Section 1

Introduction

1.1 Background

1.1.1 This document provides specific guidance for the Special Consideration process in situations where Clients intend to apply materials in their designs which are outside the current scope of Lloyd’s Register’s (LR) Rules and Regulations, so that LR can provide assistance to the industry in these special cases.

1.1.2 The aim of this document is to describe the Special Consideration process in detailed steps, in order for Clients to receive a smooth and timely consideration for a particular material application.

1.1.3 This document is intended to be applied to Client designs with material applications which require ‘special consideration’ to reach equivalent levels of structural safety and material performance in service, compared with the relevant prescriptive LR Rules and Regulations.

1.2 Scope of materials applications

1.2.1 Material applications requiring special consideration, hereinafter abbreviated as material applications, are defined as proposed material solutions that are beyond the scope of the current revisions of LR Rules and Regulations. These solutions will include tailored manufacturing and/or inspection requirements to be implemented by the Client. These requirements may be instead of, or supplementary to, the current Rule requirements.

1.2.2 Such material applications may involve many aspects, such as the associated material manufacturing processes, material specifications, material fabrication processes, inspection methods and service conditions, etc.

1.2.3 In general, the material applications being dealt with in this document will fall into one or more of the following categories:

- Material type and/or grade, out of the scope of standard materials in Rules for the Manufacture, Testing and Certification of Materials;
- Standard and/or Non-standard material with a novel manufacturing process;
- Standard and/or Non-standard material with novel fabrication process;
- Standard and/or Non-standard material for novel applications;
- Where the Rules or Codes indicate that materials will be ‘specially considered’ or ‘subject to special consideration’.

1.3 Applying special consideration

1.3.1 Where it is identified at the material selection stage of design engineering that a material application is out of the scope of current Rules, and will require ‘special consideration’ since it falls into one or more of the categories listed in Ch 1, 1.2 Scope of materials applications, the application shall be submitted to LR at the design appraisal stage at the latest. It is recommended to submit such applications at the earliest possible stage (i.e. at the concept phase of the project). The submission shall include the available information regarding the actual design of the structure and material specification in question. For details regarding the minimum submission content see Ch 1, 2.2 Step 1: Initial review of Client’s proposal 2.2.2.

1.3.2 The process of special consideration is scalable according to the degree of novelty and/or deviation from the prescriptive requirements of the Rules and Regulations, the criticality of the item, complexity of design, and safety considerations, etc. Hence, the rigour, time and ultimately the cost required to review and assess each application will be tailored accordingly.

1.3.3 In ‘special consideration’ cases, reference should be made to the relevant part of the Rules and Regulations. These will be recorded as the primary Rule requirements to be satisfied prior to commencement of the initial review.
1.3.4 The Special Consideration process described in Ch 1, 2 Special consideration process of this document will result in a decision being issued to the Client based on the outcome of the assessment described in Ch 1, 2.5 Step 4: Review and technical justification and Surveyor involvement described in Ch 1, 2.6 Step 5: Verification of Client implementation of agreed measures.

1.3.5 Acceptance of a “specially considered” material application is in principle only valid for a specific application, i.e. detailing defined material application, with its design purposes and service conditions acting as the boundary conditions for acceptance.

1.3.6 The scope of an acceptance, whether it is for one single case, or for a series of cases or a product range, etc. is to be made clear in the decision to the Client.

1.3.7 Unless otherwise specified in this document, the relevant LR Rules, Regulations and Procedures governing the manufacturing of the product under special consideration shall be followed.

Section 2 Special consideration process

2.1 General

2.1.1 To ensure that special consideration is undertaken in a consistent manner, with an appropriate degree of rigour and in compliance with the applicable Classification and Certification (Rule) requirements for materials, the Special Consideration process shall be conducted in accordance with the steps given in Ch 1, 2.1 General 2.1.2.

2.1.2 This Section gives the steps to be taken for special consideration. Each step is outlined in Ch 1, 2.2 Step 1: Initial review of Client’s proposal to Ch 1, 2.6 Step 5: Verification of Client implementation of agreed measures respectively including the objectives and output associated with each step:

(a) Step 1: Initial review of Client’s proposal;
(b) Step 2: Identification of specific concerns regarding the proposal;
(c) Step 3: Discussion and submission of measures taken and evidence submitted by the Client to address the specific concerns identified;
(d) Step 4: Review and technical justification of the measures taken;
(e) Step 5: Verification of Client implementation of agreed measures via survey, if necessary.

2.1.3 In general, communication between LR and Client will be through the local office.

2.2 Step 1: Initial review of Client’s proposal

2.2.1 The Client initially informs LR of the intention to use a material that is out of the scope of the Rules at the concept or design stage.

2.2.2 The following information shall be submitted for special consideration by the initial review:

- Equipment / component descriptions where the material application is proposed;
- Documentation (e.g. structural drawings showing the items in question as required by design appraisal (reference is to be made to the applicable Sections of LR’s Rules and Codes);
- Welding details;
- Operational environment/limitations, including design temperatures, load conditions and service environment;
- Supporting documents, e.g. previous designs, reasoning behind the material application, etc.;
- Reference relevant Rules, Codes and Standards for Classification or Certification, as applicable;
- Identification of primary or secondary structural members as required in the relevant design Rules and/or Codes;
- Proposed material specification and national and/or international standards;
- Other supporting information, as required.

2.2.3 An initial review is undertaken to confirm that the proposal qualified for special consideration. Based upon the outcome of the initial review conducted by LR, the Client will either receive an acceptance or rejection in principle, including the reasoning that led to the decision. It is possible for the Client to appeal against this decision and provide further justification to support their case.
2.2.4 In order to ensure an efficient review process, Clients should submit the information listed in Ch 1, 2.2 Step 1: Initial review of Client’s proposal 2.2.2 as comprehensively as possible. Discussions at an early stage (e.g. concept design stage) with LR specialists are encouraged for a smooth and timely approval process.

2.2.5 The initial review will be based on the information submitted in conjunction with stress calculations submitted by the Client, which may not have been independently verified by LR. If during the subsequent LR design appraisal stage, the designed service conditions (including load conditions, stress levels, environment etc.) for the material application concerned are found to be incorrect, it will be the responsibility of the Client to ensure appropriate action is taken to achieve compliance. This may result in the initial review stage of the Special Consideration process being repeated.

2.3 Step 2: Identification of specific concerns

2.3.1 Further to the positive outcome of the initial review and an acceptance in principle, LR will identify the specific concerns highlighted during the initial review of the proposal. The result will be a list of further considerations or specific concerns to be addressed by the Client.

2.3.2 The further considerations or specific concerns need to include all root causes of the specific failures in material function and performance through-life.

2.3.3 The further considerations and the specific concerns may include, but are not limited to:

(a) Concerns raised due to the restriction of the Rule requirement, i.e. the reason why the material application is not in the scope of the current Rules and Regulations;
(b) Reported failures in similar industrial applications;
(c) Engineers’ and specialists’ knowledge and experience in the areas relevant to the material application;
(d) Applicable concerns from previous similar cases;
(e) Possible failures identified by the Client based on their knowledge and expertise;
(f) Risks associated with this material application with respect to possible material failures.

2.3.4 In particular regard to item (f) of Ch 1, 2.3 Step 2: Identification of specific concerns 2.3.3, the specific material failures shall be scrutinised throughout all the scenarios of the material life span as categorised in (a) to (i) of this paragraph, if applicable, in order to identify the specific concerns that could act as the root causes of the possible failures:

(a) Design accuracy and safety margin demonstrated in structural and stress analysis and calculation reports, etc., where applicable;
(b) demonstrated in structural and stress analysis and calculation reports, etc., where applicable;
(c) Material selection, where the relevant design codes, material standards and material selection principles or methods shall be referred to;
(d) Manufacturing processes, including technology and capacity, chemical composition and microstructure (if applicable), processes and quality control, sampling and testing, and maximum permissible manufacturing defects;
(e) Material property degradation during the fabrication processes, e.g. cutting, forming and welding/joining, such as strain ageing, welding HAZ properties and susceptibility to hydrogen cracking and embrittlement of high strength steels from supporting documents such as associated welding procedures and qualification records, testing and inspection plans and acceptance criteria;
(f) Material property degradation due to the service environment, such as chemical attack (e.g. hydrogen embrittlement and stress corrosion), and service temperatures;
(g) Material property degradation in extreme load conditions, including impact and strain rate effects, fatigue propagation etc.;
(h) Sampling, testing and procedure qualifications shall be representative of the worst case scenarios; Quality control and inspection practices including acceptance criteria and procedures, with the achievable detection limits of the techniques in use;
(i) Service records and periodic inspection reports, if existing structures/machinery are involved.

2.4 Step 3: Discussion and submission of measures

2.4.1 The identified concerns are then communicated and discussed with the Client in order for them to provide evidence and/or take measures to address and mitigate them.

2.4.2 In order to eliminate the root causes of possible failures, as listed in the specific concerns and identified in step 2, the Client shall agree to take measures and to demonstrate that the possible failures shall be prevented sufficiently and effectively. Submission of such measures shall include, but are not limited to, the following items:

(a) Works approval status of the material supplier;
(b) Capabilities of the material fabricator, e.g. company’s historical data and product performance records, if available;
(c) Sufficiently detailed stress calculations and fatigue assessments for all required design conditions;
(d) Manufacturer or fabricator’s Inspection and Testing Plan (ITP);
   The ITP shall provide useful information on the quality control aspects identified by the manufacturer, based on which local LR Surveyors can examine the execution of manufacturing and the ITP. An ITP shall include a minimum of the following aspects:
   • Material designations and specifications in accordance with recognised National and/or International Standards.
   • Details of the material manufacturing and heat treatment processes, including quality control aspects.
   • Mechanical testing plans and procedures, including sampling plans, frequency and acceptance criteria.
   • Material fabrication/welding procedures, quality control and inspection plans, including welding repair procedures if applicable.
(e) A specific testing program and defined acceptance criteria based on the concerns raised during the “initial review” and “identification of specific concerns” stages, if applicable. The Client’s research regarding the material service conditions, expected material behaviour/performance and life span, including possible analysis of material failure modes and material related structural failures, if available;
(f) Level/extent of NDE, which needs to be suitable for the design details and the application of the proposed material and weld types;
(g) Findings from relevant research regarding the aforementioned aspects, if available;
(h) Any applicable test results regarding the aforementioned aspects, if available;
(i) Inherent safety factors relating to the material application.

2.5 Step 4: Review and technical justification

2.5.1 Technical justification is to be conducted based on a review of the information listed in Ch 1, 2.4 Step 3: Discussion and submission of measures 2.4.2 as submitted to LR by the Client.

2.5.2 If during the review, a need for additional information is identified, this will be requested from the Client.

2.5.3 LR will assess whether the measures taken have adequately and effectively addressed the concerns, and whether the material application can ensure the structural integrity, safety, and component performance in service. Justification and evidence offered to address the concerns raised may take the form of the following items:
   • Material specifications and requirements for material quality and selection are demonstrated as being suitable for the design purpose by means of Structural Integrity and Safety Assessment or Fit For Service Assessment in compliance with the relevant Standards, if necessary;
   • Conservatism in the design calculations for the load cases, and service/environment conditions;
   • Sufficient manufacturing capability demonstrated with product history and performance data, if available;
   • Testing results, particularly with regard to the sampling procedure for the representative properties and worst-case scenarios;
   • Sufficient capability of fabrication practices, inspection and quality control for a minimum level of defects in a new build structure;
   • Risk of material failure in service related to material properties mitigated.

2.6 Step 5: Verification of Client implementation of agreed measures

2.6.1 Where applicable, the LR Surveyors on site will be informed of the agreed requirements for the manufacturing and testing procedures. These will include activities requiring LR witnesses during manufacturing, material testing, fabrication and inspection, in order to verify compliance during the manufacturing and construction stages.

2.6.2 Confirmation of compliance with the agreed requirements shall be documented. In the case of non-compliance, it shall be resolved prior to the product entering into service.
Section 3
Decision making

3.1 General

3.1.1 At the final stage of the Special Consideration process, LR will advise the Client of the findings based on a thorough technical justification of the measures demonstrated by the Client to mitigate the identified concerns regarding possible failures; and will evaluate the overall justification for acceptance for the material application.

3.1.2 Where LR is satisfied with the proposed material application, confirmation of LR’s acceptance of it will be provided in the decision.

3.1.3 Any actions required during manufacturing and/or fabrication will be detailed in the decision to the Client, including any follow-up requirements that the Client is required to submit to LR.

3.1.4 For resolving outstanding issues, or where Surveyor involvement is required, the process identified in Ch 1, 2.6 Step 5: Verification of Client implementation of agreed measures will be followed.

3.1.5 When an identical material application is to be applied in a number of cases or to a product range, the conditions under which the acceptance for these cases or product range will clearly defined in the scope of acceptance.

Section 4
Generic acceptance of material applications

4.1 General

4.1.1 Special consideration and acceptance of a material application may constitute generic acceptance or set a precedent for repeated design cases where a Client uses the same material types and/or grades for the same design purpose under the same service conditions.

4.1.2 This generic acceptance is dependent on the Client demonstrating that the material application of the products or product range is substantially identical to that case initially considered. Further guidance on applying for a generic acceptance by a Client for their specific material application may be obtained from the Client’s local LR office.

4.1.3 The materials, manufacturing and fabrication techniques, and applications accepted via Special Consideration processes may become more widely utilised. Following successful performance and in-service feedback that the material application has become a common practice within industry, this will eventually be reflected in revisions to standards, statutory regulations and the Rules where applicable, based on the evidence provided by the industry from such wider applications.