measurement for blade cavity extent, fluctuating forces on blades…).
6. Organize the proposed round-robin test case as recommended in the 29th Noise committee.
7. Further monitor and investigate specific aspects of model-scale noise measurements including reverberation, tip vortex scaling, water quality and the effect on uncertainty.
8. Review any open literature dealing with the respective contributions of the hull vibrations and of the propeller in the ship radiated noise at full scale (frequency line and broad band spectrum) and investigate ways of assessing those contributions
9. Continue monitoring progress on shipping noise measurement procedures for shallow water and regulations as developed by ISO, classification societies and regulatory agencies.
10. Continue monitoring progress on ship noise prediction by computational methods with emphasis on the prediction of cavitation noise using CFD methods and methods such as data driven models and machine learning techniques, and noise propagation modelling, especially for shallow waters

Specialist Committee on Ice

1. Continue to maintain, review, and update existing accepted procedures and guidelines in accordance with current practice.
2. Continue work on uncertainty analysis including conducting benchmarking study among ice model basins. Focus on the largest error sources is recommended such as the uncertainty related to the ice properties.

Based on conducted measurement and analyses, include a review of how the findings may reflect ice measurements.
3. Develop Guideline 7.5-02-04-02.5 – Experimental Uncertainty Analysis for Ship Resistance in Ice Tank Testing, including findings related to the uncertainty analysis.
4. Revise the procedure 7.5-04-03-01 Ship Trials in Ice. Pay special attention to ice conditions (such as flexural strength, thickness, snow coverage / density and ice types).
5. Continue to develop a Guideline for the Testing of Fixed Structures, including monopiles, based on prepared outline (Table of Content). Pay special attention to scaling issues for vertical structures where crushing strength is dominant.
6. Review State of the Art on numerical modelling.
7. Review and study current methods for testing waves in ice and based on this prepare outline for guidelines.

Specialist Committee on Performance of Wind Powered and Wind Assisted Ships

1. Review technologies for wind propulsion and wind assistance. Clarify the distinction between wind powered and wind assisted ships.
2. Review methods of ship model hydrodynamic tests, wind tunnel tests, CFD, ship dynamics simulations and routing relevant for predicting the performance and safety of wind powered and wind assisted ships at design stage with particular attention paid to higher side forces and drifting of the ship due to wind powering.
3. Review long-term statistics of winds and waves from the point of view of applicability for the evaluation of wind assisted ships at design stage.
4. Derive a guideline for predicting the fuel consumption of a wind propulsion ship on a route at design stage with the consideration of weather-routing effects.
5. Review safety and regulatory issues related to hydro/aero dynamic testing and evaluation and recommend measures to take at design stage.
6. Derive performance indicators for comparing the performance of wind propulsion at design stage.
7. Investigate the effect on propulsive factors due to reduced propeller load arising from the use of wind power. Identify the effects of wind propulsion on the propulsion system, e.g. pressure side cavitation occurrence. Liaise with Resistance and Propulsion Committee and SC on Cavitation and Noise.
8. Derive a modified procedure for full scale trial of wind propulsion ships. Liaise with Full Scale Performance Committee.
9. Cooperate with MEPC on the continuous development of the EEDI for wind propulsion ships. Liaise with Full Scale Ship Performance Committee.
10. Liaise with the Ocean Engineering Committee regarding their work on SiL and controllable fans to model wind loads.

Specialist Committee on Combined CFD and EFD Methods

For the 30th ITTC, the Specialist Committee on CFD and EFD Combined Methods has the responsibility for CFD/EFD combined methods including CFD issues on an overview level. This includes the procedures for uncertainty assessment and quality assurance of CFD, review and highlight good examples of combined methods, suggest, and initiate new applications of combined methods. Co-ordinate, advise and encourage each technical committee to perform the detail work related to CFD/EFD combined methods.

1. Coordinate and advise all other Technical Committees on CFD/EFD Combined Methods and encourage them to investigate and develop CFD/EFD combined methods within each specific area. Summarize common challenges, conclusions, and new applications.
2. Monitor and review the advances, accuracy and challenges within full-scale and model-

scale CFD of maritime applications with special focus on speed/power predictions.

3. Review the outcome of ongoing CFD benchmark campaigns. Liaison with relevant technical committees, discuss the impact on existing ITTC procedures and propose relevant updates. Liaison with organisers of future benchmark studies of ship and ocean hydrodynamics when applicable.
4. Encourage the establishment of open validation data for high Reynolds number flow cases for marine applications. Initiate, promote, suggest or in other way support more open data to be available.
5. Review and study the performance of turbulence models and wall treatments at full scale. Monitor the development of new turbulence modelling approaches when they become available. Evaluate their performance for marine applications.
6. Monitor advances in the application of detailed flow measurements in the ITTC community and assess the need for detailed evaluation and implementation of best-practice, uncertainty analysis, and benchmark guidelines.
7. Develop a standard process of performing a CFD benchmark study within ITTC. Assist other Technical Committees to plan and analyse benchmark studies.
8. Monitor how Verification and Validation is applied and reported in research publications and commercial work. Monitor new approaches and existing procedures for Verification and Validation.
9. Continue to maintain and improve the existing Recommended Procedure 7.5-03-01-01, "Uncertainty Analysis in CFD, Verification and Validation Methodology and Procedures". Consider narrowing down the different options.
10. Monitor the use of the new Recommended Procedures 7.5-03-01-02 "Quality Assurance in CFD Ship Applications" and update it if needed. This includes the way to present the statistics of the comparison error in the demonstration process.
11. Produce information material (articles, conferences, social media) directed towards stakeholders who receive and use the results hydrodynamic predictions, such as designers, yards, shipowners and authorities. Explain issues like uncertainty level, state-of-the-art capability, and challenges of CFD versus EFD and Combined methods. This should be done in cooperation with other technical committees.

Additional Remark:

The following procedures will be handled by this specialist committee:

- 7.5-03-01-01, "Uncertainty Analysis in CFD, Verification and Validation Methodology and Procedures"
- 7.5-03-01-02 "Quality Assurance in CFD Ship Applications" (replace previous procedure 7.5-03-01-02 "Uncertainty Analysis in CFD, Guidelines for RANS codes)"

4.5 Terms of Reference for the Groups

Quality Systems Group

1. During the first six months after the conference perform a detailed review of all ITTC Recommended Procedures and Guidelines for compliance with ITTC quality requirements with regard to format, references, symbols, terminology, uncertainty analysis and parameter lists, and either update the procedures in these aspects or cooperate with the relevant committee on these updates. Submit the updated procedures to the Advisory Council before 31.12.2021.
2. During the first six months after the conference perform a detailed review of all uncertainty analysis procedures for compliance with ITTC quality requirements about format, references, symbols, terminology and parameter lists. Check that all uncertainty analysis procedures contain a worked example based on the current versions of model

test procedures. Cooperate with the relevant technical committees on updating the procedures, including a worked example. Submit a status report on this task to the Advisory Council before 31.12.2021. Updating expected to be completed before 30.06.2022.

3. Review the titles and numbering of technical procedures and propose changes, if any, for approval by the Advisory Council before 31.12.2021.
4. Maintain the Register of ITTC Recommended Procedures and Guidelines.
5. Introduce New Uncertainty Analyses Guidelines to include data anomalies in Machine Learning Algorithms for Autonomous and Intelligent ships.
6. Observe the development or revision of ISO Standards regarding Quality Control.
7. Update the ITTC Symbols and Terminology List.
8. Update the Uncertainty Analysis section of the Symbols & Terminology List.
9. Update the ITTC Dictionary of Hydromechanics.
10. Expand the content of current ITTC dictionary version, considering CFD, MASS, etc.
11. Support the technical committees dealing with stochastic processes with guidance on development, revision, and update of procedures for the inclusion of confidence bands on their computational and experimental results.
12. Observe BIPM/JCGM standards for uncertainty analysis, in particular the uncertainty analysis terminology.
13. Review developments in metrology theory and uncertainty analysis and issue appropriate procedures.
14. Setup an effective way to collect benchmark data.
15. Upload all the collected and verified benchmark data into the ITTC benchmark data repository
16. Liaise with relevant technical committees to complete a questionnaire about the demand and use of benchmarks, not to be limited to model scale.
17. Cooperate with technical committees to establish the ITTC benchmarks, including definition, raw data, data format, etc.
18. Prepare a procedure on the internal calibration of steel rulers or a practical way to check length measurement devices in towing tanks.