GUIDANCE NOTES
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CHINA CLASSIFICATION SOCIETY

GUIDELINES FOR QUALIFICATION OF NEW TECHNOLOGY APPLICATIONS

2024

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Beijing

CONTENTS

Chapter 1 GENERAL

1.1 Purposes

1.1.1 The Guidelines intend to promote the application of new technologies of ships and offshore installations, and provide guidance for the qualification of related new technology applications.

1.1.2 The Guidelines confirm the achievement of control objectives for the safety, reliability and other risks of new technology applications through a multi-stage system evaluation of new technologies and related products from conceptual design to real ship applications.

1.2 Scope of Application

1.2.1 The Guidelines apply to the qualification for new technology applications of marine or offshore engineering equipment (hereinafter called the equipment), systems, ships or offshore installations (herein after called the ship) in the case of the new technologies lacking of specific technical requirements and relevant criteria in the recognized standards, e.g.: maritime conventions, codes, regulations, rules and domestic and foreign standards.

1.2.2 The new technologies described in the Guidelines include but are not limited to novel products applied on ships, as well as new products, marine systems or ship technology solutions (including operation and maintenance, monitoring and inspection, and fault response procedures) designed to meet the target functional requirements of conventions, codes or rules. Due to the lack of relevant technical criteria, testing and verification processes and inspection basis, these new products, ship systems or technical solutions cannot be directly applicable to ships through the existing product qualification mode and ship plan approval and inspection process of China Classification Society (CCS).

1.2.3 A new technology may be the adoption of new technologies in existing products, ships and related technical solutions, or new products that adopt new technologies, general including:

(1) Technical principles or design program of innovative products;

(2) Innovative products not meeting the conditions for design approval, type approval or works approval;

(3) Innovative complex systems or marine technology solutions with innovative designs.

1.3 Terminologies and Abbreviations

1.3.1 Terminologies

(1) Consequence means the measure of the outcome of an event occurrence in terms of people affected, property and funds lost, outage time or any other chosen parameter usually expressed in terms of consequence per event or consequence amount per unit of time, typically per year.

(2) Hazards means conditions that exist which may potentially lead to an undesirable event.

(3) Risk means the combination of the frequency or probability of a dangerous event and the consequence of the event.

(4) Failure means the loss of the ability to perform the intended function.

(5) Failure mode means the specific process or manner that causes the failure.

(6) Availability means the ability of a product or system to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided.
(7) Maintainability means the ability of a product or system under given conditions of use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources.
(8) Reliability means the ability of a product or system to perform a required function under given conditions for a given time interval.
(9) Validation means the timely and accurate acquisition of relevant technical parameters that can determine the different states and operational performances of a product or system through monitoring, testing or inspection.
(10) Verification means the process of evaluating or determining whether the product satisfies the acceptance requirements at different qualification stages by test, analysis or inspection.
(11) Engineering evaluations means various engineering analysis tools and testing that may be used to support new technology qualification activities. Typical examples include but not limited to the following: Finite Element Analysis(FEA), Computational Fluid Dynamics(CFD), Functional and Performance Testing, Model Testing, System Integration Testing, etc.
(12) Risk analysis means the systematic use of existing information to identify hazards and predict their risks to personnel, property and environment.
(13) Risk evaluation means the process of making judgments on the tolerance of risks based on risk analysis, considering social, economic, environmental and other factors (the work of risk assessment sometimes includes comparing the results of risk analysis based on certain risk acceptance criteria).
(14) Risk assessment means an integrated process of connecting risk analysis and risk evaluation.
(15) Principle prototype means a model sample designed and manufactured in the early stages of product or system development to evaluate and verify the feasibility of technical principles or solutions, which can be designed using the principle of similarity.
(16) Engineering prototype means a practical sample designed and manufactured in a standardized manner to evaluate and verify the rationality and correctness of a technical design or solution, and can be optimized and adjusted under engineering application conditions to verify its performance parameters.
(17) Manufacturing plan means the document setting out the specific manufacturing rules, technical resources and sequences of activities relevant to the production of a particular product including any specified acceptance criteria at each stage.
(18) Quality control means the operating technologies and activities adopted to meet quality requirements.
(19) Fault mode means a status of a faulty product relative to the given specified function.

1.3.2 Abbreviations
(1) FMEA: Failure Mode & Effects Analysis;
(2) FTA: Fault Tree Analysis;
(3) HAZOP: Hazard and Operability;
(4) HAZID: Hazard Identification;

(5) MTBF: Mean Time Between Failure;
(6) RAM: Reliability, Availability and Maintainability.

1.4 Responsibilities of Parties Concerned

1.4.1 China Classification Society (CCS) is to carry out new technology qualification work in accordance with the relevant processes and requirements stipulated in the Guidelines, and is to be responsible for the verification and qualification quality. CCS is not to be liable for any consequences arising from the use of by a third party without qualification conducted by CCS.

1.4.2 The designers and manufactures of new technical products are to fully consider the safety, reliability, environmental friendliness and sustainability of new technical products or systems, and be responsible for the quality of the designed and produced new technical products or systems. The qualification of new technology applications can neither substitute the control quality of ship designers and process control and quality control of manufacturers, nor can it reduce or relieve the responsibilities of new technical product designers and manufactures.

1.4.3 The ship designers are to fully consider the risks and relevant risk control measures brought by the application of new technical products, systems, and related technical solutions on board the real ships, and be responsible for the quality of designed ships. The qualification of new technology applications cannot substitute the quality control of ship designers, nor can it reduce or relieve the responsibility of ship designers.

1.4.4 The shipbuilders are to construct/modify the ships in accordance with the drawings approved by CCS and be responsible for the construction quality of the ships it constructs. The qualification of new technology applications cannot substitute the process control and quality control of shipbuilders, nor can it reduce or relieve the responsibilities of shipbuilders.

1.4.5 Other firms/experts involved in risk assessment or engineering evaluation of new technologies at various stages from product design to real ship application are to be responsible for the evaluation opinions provided by them.

1.4.6 The shipowners/operators and masters are to ensure that the ship is in a seaworthy state during the application of new technologies, and the valid relevant certificates or documents issued by the competent authorities are available (if necessary), implement relevant operations, maintenance, faults and emergency measures and procedures proposed by the new technical products designers and manufacturers, ship designers and builders as much as possible, and be responsible for the safety of ship operation. The qualification of new technology applications cannot substitute the operation management of shipowners/operators and masters during the application of new technologies, nor can it reduce or relieve the responsibilities of shipowners/operators and masters.

1.4.7 Any documents issued by CCS related to survey only reflect the condition at the time of survey. The contents contained in any reports, documents and certificates issued by CCS do not imply any reduction or release of any responsibility of the parties mentioned above.

1.4.8 For items where the responsibilities of all parties concerned are not fully covered, refer to the relevant requirements of Chapter 2, Section 13 of PART ONE in the CCS Rules for Classification of Sea-going Steel Ships.

Chapter 2 PROCESS OF QUALIFICATION

2.1 Basic Process

2.1.1 The qualification of new technology applications is to be generally divided into the new technology qualification for products and the new technology qualification for ship applications based on the scope of qualification and the level of technology maturity[①]. This includes the concept verification stage, prototype validation stage, system integration stage, real ship application qualification stage, ship design evaluation stage, and ship application verification stage. The main contents of each stage are as followings:

(1) New technology qualification for products:

① Concept verification stage: to verify the feasibility and concept of new technologies;

② Prototype validation stage: to validate the technical qualification (including principle prototype validation or engineering prototype validation);

③ System integration stage: to conduct technical validation of integrated systems based on future practical application scenarios;

④ Product real ship application qualification stage: to promote product quality improvement and technology perfection through the application of new technical products onboard full-scale ships.

(2) New technology qualification for ship applications:

① Ship design evaluation stage: to evaluate detailed design plans of new technologies for ship applications;

② Ship application verification stage: to verify the application of new technologies at the ship construction and in-service stages.

2.1.2 Upon the voluntary application by the applicant and the evaluation by CCS, CCS is to carry out new technology application qualification and issue qualification certificates or statements at the corresponding stages. The qualification process for new technology application is shown in Figure 2.1.2.

① For the technical maturity, refer to the division in ISO16290:2013.

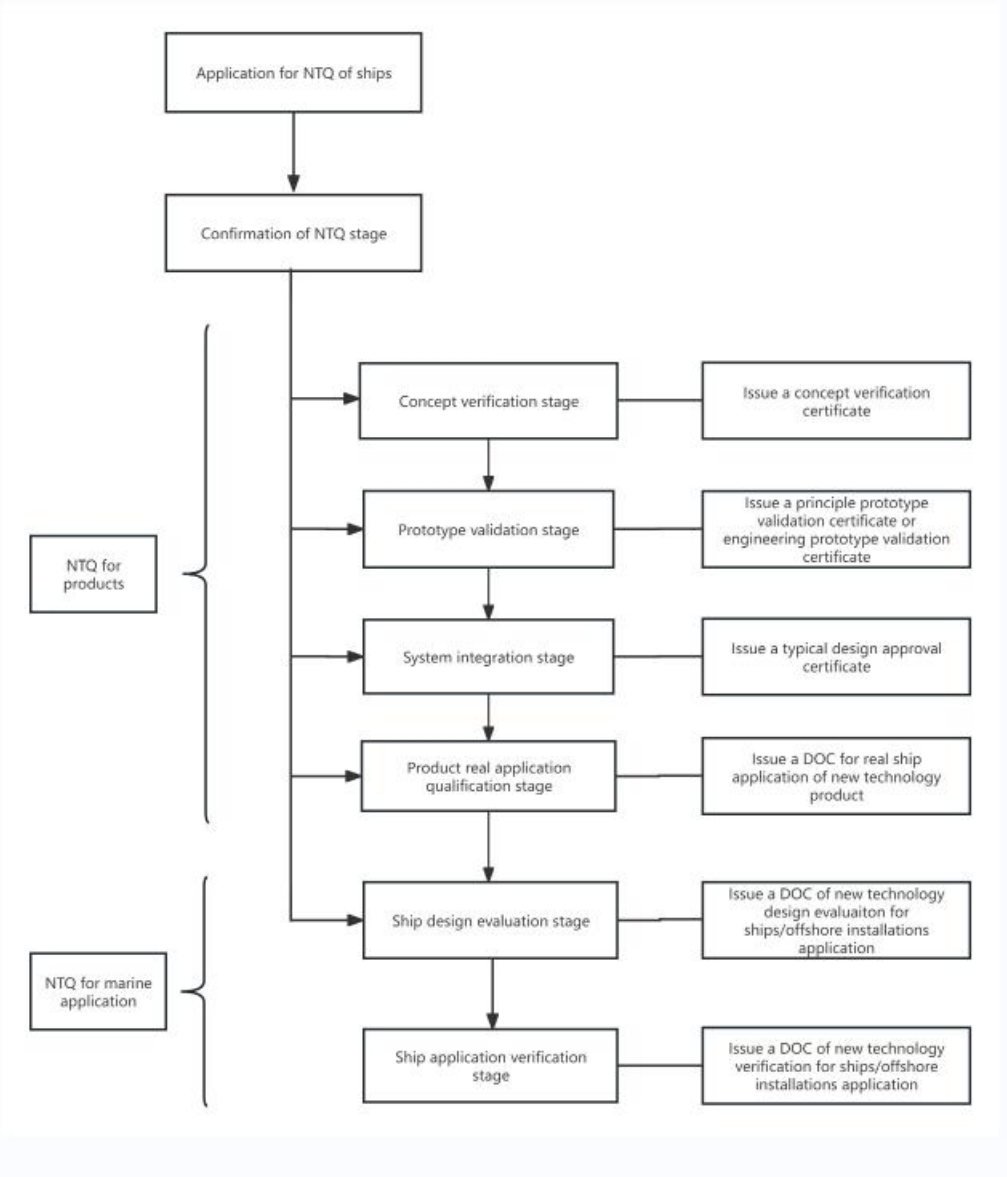

Fig. 2.1.2 Process for Qualification of New Technology Applications

2.1.3 The application for new technology qualification for ship applications is to be submitted in writing to CCS, including the name and overview of the new technology, its purposes and operational limitations, qualification stage of the application, qualification plan, etc. When applying, at least the necessary qualification documents are to be submitted in accordance with the requirements of 2.2 of this Chapter.

2.1.4 The applicant may apply for qualification at different stages specified in Figure 2.1.2 based on the maturity of the new technology. CCS is to evaluate the application for qualification and submitted materials, determine its qualification stage, and organize the subsequent qualification work.

2.1.5 The concept verification and prototype validation of new technical products are within the scopes of principle approval specified in CCS rules.

2.1.6 The new technical products that have met the requirements for prototype validation or system integration qualification may apply for type approval, if they have the ability to produce in batch. Upon the evaluation by CCS, type approval can also be carried out after the real ship application qualification stage of the new technical products.

2.2 Documents and Data Submitted for Qualification

2.2.1 New technology application qualification plan

2.2.1.1 The applicant of new technology qualification for products is usually to be the research and development unit, designer, manufacturer, agent, etc. of the new technical products. The applicant of new technology for ships is usually to be the designer, manufacturing unit, shipowner, etc. of the ships that apply new technical products or related new technology solutions.

2.2.1.2 The applicant is to submit a qualification plan, which usually includes the following contents:

(1) Overview of the goals, functions, performances and application scenarios of new technology applications;

(2) Stage and condition of new technology development has been completed;

(3) Timeline for critical technology research and development, manufacturing, system integration and shipboard applications;

(4) Summary of activity plans at different stages of new technology qualification, including engineering evaluation, risk assessment, etc.

2.2.2 Technical specifications

The technical specifications are to specify the application plan, basic functional and performance requirements of new technical products or ship applications, and generally include the following contents:

(1) Goals

The application conditions, shipboard application scenarios, objectives or requirements that new technologies need to meet.

(2) Functional requirements

Functional requirements are to define and be mapped to specific items that will perform the function, including a description of the function, operating environment, conditions under which the system starts and terminate the function.

(3) Performance requirements

Specify the accomplished extent of each functional requirement, and the key indicators. The performance criteria is the acceptance criteria against which the results of each qualification activity is evaluated, and it can be defined qualitatively at early design stages and progressively more quantitatively during subsequent stages of technology maturation through engineering evaluation, risk assessment, etc.

(4) Design conditions

The environmental conditions, loading requirements, arrangement requirements, safety requirements, operation and maintenance requirements, etc. for the design and operation of new technical products or systems.

(5) Interface requirements (if applicable)

All the internal and external, physical and functional interfaces (e.g., mechanical, electrical, etc.), including the human-computer interaction interface. Where necessary, the matching interface requirements between ship systems, between systems and the global ship, and between the ship and shore are to be considered.

(6) Human factor requirements

The specific areas, locations or equipment arrangement involved in ergonomics.

(7) Maintainability (if applicable)

Monitoring, inspection and maintenance requirements, including the service period.

(8) Reliability (if applicable)

The durability, consequence of failure and redundancy of the products or systems by risk assessment or reliability verification methods (e.g.: MTBF).

(9) The specific technical specifications and drawings and information of the relevant system are to generally include but are not limited to the following contents:

① List of equipment;
② Comparative analysis with existing similar technologies;
③ Experience learned from similar technologies;
④ Applicable standards, rules or industry practices;
⑤ Engineering documents, e.g.: materials and specifications, schematic diagrams and arrangement, etc.;
⑥ Details of control and safety systems;
⑦ Installation, commissioning, operation, maintenance and inspection details;
⑧ Intellectual property declaration.

Chapter 3 QUALIFICATION FOR NEW TECHNOLOGY APPLICATIONS

3.1 Implementation of Qualification Plan for New Technology Applications

3.1.1 General provisions

3.1.1.1 The new technologies and products are to be usually carried out engineering evaluation and risk assessment at various stages. Iterative design upgrades and further evaluation are to be conducted based on the evaluation results to verify that it meets the predetermined performance requirements and criteria, as shown in Figure 3.1.1. According to the qualification at each stage, the program can be adjusted.

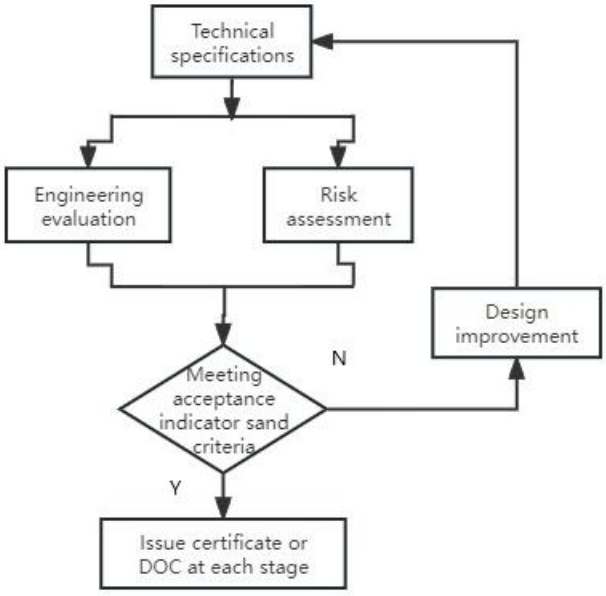

Figure 3.1.1 Simplified Diagram of New Technology Qualification at Each Stage

3.1.1.2 The data and reports of engineering evaluation and risk assessment carried out at each stage are to be submitted to CCS for review.

3.1.2 Engineering evaluation

3.1.2.1 The technological maturity of products is to iteratively develop at each stage with design improvement. Engineering evaluation is to be conducted to validate whether the new technical products meet the acceptance indicators and criteria of each stage, in order to achieve the final safety goals and functional requirements. Engineering evaluation can include:

(1) Validation of engineering design requirements: The functional requirements and performance requirements are be reviewed to meet the design goals, and updated as needed;
(2) Technical analysis and simulations: Engineering design analyses and simulations are to be used to conduct evaluation at the earlier concept verification and prototype validation stages;
(3) Testing: Tests are to be used to verify that the new technical products satisfy all the specified functional and performance requirements, including the reliability and safety requirements, etc.;
(4) Interface analyses: Interaction between new technical products and their connected systems (including humans and the environment) is to be analyzed, including the interface between the technology and existing systems, and system integration testing is to be carried out;
(5) Operational verification of new technical products: Operational testing and test data analysis are to be required to verify the new technology can be normally operated;
(6) Ship design evaluation: The ship design plan is to be reviewed whether the operation conditions, risks and risk control measures of the new technologies or products have been fully considered, and appropriate arrangements have been made;
(7) Ship application verification: The effectiveness of the operation, maintenance and shipboard control of new technical products or systems, as well as the equipment/facilities/arrangements/ procedures related to shipboard risk control of new technology applications at the ship construction and in-service stages;
(8) Quality control program: An effective quality control procedure and quality acceptance criteria at each stage is to be established and maintained in accordance with recognized industry standard;
(9) Others identified in risk assessment (if necessary).

3.1.3 Risk assessment

3.1.3.1 Risk assessment is to be conducted or updated at each applicable stage. Before and after the risk assessment, the risk assessment plan and risk assessment report are to be submitted to CCS individually.

3.1.3.2 Risk assessment is to be intended to identify technical risks and uncertainties related to design, manufacturing, etc., analyze the causes and consequences, and develop risk control measures. For certain new technical products or ship applications with high-level risk, further risk assessment is to be conducted by the means of FMEA, HAZOP or HAZID, etc.. With the continuous improvement of technological maturity, risk assessment can transit from qualitative to quantitative.

3.1.3.3 The risk assessment plan is to including the following information:
(1) Scope of the assessment: Evaluate the functions, expected applications, physical and operational boundaries of new technical products and systems; For ship application verification, it is also to include the detailed design plans for new technical products of ship applications;
(2) Assessment method: Appropriate risk assessment method is to be selected based on the characteristics of new technology to assess potential design-related failures under all expected operating modes. For example, FMEA methods may be used for hardware or mechanical systems;
(3) Assessment team: Design team and relevant experts, participants concerned (e.g.: shipowners, surveyors, etc.) and risk analysis experts.

3.1.3.4 Assessment preparation: all relevant information (e.g.: design basis, drawings, procedures, etc.); proposed risk assessment method and risk assessment criteria (e.g.: risk matrix).

3.1.3.5 After the risk assessment has been completed, a report that includes the following information is to be submitted to CCS for review:

(1) Scope of risk assessment;

(2) Description of the new technical product, including physical and operational boundaries, expected application scenarios; For ship application verification, it is also to include detailed design plan of new technical product of ship applications;

(3) Assumed conditions and reference data;

(4) Technical data and drawings;

(5) Risk identification (including risk level, measures to be taken and recommendations).

3.1.3.6 Exemption from risk assessment: When the failure of new technology or any related product components brings no risk to personnel, ships and the environment, or is known to be of low-level risk, risk assessment can be exempted. The reason for exemption from risk assessment is to be explained in the new technology qualification plan and confirmed by CCS.

3.1.4 Design improvements

3.1.4.1 Based on the results of the engineering evaluation and risk assessment, design improvements may be necessary to enhance reliability and safety of the design. Design improvements are to be made by inherently safe design methods as much as possible, including material changes, reconfiguration or redundancy requirements, etc.

3.1.4.2 The design improvement plan is to be reevaluated based on the acceptance indicators and criteria requirements in the technical specifications.

3.2 New Technical Qualification for Products

3.2.1 Concept verification stage

3.2.1.1 General provisions

This stage is to verify the safety and reliability of the new technology concepts in practical applications through design review, functional and model testing and reliability testing (if applicable). At the concept verification stage, an evaluation of the applicability of conventions, codes or rules, as well as the need for alternative designs or equivalents, are to be conducted.

3.2.1.2 Engineering evaluation requirements

(1) Engineering design review

① At the concept verification stage, define the composition and functional requirements of entire system, subsystem and components by confirming the feasibility of the concept and reviewing the engineering design, and verify the conformity of the new technology and product functions and performances with the design objectives;

② Define the performance requirements of new technology or product, explain the principle of realizing its functional requirements, the range of technical parameters related to new technology and the range of corresponding product performances, as well as the integration

requirements of subsystems and components, system configuration and interface requirements, design constraints, and scope of materials.

(2) Functional and model testing

① Select suitable test types based on the characteristics of the new technology to verify the performance of the new technology and product. The test is to be conducted under the anticipated environment and operating conditions, as well as the key failure modes identified in the risk assessment. With the consent of CCS, partial or complete substitution can be conducted through simulation conditions or numerical model experiments, e.g.: finite element analysis (FEA), computational fluid dynamics (CFD) and other tools;

② Material testing, including destructive testing or non-destructive testing, is to be conducted on new materials or critical materials of the system. If reliability testing is required, with the consent of CCS, accelerated testing methods can be used;

③ Test program is to be submitted for review.

3.2.1.3 Risk assessment requirements

Design risk assessment is to be conducted to identify technical risks related to the design of new technologies. This design risk assessment is to take into account the followings:

(1) The range of design modifications accepted at concept verification stage;

(2) Updated functional and performance requirements;

(3) Update of system composition;

(4) Interfaces and system integration (if applicable);

(5) Potential failure modes, failure causes and failure mechanisms;

(6) Risk control measures.

3.2.1.4 Certificate issuance

Upon the completion of verification according to the concept verification requirements, CCS may issue a concept verification certificate.

3.2.2 Prototype validation stage

3.2.2.1 General provisions

This stage is to verify the expected functions, performances, safety and reliability (if necessary) through prototype testing, which can be divided into two validation stages: principle prototype and engineering prototype.

(1) Principle prototype stage

At the prototype stage, a non-full-scale prototype is to be usually designed and manufactured for experimental validation of the applicability and correctness of the principle, which can meet the expected technical indicators, including:

① Improvement of technical data (clearly describe application scenarios, functional characteristics, technical principles and form relevant drawings and technical solutions, etc.);

② Necessary risk assessment;

③ Principle prototype design, manufacturing and evaluation;

④ Principle prototype testing.

(2) Engineering prototype stage

At the engineering prototype stage, a full-scale prototype is to be manufactured for validation testing to meet the engineering practicality, stability and reliability, including:

① Defined performance requirements;

② Detailed design of engineering prototype;

③ Risk assessment;

④ Engineering prototype manufacturing and evaluation;

⑤ Engineering prototype testing.

3.2.2.2 Engineering evaluation requirements

(1) Engineering design review

The drawings and technical requirements of engineering design are to fully taken into account the impact of component and electrical component faults/failures, as well as the impact on system integration, installation and the entire life cycle.

(2) Prototype testing

The test program is to include test methods, restrictive conditions, expected test data, safety assurance measures, etc. With the consent of CCS, partial or complete substitution can be made through simulation conditions or numerical model experiments, e.g.: finite element analysis (FEA), computational fluid dynamics (CFD) and other tools. The test program is to be submitted to CCS for approval.

(3) Prototype manufacturing and inspection

Detailed production plans and quality assurance plans are to be submitted for review, and CCS is to witness the critical nodes and type testing processes in accordance with the inspection and test program agreed by both parties.

3.2.2.3 Risk assessment requirements

Risk assessment is to be carried out for design, design changes and subsequent manufacturing and assembly processes, in order to validate the safety and reliability of the final design product of the new technology.

3.2.2.4 Certificate issuance

Upon the completion of validation according to the prototype validation requirements, CCS may issue a prototype validation certificate or engineering prototype validation certificate.

3.2.3 System integration stage

3.2.3.1 General provisions

This stage is to identify and eliminate the errors and failures in the process of system integration by testing and evaluation, and verify the compatibility, reliability and stability of the system with the final product or system in the set environment conditions.

3.2.3.2 Engineering evaluation requirements

(1) Based on the system interface and product operating requirements, the functional and interface requirements between systems (including human-computer interface) is to be defined, the detailed parameters of their system functions and interfaces, and operating procedures of the system are to be determined, verification and evaluation are to be carried out by compatibility analysis, system

integration testing, etc.. New materials are to be tested and verified their performances in the final product state if they are involved;

(2) Compatibility analysis means analyzing whether new technologies will have a negative impact on surrounding systems and components. The compatibility analysis report and necessary engineering solutions are to be submitted to CCS for review;

(3) The system integration test program is to include detailed testing instructions, product or system details, limiting conditions, testing scope, testing items and prediction indicators, and is to be submitted to CCS for approval;

(4) System integration testing is usually to be carried out in a laboratory or onboard a real ship, and the testing environment is to be confirmed by CCS. During the testing period, the surveyor is to witness and confirm on site that all items are tested according to the approved program. The test report is to be submitted to CCS for review.

3.2.3.3 Risk assessment requirements

Appropriate methods are to be used to evaluate processes or technical risk points that have not been involved in the previous risk assessment stage, with the purposes of assessing all technical risks resulting from system integration. For risks that may affect ship safety, relevant risk control measures are to be developed and necessary design modifications are to be made, if necessary.

3.2.3.4 Certificate issuance

Upon the completion of qualification according to the system integration requirements, CCS may issue a standardized design approval certificate.

3.2.4 Product real ship application qualification stage

3.2.4.1 General requirements

This stage is to validate the new technical products through real ship applications to meet the product design goals.

3.2.4.2 Qualification plan

(1) Definition of necessary verification items for survey, inspection, monitoring, sampling and testing for new technical products based on their specific and quantifiable performance indicators and application conditions determined by the design and risk assessment;

(2) Discussion with CCS on the verification method and completion time for real ship operation by taking the consideration of factors such as operation time, failure rate and exposure time of the actual equipment.

3.2.4.3 Product real ship application qualification

A real ship application verification is to be carried out for products in accordance with the approved qualification plan, including the following contents:

(1) Implementation of survey, inspection, monitoring, sampling and testing;

(2) Confirmation of the product application conditions determined in the previous qualification stages, and providing updating plan if necessary;

(3) Collection of RAM data and other operational data, and comparison with the previously specified performance requirements;

(4) Performance of root cause analyses for failure and introduce of modifications for improvement for the product;
(5) The relevant records and reports of real ship application verification for products are to be submitted to CCS for review.

3.2.4.4 Certificate issuance

Upon the completion of qualification according to the product real ship application qualification requirements, CCS may issue a document of compliance of real ship application for new technical products.

3.3 New Technology Qualification for Ship Applications

3.3.1 General requirements

3.3.1.1 This stage is to comprehensively verify the applications of new technical products onboard ships and related technical solutions to meet the ship design goals through ship design review, testing and verification at ship construction and in-service stages. The qualification of ship applications is to include two stages: ship design evaluation and ship application verification.

3.3.1.2 The operation conditions, risks and risk control measures, including appropriate arrangements, monitoring, maintenance and inspection, response plans, etc., of new technologies and products are to be fully considered for the design, construction and operation of ships.

3.3.1.3 For a series of ships that apply the same new technology and the same design, an one-time qualification application can be submitted.

3.3.2 Ship design evaluation stage

3.3.2.1 General provisions

In general, design evaluation of new technologies or products applied onboard ships is to be carried out during the detailed design of ships.

3.3.2.2 Engineering evaluation requirements

(1) Confirmation of the applicable rules and standards of the new technology design plan for ships, evaluate its consistency with the functional requirements (if any) in the existing rules and standards, the necessity of deviating from specific descriptive rules and standards (if any), and the feasibility and rationality of equivalent designs used;
(2) Confirmation of the goals and functions of the new technologies applied onboard ships, and evaluate their compatibility with ship design goals and operational functions;
(3) Evaluation of the compatibility of new technologies or products with the entire ship and the shore;
(4) Evaluation on whether appropriate and detailed design and arrangement plans have been developed or updated based on the application goals, conditions and relevant risk control measures of the new technologies;
(5) The new technology testing and verification plan at the ship design and construction stages are to be submitted to CCS for review. The plan is to include testing of new technical equipment/systems, as well as inspection of equipment/facilities/systems/arrangements/procedures

related to risk control of new technology ship applications. The modification design review for existing ships may be carried out by reference;

(6) The monitoring, inspection and maintenance plan for new technologies and related equipment/systems at the ship in-service stage, including a defined verification cycle (which can be coordinated with the relevant inspection cycle in the in-service survey plan for class), is to be submitted to CCS for review.

3.3.2.3 Risk assessment requirements

(1) A comprehensive identification of the safety, environmental and other risks brought by the application of new technologies onboard real ships, and if necessary, further quantitative risk assessment, emergency survival and evacuation capability risk assessment for high-level risk sources are to be conducted and relevant risk control measures and plans are to be developed;

(2) Based on the analysis of faults or failure modes of new technologies or products, ship designs are to be considered of sufficient safety margins. The safety margins are to be appropriate to the identified and determined indicators and risk levels.

3.3.2.4 Design evaluation data are to be submitted, including the following contents:

(1) Detailed ship design plans related to the application of new technologies (including relevant rules and standards, system interfaces, ship-shore interface identification, etc.), as well as relevant drawings and documents;

(2) Submitted materials and relevant engineering and risk assessment reports, conclusions and review comments (if any) for each previous stage of new technology qualification;

(3) A comprehensive quantitative risk analysis report on the new technologies for ship application, and other related safety research and analysis reports;

(4) The onboard testing and verification plan of new technologies at the ship construction stage (which can be combined with the mooring and sea trial program) and compliance indicators (for new technical products, it can be provided in conjunction with the qualification plan for new technical products applied onboard real ship);

(5) The monitoring, maintenance and inspection plan and compliance indicators for new technologies and related equipment/systems at the ship in-service stage (for new technical products, it can be provided in conjunction with the qualification plan for new technical products applied onboard real ship).

3.3.2.5 Certificate issuance

Upon the completion of qualification according to the ship design review requirements and the confirmation of meeting the compliance indicators, CCS may issue a document of compliance of new technology design evaluation for ships/offshore installations.

3.3.3 Ship application verification stage

3.3.3.1 General provisions

The ship application verification is to involve construction application verification (including modification of existing ships with new technical products and related technical solutions) and in-service application verification.

3.3.3.2 The construction application verification is to be carried out in accordance with the new technical product testing and verification plan approved by CCS, relevant data are to be provided and a test report is to be prepared and submitted to CCS. The surveyor is to witness the relevant tests on site and confirm that all items are tested according to the approved plan.

3.3.3.3 The in-service application verification is to be carried out in accordance with the new technical product monitoring, inspection and maintenance plan approved by CCS, relevant data are to be provided and a test report is to be prepared and submitted to CCS.

3.3.3.4 The data are to be submitted for application verification, including the following contents:

(1) For construction stage:

① Monitoring, testing and inspection data and reports for new technical products/systems, critical component failure data analysis and corrective measures (if any);

② Equipment/facilities/arrangements/procedures related to the ship control risks of new technology applications, and other related data monitoring, maintenance, inspection, and onboard verification reports of emergency facilities/equipment;

③ Relevant risk assessments (e.g.: FMEA), reliability evaluation and other related reports updated based on operational test data at the construction stage;

④ Revised monitoring, maintenance and inspection plans for new technologies and related equipment/systems at the in-service stage (if necessary);

⑤ The data and relevant engineering and risk assessment reports, conclusions and review comments (if any) submitted at each previous stage of new technology qualification.

(2) For in-service stage:

① Operational data and reports for new technologies and related systems and equipment, critical component failure data analysis and corrective measures (if any);

② Other maintenance, inspection implementation related to new technologies or equipment, or operation records of emergency facilities/equipment;

③ Relevant risk assessments (e.g.: FMEA), reliability evaluation and other related analysis and assessment reports updated based on operational test data at the in-service stage;

④ Revised monitoring, maintenance and inspection plans for new technologies and related equipment/systems at the subsequent in-service stage (if necessary);

⑤ The data and relevant engineering and risk assessment reports, conclusions and review comments (if any) submitted at each previous stage of new technology qualification.

3.3.3.5 Certificate issuance

Upon the completion of qualification according to the ship application verification requirements and the confirmation of meeting the compliance indicators, CCS may issue a document of compliance of new technology verification for ships/offshore installations.