

# **Rules for the Type Approval Certification of Lithium Battery Systems**

*Effective from 1 January 2022*

**GENERAL TERMS AND CONDITIONS**  
**OF EMIRATES CLASSIFICATION SOCIETY – L.L.C – O.P.C (TASNEEF)**  
**EFFECTIVE AS OF 1 APRIL 2025**

**DEFINITIONS**

<b>Administration</b>	means the government of the state whose flag the Ship is entitled to fly or under whose authority the Ship is authorised to operate in the specific case.
<b>Client</b>	means the interested party and any other party who requires the Services.
<b>Certificate of Classification</b>	means a certificate of classification, issued by a Society and the certificate confirms that the vessel's structure, machinery, and equipment meet the society's specific technical rules and regulations.
<b>Interested Party</b>	means the party, other than the society, having an interest in or responsibility for the Ship, product, plant or system subject to classification or certification (such as the owner of the Ship and his representatives, the Ship builder, the engine builder or the supplier of parts to be tested) who requests the Services or on whose behalf the Services are requested.
<b>Owner</b>	means the registered owner, the Ship owner, the manager or any other party with the responsibility, legally or contractually, to keep the Ship seaworthy or in service, having particular regard to the provisions relating to the maintenance of class laid down in part a, chapter 2 of the rules for the classification of Ships or in the corresponding rules indicated in the specific rules.
<b>Register of Ships</b>	means a register book, also known as a Register of Ships, is a comprehensive record of vessels that are classified by a society.
<b>Rules</b>	means the documents below issued by the Society: <ul style="list-style-type: none"> <li>a. Rules for the classification of Ships or other special units.</li> <li>b. Complementary rules containing the requirements for certification of products, plants, systems and other or containing the requirements for the assignment of additional class notations.</li> <li>c. Rules for the application of statutory rules, containing the rules to perform the duties delegated by administrations.</li> <li>d. Guides to carry out particular activities connected with Services.</li> <li>e. Any other technical document, as for example rule variations or interpretations.</li> </ul>

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<b>Services</b>	means the activities described in Article 1 below, rendered by the Society upon request made by or on behalf of the Interested Party.
<b>Ship</b>	means ships, boats, craft and other special units, as for example offshore structures, floating units and underwater craft.
<b>Society</b>	means Emirates Classification Society LLC OPC and/or its affiliated entities providing the Services.
<b>Surveyor</b>	means technical staff acting on behalf of the society in performing the Services.
<b>UAE</b>	means United Arab Emirates.

#### ARTICLE 1

- 1.1 The purpose of the Society is, among others, the classification and certification of Ships and the certification of their parts and components.
- 1.2 The Society (a) sets forth and develops Rules; (b) publishes the Register of Ships<sup>1</sup>; and (c) issues certificates, statements and reports based on its survey activities.
- 1.3 The Society also takes part in the implementation of national and international rules and standards as delegated by various Governments.
- 1.4 The Society carries out technical assistance activities on request and provides special services outside the scope of classification, which is regulated by these general conditions unless expressly excluded in the particular contract.

#### ARTICLE 2

- 2.1 The Rules developed by the Society reflect the level of its technical knowledge at the time they are published. Therefore, the Society, though committed, also through its research and development services, to continuous updating, does not guarantee they meet state-of-the-art science and technology at the time of publication or that they meet the Society's or others' subsequent technical developments.
- 2.2 The Interested Party is required to know the Rules on the basis of which the Services are provided. With particular reference to Classification Services, special attention is to be given to the Rules concerning class suspension, withdrawal and reinstatement. In case of doubt or inaccuracy, the Interested Party is to promptly contact the Society for clarification. The Rules for Classification of Ships are published on the Society's website: [www.tasneefmaritime.ae](http://www.tasneefmaritime.ae)
- 2.3 The Society exercises due care and skill:
  - (a) in the selection of its Surveyors; and
  - (b) in the performance of its Services, taking into account the level of its technical knowledge at the time the

Services are performed.

- 2.4 Surveys conducted by the Society include, but are not limited to, visual inspection and non-destructive testing. Unless otherwise required, surveys are conducted through sampling techniques and do not consist of comprehensive verification or monitoring of each component of the Ship or of the items subject to certification. The surveys and checks made by the Society, either on board Ships or with remote techniques, do not necessarily require the constant and continuous presence of the Surveyor. The Society may also commission laboratory testing, underwater inspection and other checks to qualified service suppliers, who will carry out these duties under their responsibility. Survey practices and procedures are selected by the Society based on its experience and knowledge and according to generally accepted technical standards in the sector.

### ARTICLE 3

- 3.1 The class assigned to a Ship, like the reports, statements, certificates or any other document or information issued by the Society, reflect the discretionary opinion of the Society concerning compliance, at the time the Service is provided, of the Ship or product subject to certification, with the applicable Rules (given the intended use and within the relevant time frame).
- 3.2 The Society is under no obligation to make statements or provide information about elements or facts which are not part of the specific scope of the Service requested by the Interested Party or on its behalf.
- 3.3 No report, statement, notation on a plan, review, Certificate of Classification, document or information issued or given as part of the Services provided by the Society shall have any legal effect or implication other than a representation that, on the basis of the checks made by the Society, the Ship, structure, materials, equipment, machinery or any other item covered by such document or information meet the Rules. Any such document is issued solely for the use of the Society, its committees and clients or other duly authorised bodies and for no other purpose. Therefore, the Society cannot be held liable for any act made or document issued by other parties on the basis of the statements or information given by the Society. The validity, application, meaning and interpretation of a Certificate of Classification, or any other document or information issued by the Society in connection with its Services, are governed by the Rules of the Society, whom is the sole subject entitled to make such authentic interpretation. Any disagreement on technical matters between the Interested Party and the Surveyor in the carrying out of his functions shall be raised in writing as soon as possible with the Society, which will settle any divergence of opinion or dispute.
- 3.4 The classification of a Ship, or the issuance of a certificate or other document connected with classification or certification and in general with the performance of Services by the Society shall have the validity conferred upon it by the Rules of the Society at the time of the assignment of class or issuance of the certificate; in no case shall it amount to a statement or warranty of seaworthiness, structural integrity, quality or fitness for a particular purpose or service of any Ship, structure, material, equipment or machinery inspected or tested by the Society.
- 3.5 Any document issued by the Society in relation to its activities reflects the condition of the Ship or the subject of certification or other activity at the time of the check.
- 3.6 The Rules, surveys and activities performed by the Society, reports, certificates and other documents issued by

the Society are in no way intended to replace the duties and responsibilities of other parties including, without limitation, Governments, designers, ship builders, manufacturers, repairers, suppliers, contractors or sub-contractors, Owners, operators, charterers, underwriters, sellers or intended buyers of a Ship or other product or system surveyed.

- 3.7 These documents and activities do not relieve such parties from any fulfilment, warranty, responsibility, duty or obligation (also of a contractual nature) expressed or implied or in any case incumbent on them, nor do they confer on such parties any right, claim or cause of action against the Society. With particular regard to the duties of the Owner, the Services undertaken by the Society do not relieve the Owner of his duty to ensure proper maintenance of the Ship and ensure seaworthiness at all times. Likewise, the Rules, surveys performed, reports, certificates and other documents issued by the Society are intended neither to guarantee the buyers of the Ship, its components or any other surveyed or certified item, nor to relieve the seller of the duties arising out of the law or the contract, regarding the quality, commercial value or characteristics of the item which is the subject of transaction.
- 3.8 In no case, therefore, shall the Society assume the obligations incumbent upon the above-mentioned parties, even when it is consulted in connection with matters not covered by its Rules or other documents.
- 3.9 In consideration of the above, and within the limits of liability under Article 5 below, the Interested Party undertakes to relieve and hold harmless the Society from any third party claim, as well as from any liability in relation to the latter concerning the Services rendered, where these are attributable to the Interested Party.
- 3.10 Insofar as they are not expressly provided for in these General Conditions, the duties and responsibilities of the Owner and Interested Parties with respect to the Services rendered by the Society are described in the Rules applicable to the specific Service rendered.

#### ARTICLE 4

- 4.1 Any request for the Society's Services shall be submitted in writing and signed by or on behalf of the Interested Party. Such a request will be considered irrevocable as soon as received by the Society and shall entail acceptance by the applicant of all relevant requirements of the Rules, including these General Conditions. Upon acceptance of the written request by the Society, a contract between the Society and the Interested Party is entered into, which is regulated by the present General Conditions.
- 4.2 In consideration of the Services rendered by the Society, the Interested Party and the person requesting the service shall be jointly liable for the payment of the relevant fees and costs, even if the service is not concluded for any cause not pertaining to the Society. In the latter case, the Society shall not be held liable for non-fulfilment or partial fulfilment of the Services requested. In the event of non-payment of the invoice within the contractually agreed terms, the Society reserves the right to request, in addition to the full payment of the principal amount due and without the need for further formal notice, also:
- (a) Late payment interest at a rate of 5% per annum, calculated from the due date of the invoice until full payment is received, in accordance with the applicable laws in the United Arab Emirates or the country from where the invoice is issued. Any applicable VAT, taxes, or statutory levies shall be borne by the Client as per the laws

of the respective jurisdiction;

- (b) full reimbursement of any costs incurred for debt recovery, including, but not limited to, legal fees, administrative expenses, and the costs of any extrajudicial actions; and
- (c) any additional amount due as compensation for damages suffered as a result of the delay or non-compliance, where documented.

- 4.3 The contract for the classification of a Ship or for other Services may be terminated and any certificates revoked at the request of one of the parties, subject to at least 30 days' notice to be given in writing. Failure to pay, even in part, the fees due for Services carried out by the Society will entitle the Society to immediately terminate the contract and suspend the Services.
- 4.4 The Society may withhold, suspend or withdraw any certificate, report or service in the event of non-payment of fees due to any member of the Society by the Client in relation to the entire business relationship between any member of the Society and the Client or by any other companies belonging to the same group as the Client. This also applies when the obligation to pay rests with a builder or with the Ship's previous Owner.
- 4.5 For every case of termination or suspension of the contract, the fees for the activities performed until the time of the termination or of the suspension shall be owed to the Society as well as the expenses incurred in view of activities already programmed; this is without prejudice to the right to compensation due to the Society as a consequence of the termination or of the suspension.
- 4.6 With particular reference to Ship classification and certification, unless decided otherwise by the Society, termination of the contract implies that the assignment of class to a Ship is withheld or, if already assigned, that it is suspended or withdrawn; any statutory certificates issued by the Society will be withdrawn in those cases where provided for by agreements between the Society and the flag State.

#### **ARTICLE 5**

- 5.1 In providing the Services, as well as other correlated information or advice, the Society, its Surveyors, servants or agents operate with due diligence for the proper execution of the activity. However, considering the nature of the activities performed (see Article 2), it is not possible to guarantee absolute accuracy, correctness and completeness of any information or advice supplied. Express and implied warranties are specifically disclaimed.
- 5.2 Therefore, subject to what provided for in Article 5.3 below, and also in the case of activities carried out by delegation of Governments, neither the Society nor any of its Surveyors will be liable for any loss, damage or expense of whatever nature sustained by any person, in tort or in contract, derived from carrying out the Services.
- 5.3 Notwithstanding the provisions in Article 5.1 above, should any user of the Society's Services prove that he has suffered a loss or damage due to any negligent act or omission of the Society, its Surveyors, servants or agents, then the Society will pay compensation to such person for his proved loss, up to, but not exceeding, five times the amount of the fees charged for the specific Services, information or opinions from which the loss or damage derives or, if no fee has been charged, a maximum of AED5,000 (Arab Emirates Dirhams Five Thousand only).
- 5.4 Where the fees charged are related to a number of Services, the amount of the fees will be apportioned for the purpose of the calculation of the maximum compensation, by reference to the estimated time involved in the

performance of the Service from which the damage or loss derives. Any liability for indirect or consequential loss, damage or expense is specifically excluded. In any case, irrespective of the amount of the fees charged, the maximum damages payable by the Society will not be more than AED 300,000 (Three Hundred Thousand Dirhams). Payment of compensation under this Article will not entail any admission of responsibility and/or liability by the Society and will be made without prejudice to the disclaimer clause contained in Article 5.

- 5.5 Any claim for loss or damage of whatever nature by virtue of the provisions set forth herein shall be made to the Society in writing, within the shorter of the following periods: THREE MONTHS from the date on which the Services were performed or THREE MONTHS from the date on which the damage was discovered. Failure to comply with the above deadline will constitute an absolute bar to the pursuit of such a claim against the Society.

#### ARTICLE 6

- 6.1 Any dispute, controversy, or claim arising out of or relating to these Rules, the Services of the Society, or the interpretation, breach, or termination thereof, shall first be referred to the parties' senior management for amicable resolution within thirty (30) days of written notice by either party.
- 6.2 If the dispute is not resolved amicably under Article 6.1, it shall be exclusively governed by and construed in accordance with the laws of the Emirate of Abu Dhabi and the applicable federal laws of the United Arab Emirates. The courts of Abu Dhabi shall have exclusive jurisdiction to settle any such dispute.

#### ARTICLE 7

- 7.1 All plans, specifications, documents and information provided by, issued by, or made known to the Society, in connection with the performance of its Services, will be treated as confidential and will not be made available to any other party other than the Owner without authorisation of the Interested Party, except as provided for or required by any applicable legislation from a competent authority. Information about the status and validity of class and statutory certificates, including transfers, changes, suspensions, withdrawals of class, conditions of class, operating conditions or restrictions issued against classed ships and other related information, as may be required, may be published on the website or released by other means, without the prior consent of the Interested Party.
- 7.2 Information about the status and validity of other certificates and statements may also be published on the website or released by other means, without the prior consent of the Interested Party.
- 7.3 Notwithstanding the general duty of confidentiality owed by the Society to its clients in Article 7.1 above, the Society's clients hereby accept that the Society will participate in the IACS Early Warning System which requires each Classification Society to provide other involved Classification Societies with relevant technical information on serious hull structural and engineering systems failures, as defined in the IACS Early Warning System (but not including any drawings relating to the Ship which may be the specific property of another party), to enable such useful information to be shared and used to facilitate the proper working of the IACS Early Warning System. The Society will provide its clients with written details of such information sent to the involved Classification Societies.
- 7.4 In the event of transfer of class, addition of a second class or withdrawal from a double/dual class, the Interested Party undertakes to provide or to permit the Society to provide the other Classification Society with all building plans and drawings, certificates, documents and information relevant to the classed unit, including its history file,

as the other Classification Society may require for the purpose of classification in compliance with the applicable legislation and relative IACS Procedure. It is the Owner's duty to ensure that, whenever required, the consent of the builder is obtained with regard to the provision of plans and drawings to the new Society, either by way of appropriate stipulation in the building contract or by other agreement.

- 7.5 In the event that the ownership of the Ship, product or system subject to certification is transferred to a new subject, the latter shall have the right to access all pertinent drawings, specifications, documents or information issued by the Society or which have come to the knowledge of the Society while carrying out its Services, even if related to a period prior to transfer of ownership.

#### ARTICLE 8

- 8.1 The Society shall not be obliged to perform any obligation towards the Client (including, without limitation, obligation to (a) perform, deliver, accept, sell, purchase, pay or receive money to, from or through a person or entity, or (b) engage in any other act) if this would be in violation of, inconsistent with or expose the Society to punitive measures under any United Nations resolutions and/or under any laws, regulations, decrees, ordinances, orders, demands, requests, rules or requirements of EU, United Kingdom, and/or United States of America and which relate to foreign trade controls, export controls, embargoes or international boycotts (applying, without limitation, to the financing, payment, insurance, transportation, delivery or storage of product and/or services) hereinafter referred to as "Trade Sanctions".
- 8.2 Recurring the above circumstances during the performance of the contract, the Society shall be entitled at its sole and absolute discretion:
- (a) to immediately suspend payment or performance of the Services which are the object of the contract until such;
  - (b) time as the Trading Sanctions are in force;
  - (c) to a full disengagement from the obligation affected by the Trading Sanctions, in the event that the inability to fulfill the said obligation persists until the term provided for the fulfilment hereunder, provided that where the relevant obligation relates to payments for activities and/or Services which have already been delivered, the affected payment obligation shall remain only suspended until such time as the Trading Sanctions no longer apply to the payment ; and/or
  - (d) to terminate the contract, without prejudice of the Society's rights pursuant to Article 4.

#### ARTICLE 9

Should any part of these General Conditions be declared invalid, this will not affect the validity of the remaining provisions.

#### ARTICLE 10

When the Society provides its Services to a consumer - i.e. a natural person who does not act within the scope of his business or professional activity - the following provisions do not apply Article 3 (as far as the Society is solely entitled to the authentic interpretation of the Rules); Article 4, (as far as the payment of the fees is also due for Services not

concluded due to causes not attributable to the Interested Party); Article 5 (as far as the exclusion of liability is concerned), and Article 6 (as far as the jurisdiction of a Board of Arbitrators based in Abu Dhabi is concerned).

#### **ARTICLE 11**

- 11.1 The Society and the Interested Party shall promote safety, protect human health and environment and create safe working conditions for their personnel.
- 11.2 The Interested Party shall guarantee that the working environment in which the Society's Surveyor will be required to work is adequate, safe and in all respect compliant with the applicable legislation and Rules and shall adopt all necessary measures to mitigate and/or control any relevant risk.
- 11.3 Furthermore, in accordance with the applicable legislation and Rules, the Interested Party shall provide the Society with complete and detailed information relevant to any actual or potential specific risk existing in the work areas where the Surveyor will be required to operate and relevant to the performance of the Services as well as with any specific safety measure that the Society's Surveyor is requested to comply with.
- 11.4 The Society reserves not to commence and/or to suspend the Services and/or to terminate the contract, claiming compensation for any damage occurred, if it considers that the safety requirements listed in this Article are not satisfactorily met.

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**1 GENERAL**

**1.1 FIELD OF APPLICATION**

1.1.1 These Rules apply to lithium battery systems intended for marine and offshore application.

1.1.2 These Rules are to be used in conjunction with the requirements of Part C of the «Rules for the Classification of Ships», hereafter referred to simply as the «Rules» (see Note 1), and Rules for Testing and Certification of Marine Materials and Equipment.

Note 1: for units classified according to the Rules for the Classification of Pleasure Yachts or Rules for the Classification of Yachts designed for Commercial Use, the relevant requirements are to be applied. In case of missing requirements, Tasneef Rules for the Classification of Ships are to be applied.

1.1.3 These Rules are applicable to installations with a variety of lithium battery chemistry. Since the battery technology is under development, additional

requirements to those specified in these Rules may be required by the Society on a case by case basis.

**1.2 DEFINITIONS**

1.2.1 For the purposes of these rules, the following terms and definitions apply.

- *Battery Management System (BMS)*: an electronic system that control and monitor the state of the battery by protecting the battery from operating outside its safe operating area.
- *Cell*: an individual electrochemical unit of a battery consisting of electrodes, separators, electrolyte, container and terminals.
- *Battery*: assembly of cells ready for use as storage of electrical energy characterized by its voltage, size terminal arrangement, capacity and rate capability.
- *Battery system*: the whole battery installation including battery banks, electrical interconnections, BMS and other safety features.

**1.3 DOCUMENTATION TO BE SUBMITTED**

1.3.1 The documentation listed in Tab 1 is to be submitted for review:

**Table 1: Documents to be submitted**

No	Document
1	Technical specification of the batteries, including technical data (electrical characteristics like voltage and capacity, discharge and recharge rates), battery chemistry, identification of potential hazards which covers all potential hazards represented by the type (chemistry) of batteries in normal operation and under foreseeable abnormal condition and prescription for installation.
2	Functional description of cell/battery design including at least cell/batteries configuration safety devices (BMS), interfaces to monitoring/safety systems, diagnostic, list of controlled and monitored parameters.
3	Statements of conformity to IEC 62619, IEC 62620, IEC 60529.
4	A FMEA according to the Tasneef "Guide for Failure mode and Effect Analysis" or other equivalent methods.
5	Type test program, including tests to be carried out according to FMEA, and relevant type test reports.
6	Battery Manufacturer's guidelines on active fire extinguishing system, fire and gas detection system, ventilation system and cooling system.
7	Test Report of battery system at cellular, modular and system level in order to identify the damage potential of a possible thermal runaway event (Propagation Test) including gas analysis and explosion analysis as applicable and depending on the safety concept adopted.

## 2 PRODUCT REQUIREMENTS

### 2.1 CONSTRUCTIONAL REQUIREMENTS

2.1.1 The type approved battery system is to comply with the constructional requirements of the applicable part of Tasneef Rules.

### 2.2 DESIGN REQUIREMENTS

2.2.1 The type approved battery system is to comply with the design requirements of the applicable part of Tasneef Rules

## 3 TEST AND VERIFICATION REQUIREMENTS

### 3.1 GENERAL

3.1.1 The testing and verification requirements are divided into:

- verification
- cell tests
- battery system tests.

Test programs are to be reviewed before the tests are performed. Test reports are to be submitted for review after the tests are completed.

3.1.2 The required tests are to be carried out at the presence of a Tasneef surveyor. However, where the testing laboratory is an independent and recognized laboratory complying with the Chapter 5, item [3] of Tasneef "*Rules for testing, Certification and Acceptance of Marine Materials and Equipment*", the tests may be carried out without the presence of a Tasneef surveyor.

3.1.3 Upon satisfactory review of the required documentation and test reports Tasneef will issue a Type Approval Certificate.

### 3.2 VERIFICATION

3.2.1 The Manufacturer is to have in place a Quality Assurance System at least equivalent to one of the ISO 9000 Standards.

3.2.2 Software version is to be recorded. If a new version of the software is released during the period of validity of the certificate, Tasneef is to be informed. Software modification is to be managed according to applicable quality procedure.

### 3.3 CELL TESTS

3.3.1 Cells are to be subjected to functional and safety tests according to IEC Publication 62619 or in

accordance with other equivalent national or international standards recognized by Tasneef.

3.3.2 Cells are to be type tested according to Tab 2.

**Table 2: Cells type tests**

	Type Tests	Reference
1	External short-circuit test	IEC 62619 7.2.1
2	Impact test	IEC 62619 7.2.2
3	Thermal abuse test	IEC 62619 7.2.4
4	Forced discharge test	IEC 62619 7.2.6

### 3.4 BATTERY SYSTEM TESTS

3.4.1 Batteries are to be subjected to functional and safety tests according to IEC Publications 62619 and 62620, or in accordance with other equivalent national or international standards recognized by Tasneef, according to Tab 3.

3.4.2 Battery system and associated electronic equipment is to be subject to the type tests according to Tasneef Rules Pt C, Ch 3, Sec 6, Tab 1.

3.4.3 The Battery Management System (BMS) is to be tested together with the batteries.

3.4.4 Type tests according to Tab 4 are to be carried out.

**Table 3: Battery system type tests according to IEC**

	Type Tests	Reference
1	Drop test	IEC 2619 7.2.3
2	Overcharge test	IEC 62619 7.2.5
3	Internal short-circuit test/Propagation test	IEC 62619 7.3.2/7.3.3
4	Overcharge control of voltage	IEC 62619 8.2.2
5	Overcharge control of current	IEC 62619 8.2.3
6	Overheating control	IEC 62619 8.2.4
7	Discharge performance (rated capacity check)	IEC 62620 6.3
8	Charge retention and recovery (self discharge)	IEC 62620 6.4
9	Cell and battery internal resistance	IEC 62620 6.5
10	Endurance	IEC 62620 6.6

**Table 4: Battery system additional type tests**

	Type Tests	Reference
1	BMS safety function tests	Tasneef Rules Pt C, App 2
2	Tests based on FMEA	Documentation as per Tab.1
3	Type tests for electronic equipment according to Tasneef Rules Pt C, Ch 3, Sec 6, Tab 1	Tasneef Rules Pt C, Ch 3, Sec 6, Tab 1
4	Functional tests of control, monitoring, alarm and safety system	Tasneef Rules Pt C, App 2
5	IP verification, as declared by the Manufacturer	IEC 60529
6	Propagation Test	[3.4.5]
7	Gas Analysis	[3.4.6]

**3.4.5 Propagation test**

In order to identify the damage potential of a possible thermal runaway event in a specific battery system, a propagation test is be carried out on both cellular, modular and system level. The results from the tests satisfying the acceptance criteria will determine the design of battery spaces with associated systems for fire extinguishing, explosion relief, ventilation, etc and may be used as basis for using this type of battery systems on ships.

If the battery system design indicates that the below test set-up is not relevant, this is to be clarified in advance with Tasneef.

The propagation test can be of type A or B as described below. Auxiliary systems which are integrated in the battery pack in order to prevent propagation and which are operative when the battery is in use, may also be used during the propagation test. Loss of these auxiliary systems is to lead to shutdown of the battery system.

**Propagation Test Type A**

- a) The test is to be carried out in an enclosed space, as similar as possible to the manufacturer's recommendation for battery spaces. The temperature of the space is to be equivalent to the maximum operating temperature (+/-5°C) for the battery system.
- b) The tested module is to be surrounded by other modules and be installed in a rack system similar to the one used on board ships. The modules in the least favourable positions with regard to fire propagation from the tested module are to be operative modules. The internal structure of the modules is to be not changed. The remaining

- may be dummy modules as long as they have the same heat capacity, heat reflective properties and conductivity as the actual modules.
- c) All operative modules in the test is to have a 100% State of Charge at the start of the test.
- d) The module being tested is to be randomly selected from a production batch, and is not to be altered apart from instrumentation. Any alterations made to cells in order to initiate the thermal event, is to be clarified with Tasneef in each case.
- e) The cell or cell pair to be overloaded is to have the least favourable position in the module with regard to propagation.
- f) The safety functions of the battery management system (BMS) is to be deactivated during testing.
- g) The test is to be instrumented to continuously record relevant data. Voltage and temperatures of the tested module and the other operative modules are to be logged as a function of time. The temperature of the dummy modules is to be logged in the same way. The temperature sensors are to be placed on the surface closest to the module where the thermal event is initiated.
- h) Modules in the test set-up is to be continuously monitored and the result registered until the temperature is back to ambient temperature, and as a minimum for 24 hours after the thermal event occurred.
- i) The test is to be conducted without use of active external safety functions such as fire extinguishing system, ventilation, etc. in the test space.

A cell or cell pair in the test module are to be overcharged with a voltage of at least 150% of the maximum charging voltage over time until a thermal event occurs. The charging current is to be maximum of what the cell is designed for.

If a thermal event has not occurred after 4 hours, additional heat may be applied by using fitted heating elements.

For battery cells fitted with an internal circuit interrupt device (CID), where it is documented that this is functioning, the thermal event may be initiated by using heat.

Three tests are to be carried out. The acceptance criterion is that no propagation occurs between modules.

If the test fails, the test is to be aborted, and the criterion of propagation test A has not been satisfied.

#### Propagation Test Type B

If the propagation test A fails, the arrangement may be tested with active external safety systems upon acceptance from Tasneef. The test set-up for propagation test B is the same as for propagation test A but with the use of active external safety functions such as fire extinguishing system, ventilation, etc. in the test space.

As for propagation test A, three tests are to be carried out. The acceptance criterion is the same: no propagation between modules. All tests have to be satisfactory.

When the battery system is fitted on board, the active external safety systems are to be installed, which are to be equivalent to the test arrangement with regard to capacity and details. These systems are to be available in all relevant emergency situations. If a gas fire extinguishing system is used to inhibit propagation, it is to have the capacity for at least two subsequent releases.

### 3.4.6 Gas Analysis

A gas analysis is to be carried out for the cell type that has passed one of the propagation tests described in [3.4.5].

The test is to be conducted in an inert atmosphere by controlled heating of a single cell until the cell vents. The cell is to be randomly selected, and is to have a 100% State of Charge at the start of the test.

The resulting atmosphere is to be analysed in order to identify maximum gas generation and gas composition. In case the analyzed atmosphere is considered to be explosive the hazards, risks, consequences and mitigation measures of an explosion are to be duly assessed through an explosion analysis.

### 3.4.7 Test based on FMEA

The aim of test is to verify unsafe status of the battery system in case of single failure of components like sensors, power cables, communication cables, I/O modules, software, PLC and switchgears according to the design of battery system and judgment of the FMEA team experts.