CONTENTS

Experiments on Rarely Occurring Events

1. PURPOSE OF PROCEDURE

The rarely occurring events are associated with slamming, green water, large amplitude motion, acceleration, etc. of ships and offshore structures. Purpose of this procedure is to define standards for experiments on rarely occurring events.

2. STANDARDS FOR EXPERIMENTS ON RARELY OCCURRING EVENTS

2.1 Previous Recommendations of ITTC

1987 pp 525 When performing tests on moored systems special note should be taken of the lack of model/full scale correlation of the low frequency motions, the importance of the system damping, and the potentially important scale effects on damping that may influence the results of the tests.

1996 pp 295 Recent studies carried out with multi or single point moored vessels have shown that most severe loads do not occur when wind, wave and current are co-linear and therefore it is necessary to consider the point probabilities of both the magnitude of the wind, wave and current parameters and their direction.

2.2 Model Design and Construction

The model scale should be as large as practicable with respect to the test facility employed, and appropriate to enable the requisite of full scale significant wave height to be generated.

The model should be complete up to the upper-most weather deck, including forecastle, bulwarks, deck fittings, deckhouses and freeing ports. The model should be equipped with external appendages such as bilge keels, rudder, or fins as may reasonably be expected to influence the results of the tests.

It is recommended that ship models should be self-propelled and remotely controlled, either by radio or by a light umbilical attachment; or towed from a carriage equipped with the capability for free-to-surge under constant towing force, with freedom to heave, pitch and roll.

2.3 Standard for Duration and Repetition of Test Runs

The following interim recommended procedure for experiments on rarely occurring events is proposed:

Experiments to determine the statistics of rarely occurring events such as slamming and deck wetness in irregular waves should last for a minimum of one hour for ship and three hours for moored floating offshore structures (full scale equivalent). Care should be taken to avoid a repeating wave time history. Alternatively, selected time histories with rare wave events can be used instead. In comparative tests (e.g. to establish the relative merits of different designs) the wave conditions should be chosen so that a substantial number of events occur.

2.4 Video Recording

Video recording of test and rarely occurring events is recommended.

2.5 Criteria

Criteria for acceptable motions and other rough weather phenomena are all too often not related to specific activities of the ship. The Committee recommends that ship model basins should play a more active role in determining criteria and that:

a. Criteria should relate to responses that are of specific importance to the mission considered.
b. Acceptable response levels should be determined by long term monitoring of data, trials, questionnaires or discussions with the operators.

3. PARAMETERS

The following parameters could be taken into account:

- Relative water level at different hull positions
- Accelerations
- Instrumentation to measure roll and pitch angles, and heave position may be deemed helpful
- Frequency of deck wetness
- Volume of water accumulated during each test run
- Impact loads (pressure or forces, moments) due to green water or slamming
- State dynamic properties of model, such as stiffness and natural periods
- Waves

4. VALIDATION

4.1 Uncertainty Analysis

None

4.2 Test - Calculation

None

4.3 Test - Full Scale

None

4.4 Benchmark Tests

1) Seagoing Quality of Ships
(7^{th} 1955 pp.247-293)
A Model of the Todd-Forest Series 60, Cb=0.60:
7 tanks used 5ft. models, 2 tanks used 10 ft. models, and 1 tank used 16 ft. model Froude Numbers 0,0.18,0.21,0.24,0.27 and 0.30
The Ratio wave height to the Length of the Model: 1/36 1/48 1/60 1/72
for Wave Length 0.75L 1.0L 1.25L 1.5L

2) Comparative Tests in Waves at Three Experimental Establishments Using the Same Model
(11^{th} 1966 pp.332-342)
British Towing Tank Panel: A 10 ft. Fibre-Glass Model of the S.S.Cairndhu
A Series of Experiments on a Ship Model in Regular Waves Using Different Test Techniques

Data Obtained in Irregular and Transient Waves and Some Result Predicted by the Theory (Based on Korvin Kroukovsky's Work and Employing the Added Mass and Damping Coefficients Calculated by Grim)

3) Full Scale Destroyer Motion Measurements (11th l966 pp.342-350)
Full Scale Destroyer Motion Tests in Head Sea
Comparison among Motion Response Obtained from Full Scale Tests, Model Experiments and Computer Calculations
The Destroyer H.M. "Groningen" of the Royal Netherlands Navy
A Scale Ration 40 to 1

4) Comparison of the Computer Calculations of Ship Motions (11th 1966 pp.350-355)
ShipResponseFunctionsfortheSeries60
Cb=0.70 Parent Form

5) Computer Program Results for Ship Behaviour in Regular Oblique Waves
(11th l966 pp.408~-411)
Series 60, Cb=0.60 and 0.70 Parent Form DTMB Model 421OW and 4212W

6) Experiments in Head Seas

6-1) Comparative Tests of a Series 60 Ship Model in Regular Waves
(11th 1966 pp.411-415)
Series 60 Cb=0.60

6-2) Experiments on Heaving and Pitching Motions of a Ship Model in Regular Longitudinal Waves (11th 1966 pp.415-418)
Series 60 Cb=0.60

6-3) Experiments on the Series 60, Cb=0.60 and 0.70 Ship Models in Regular Head Waves
(11th 1966 pp.418-420)
Series 60, ~Cb=0.60 and 0.70

6-4) Comparison of Measured Ship Motions and Thrust Increase of Series 60 Ship Models in Regular Head Waves (11th 1966 pp. 420-426)
Series 60, ~Cb=0. 60 and 0. 70

6-5) Estimation of Ship Behaviour at Sea from Limited Observation (11th 1966 ~pp.426-428)

7) Computer Results, Head Seas

7-1) Theoretical Calculations of Ship Motions and Vertical Wave Bending Moments in Regular Head Seas (11th 1966 pp. 428-430)
Series 60, Cb=0.70

7-2) Comparison of Computer Program Results and Experiments for Ship Behaviour in Regular Head Seas (11th l966 pp.430-432)
Series 60, ~Cb=0.60 and 0.70

7-3) Computer Program Results for Ship Behaviour in Regular Head Waves
(11th 1966 pp.433-436) Series 60, Cb=0.60 and 0.70 Parent Form DTMB Model 421OW and 4212W

7-4) Comparison of Calculated and Measured Heaving and Pitching Motions of a Series 60, Cb=0.70 Ship Model in Regular Longitudinal Waves (11th 1966 pp.436-442)
Series 60, Cb=0.70

7-5) Computer Calculations of Ship Motions (11th 1966 pp.442)

7-6) Comparison of the Computer Calculations of Ship Motions and Vertical Wave Bending Moment (11th 1966 pp. 442-445)
Series 60, Cb=0.60 and 0.70

8) Comparison of the Computer Calculations for Ship Motions and Seakeeping Qualities by Strip Theory (14th 1975 Vol.4pp.341-350)
A Large-Sized Ore Carrier

9) Comparison on Results Obtained with Computer Programs to Predict Ship Motions in Six Degrees of Freedom
(15th 1978 pp. 79-90)
S-175, Cb = 0. 572

10) Comparison of Results Obtained with Compute Programs to Predict Ship Motions in Six-Degrees-of-Freedom and Associated Responses (16th 1981 pp.217-224)
To Identify the Differences in the Various Strip Theories and Computation Procedures utilised by the Various Computer Programs and Provide Guidance for Improvement if Necessary
S-175 Container Ship for Fn = 0.275

11) Analysis of the S-175 Comparative Study (17th 1984 pp.503-511)

12) S-175 Comparative Model Experiments (18th 1987 pp.415-427)

13) Rare Events
(19th 1990 pp.434-442, Seakeeping)

14) Validation Standards of Reporting and Uncertainty Analysis Strip Theory Predictions (19th 1990 pp.460-464)

15) ITTC Database of Seakeeping Experiments (20th 1993 pp.449-451)
Two Dimensional Model, Wigley Hull Form, S-175

16) Validation of Seakeeping Calculations (21st 1996 pp.41-43)
Basic Theoretical Limitations
Numerical Software Engineering Aspects

17) ITTC Database of Seakeeping Experiments (21st 1996 pp.43)
S-175, High Speed Marine Vehicle