

Shipyard's Quality System involvement in the classification process at the new construction phase

Participación del Sistema de Gestión de Calidad de un Astillero durante el proceso de clasificación en fase de construcción

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Lina Suárez ¹

Abstract

The Quality Management System (QMS) of a shipyard is considered as a dynamic system which ameliorates in parallel with the evolution of the shipyard, having as purpose to optimize construction performance, to reduce risks, costs and time. The interaction and participation with external organizations play an important role in the cycle processes of maintenance and improvement of the Shipyard QMS. Bureau Veritas (BV) being a Ship Classification Society, contributes to the certification process through compliance with regard to BV technical rules and statutory requirements for each ship configuration. This paper illustrates the importance of the interaction between shipyard and class society starting at early design phase until delivery of the ship. Process described is based on specific BV rules and New Building procedures which are continuously updated based on new international regulations, experiences, researches and developments. The pre-project process is founded on the definition of the scope of work, a thorough review of the contract, familiarization with the shipyard's facilities, and the definition and agreement of all activities to be addressed throughout the entire construction. The construction process unfolds according to the agreements outlined during the pre-project phase. This part is specifically concentrated on Design Review (drawings and documents), Documentation System (procedures and methods), the Verification System (monitoring, control & reporting, witnessing, inspection & test), and the Management System (but not limited to); all of which are managed under a specific BV IT Tool. The result of all this is an efficient classification process that ensures ships remain safe, compliant, efficient, and environmentally friendly throughout their operating life.

Key words: Quality Management System, Ship Classification Society, Classification rules

Resumen

El Sistema de Gestión de la Calidad (SGC) de un astillero se considera como un sistema dinámico que mejora simultáneamente con la evolución del astillero, y cuyo objetivo es optimizar la ejecución de la construcción, reducir los riesgos, los costos y tiempos. La interacción y participación conjunta con organizaciones externas también desempeñan un papel importante en los procesos del ciclo de mantenimiento y la mejora del SGC del Astillero. Bureau Veritas (BV) en su papel como Sociedad de Clasificación, contribuye al proceso de certificación mediante el cumplimiento de las normas técnicas propias y los requisitos legales para cada configuración de barco. Este artículo refleja la importancia de la relación mutua entre el astillero y la sociedad de clasificación desde la fase inicial de diseño hasta la entrega del barco. El proceso descrito se basa en la normativa de BV y procedimientos de nuevas construcciones las cuales se actualizan apoyados en nuevas normativas internacionales, experiencias, investigaciones y desarrollo. El proceso de anteproyecto se basa en la definición del alcance del trabajo, la revisión del contrato, la familiarización con las instalaciones del Astillero, la definición y el acuerdo frente a todas las actividades que se abordarán durante el proceso de construcción. Dicho proceso se realiza según los acuerdos enumerados durante el anteproyecto y se focaliza en la revisión del diseño (planos y documentos), el sistema de documentación (procedimientos y métodos), el sistema de verificación (monitoreo, control e informes, observación, inspección y actividades de pruebas) y el Sistema de Gestión (sin limitación a lo mencionado anteriormente); todo se gestiona utilizando una herramienta informática propia de BV que ha sido desarrollada para este propósito. El resultado, es un proceso eficaz de clasificación que mantiene a los barcos seguros, conformes a las normas, eficientes y respetuosos con el medio ambiente durante la totalidad de su vida operativa.

Palabras claves: Sistema de Gestión de la Calidad, Sociedad de Clasificación de Buques, Reglas de clasificación.

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¹ Bureau Veritas - Marine & Offshore, New Construction Management. Paris, France. Email: lina.suarez@bureauveritas.com

Introduction

The Quality Management System in a shipyard has the primary objective of achieving a zero-defect rate through the definition of processes, including controls, records, validations, measurements, analysis, monitoring, and improvements. This makes the QMS an integral part of a strategy to enhance market position and customer satisfaction.

The quality process must be established using standard procedures and methods, which need to be consistently followed throughout the entire process of the physical product, such as the construction of the ship.

Such a process must include targets related to the limits of acceptance for each specific process. The system's control involves documentation such as construction procedures, fabrication drawings, technical analysis reports, weight control reports, subcontractor documents, and as-built documentation, among others.

Quality records encompass contract reviews, drawings, procedures, inspection and test records, verification records, pre-commissioning, calibration records, material and equipment certificates, non-conformities, commissioning dossiers, among others.

The validation process in production includes monitoring or verification of welder certification, welding procedures, welding machines, welding consumables, NDT operator certification, NDT plan, and NDT reports, among others.

Measurement analysis and improvement aim to demonstrate the conformity of the quality management system and the quality of the product. This involves a quality audit plan, control of non-conformities, management reporting, corrective actions necessary to improve the system, and client feedback.

This article aims to emphasize the importance of defining, planning, and reaching agreements at an early stage by integrating all the mentioned activities and ensuring continuous follow-up within

cross-functional processes during construction. This approach is based on the extensive knowledge and experience in high-quality standards gained since 1828 in the shipping industry.

Pre Project Process

The classification process involves the definition of rules, guidance notes, and other relevant documents for a ship, taking into account its structure, material, machinery, equipment, and other components contributing to its definition.

This process includes the review of plans/documents, calculations, surveys, checks, verification, validations, witnessing, and tests intended to demonstrate that the ship complies with the BV rules and applicable statutory requirements.

For Bureau Veritas, the key to achieving the classification process in new construction is to identify and agree with the client on the scope of work. It is essential to possess a comprehensive understanding of the shipyard's capacities and to reach consensus on every activity to be followed during the construction, as illustrated in Fig. 1.

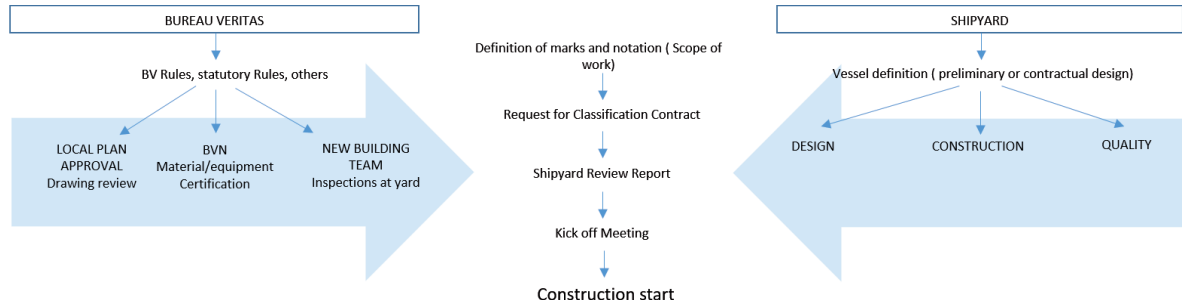
Definition of marks and notations

The class notations establish the framework upon which the ship's classification is founded. They reference specific rule requirements that must be adhered to for their assignment. Class notations are specifically allocated based on the ship's type, service, operating area, and other criteria outlined by the interested party when applying for classification.

The types of class notations to be assigned to a ship are as follows:

- **Class Symbol:** Indicates the degree of compliance of the ship with the rule requirements concerning its construction and maintenance.
- **Construction Marks:** Identifies the procedure under which the ship and its main equipment

Fig. 1. Workflow at pre-project phase between Bureau Veritas and Shipyard.



or arrangements are to be surveyed for the initial assignment of the class. It is assigned separately to the hull of the ship and its appendages, to the machinery installation, and to some other installations for which an additional classification notation can be added.

- Service Notation: Defines the type and/or service of the ship considered for its classification.
- Additional Service Features: Provide further precision regarding the type of service of the ship, as applicable.
- Navigation Notations and Operating Area Notations: Assigned to limit the operational zone, as applicable.
- Additional Class Notations: Specify the classification of additional equipment or specific conditions/installations, as applicable.

Classification Request

It is the technical contract between the shipyard and the classification society. This document identifies the client's inquiry and outlines key items to initiate the classification process.

1. General description:

a. RFC data: client data (designer, shipyard and/or shipbuilder). Local Plan Office designed for each system as Hull, Machinery, Refrigeration, Electricity, Automat, Safety, Cargo cont, Intact Stability and Damage Stability.

b. Remarks and/or Follow-up comments

2. General data:

a. Identification: hull number, ship name,

leader/ sistership /quasisistership identification, type and service, flag (military included), option of dual/double class, BV construction office, yard subcontractor, registered and commercial owner, designer, manager, commercial BV offices.

b. Schedule: contractual dates, declaration data of contract (definition of rules version)

c. Definition of marks and notations (construction marks, classification symbols, service notations, additional service feature, navigation notation, operating area notation, etc)

d. Additional notations and additional information (as applicable)

3. Ship details:

a. Hull: dimensions and characteristics, important details as lifting appliances, transport capacity, refrigeration installation, number of persons on board, etc.

b. Machinery: propulsion type, propulsion power, contract speed, electrical power, engines and generators details, etc

c. Propellers: propulsor type, propeller material, manufacturer, license, tail shaft type, bearing type, shaft diameter, shaft material, location on board, survey, stern tube lining, tail shaft seal, shaft coupling, shaft configuration, etc.

d. Automation characteristics for

i. Main propulsion: main engine type, number main engines, crosshead engine, reduction gear, etc

ii. Auxiliaries: number of generators, number of shaft driven generators, number of starting/control air compressor, fresh water generator, etc.

4. Annexes (as applicable):

- a. List of statutory attestations/ certificates
- b. List of statutory documents without survey (Stability examination, attestations)

Shipyard Review Record

This document is prepared to familiarize with the shipyard's production facilities, management processes, and safety considerations. During this initial approach, BV aims to understand the shipyard's capability to meet contractual requirements before initiating any new construction. The following items need to be considered: Detail of any management systems : ISO standards or others

1. Construction facilities: identification

- a. Building Berth or Dock (name, dimensions, capacity (GT), cranes)
- b. Outfitting quays (name, dimensions, berthing capacity (GT), cranes)
- c. Main fabrication and erection facilities
 - i. Marking and cutting of steel plates
 - ii. Marking and cutting of section bar
 - iii. One-side automatic welding machine
 - iv. Fillet welding machine gravity or automatic and percentage of automatization for this last one
 - v. Painting equipment
 - vi. Vertical automatic welding machine
 - vii. Other main fabrication facilities

2. *Shipyard control of qualified welders for shipyard workers and/or subcontracted workers* (certification, traceability, supervision, maintenance of qualification).

3. Feature of construction procedure

- a. Subcontract of hull blocks (weight): Sub members and blocks (ratio of subcontracted works and number of subcontractors)
- b. Method of plate block assembly: method fitting and welding longitudinal and transverse webs on jointed panels; method welding longitudinal on jointed panels prior to fitting and welding transverse webs; method fitting and welding a frame consist of longitudinal and transverse webs on jointed panels ;

method jointing panels with pre-assembled longitudinal by welding prior to fitting and welding transverse webs ; other

c. Pre-erection outfitting carried out, grand block/mega block adopted & method of erection at building berth/dock: max weight of loading block (tons); construction method in building dock/ berth/land construction (1 ship, 1.5 ships: semi-tandem, dual entrance); block loading process (single starting block, multi starting blocks, inserting block).

d. Final dock : in house or other

e. Other feature of construction procedure

4. Quality Control System

a. Existence of the organization chart including the departments of design, purchasing, manufacturing and quality assurance

b. Quality control organization: number of employees within the organization, existence of procedures or plans related to test and inspections

c. Pre-inspection system of shipyard: pre-inspection carried out prior to class inspection; pre-inspectors assigned; number of pre-inspectors (related to hull only); records of pre inspections results; acceptance of pre-inspections if subcontracted.

d. Record of inspections and test: records made and recorded; adoption of necessary corrective actions against Non-Conformities; acceptance of pre-inspections if subcontracted.

e. Condition at the time of the surveys in the presence of class surveyors: schedule, pre-inspections, shipyard inspections and repairs completed beforehand; sufficient preparation for surveys such as scaffoldings, lighting, cleaning made.

5. Measures for safety and health

a. Conditions of scaffolding, nets, safety belt, lighting and ventilation

b. Radiographic examination and operations of cherry picker

6. Control system of Non-Destructive Examinations (NDE)

a. Number of NDE supervisor in shipyard

(including persons responsible for judging results)

- b.** Dependence of subcontracted NDE work: number of shipyard employees and subcontractors
- c.** NDE sub-contractor company's name and official technical qualifications
- d.** Grade and number of NDE employees with official technical qualifications in shipyard: specialized in radiography, ultrasonic and/or surface detection
- e.** If non-destructive examinations are subcontracted, the grade and number of officially qualified persons: specialized in radiography, ultrasonic and/or surface detection
- f.** Non-destructive examination equipment (in house): number of radiographic and ultrasonic equipment.

7. **Quality control on Production Line**

- a.** Preventative measures for misuse of materials
- b.** Shot blasting / Primer coating
- c.** Marking and cutting (Assembly work)
- d.** Bending and strain free
- e.** Control of welding procedure
- f.** Treatment of serious non-conformities
 - i.** Repair plans submitted when serious non-conformities happens.
 - ii.** NDE (Radiographic Test /Ultrasonic Test) plans submitted at appropriate time
 - iii.** Test extension considering the result of test
- g.** Hydrostatic and watertight test
 - i.** Test Plan submission
 - ii.** Vacuum test and local air injection test during sub-assembly works (if applicable)

Kick off Meeting

Once the scope of work is defined, and shipyard facilities are known by BV, discussions with the shipbuilder regarding specific activities are crucial before commencing the construction. The Kick-off meeting is divided into two parts: general aspects and hull construction. To prepare and agree on activities during the construction, each item mentioned below is to be discussed, including

description, agreement, remark/conclusion, follow-up, and due dates, as far as applicable.

General aspects contain:

- Description as per Classification Request
 - a.** Class symbols and construction marks (which define the scope of the work to be performed from BV for drawing review and inspections at yard)
 - b.** Service notations and navigation notations
 - c.** Additional service features
 - d.** Additional class notations
 - e.** Statutory surveys as per agreed in RFC within the scope of the required certificates (verification of flag authorization/delegation, if applicable)
 - f.** Other surveys for issuance of the specific attestations
- Description or detail of agreements between shipyard and BV
 - g.** Applicable rules: BV rules, statutory/flag rules (to be available at the Shipyard)
 - h.** List of drawings and documents to be submitted
 - i.** List of materials and equipment to be certified
 - j.** Statutory materials and equipment to be certified
 - k.** Review of the construction facilities. (if update need to be done)
 - l.** List of subcontractors with contacts to be provided by the Builder (design, hull construction, NDT, machinery, electricity, etc.)
 - m.** Shipyard main contacts for BV Team
 - n.** Circulation and distribution of drawings/ documents between Builder/ Shipyard and BV
 - o.** BV intervention procedure to be applied: Intervention form, notification time, shipyard inspections prior to BV survey, safety conditions during surveys
 - p.** Inspection plan (witness and notified points, etc.) to be submitted by the Builder to BV
 - q.** Unscheduled or patrol inspections (BV may perform patrol inspections at any time during the construction, plan and access to be agreed with Shipyard)

- r.* Process to issue and clear non-conformities on reviewed drawings and result of inspections
- s.* Shipyard fabrication standard to be accepted by BV
- t.* Quality meetings with the Builder/ Shipyard when deemed necessary. Subjects such as (but not limited to): additional survey, missing drawings or certificates, pending remarks, etc. Minutes of meeting to be recorded and followed-up
- u.* Documents given to the Builder during the KoM: any documents deemed necessary, such as (but not limited to): list of drawings and materials to be certified, Approval Testing of Welders, etc.
- v.* Documents requested from the Builder during the KoM, such as (but not limited to): block plan, inspection plan, NDT plan and reports, WPS and WPQR, tank test list, software registry, cable transit seal systems register, ship construction file.
- w.* Documents requested from the Builder before ship delivery , such as (but not limited to): commissioning and test records , dock trial records , sea trial records
- x.* Documents issued to the Builder/Client at ship delivery , such as (but not limited to): class and statutory certificates , attestations
- y.* Plan Approval office
- z.* Miscellaneous as PSPC, Asbestos attestation, Steering gear test, Tank test plan, Green passport, Ship Construction File, Others

The second part contains specific activities of the hull construction survey. The purpose is to discuss in detail with the Shipyard QA-QC team, requirements and the principle of Patrol surveys performance. Each item mentioned below need to be discussed including survey requirement and survey method, BV rules, statutory requirements (if any), relevant references, documentation available to the surveyor during the construction, documentation for the ship construction file, specific activities and BV proposals for the project as far as applicable.

- Shipbuilding quality control
 - a.* Welding (welding consumables, welder

qualification, welding procedures, welding equipment, welding environment, welding supervision, welding surface discontinuities, welding embedded discontinuities)

- b.* Steel preparation and fit-up (surface, preparation marking & cutting, straightening, forming, conformity with alignment/fit-up/gap criteria, conforming for critical areas with alignment / fit-up or weld configuration

- c.* Steelwork process (e.g. sub assembly, block, grand and mega block assembly, pre-erection and erection, closing plates)

- d.* Remedial work and alteration

- e.* Tightness testing, including leak and hose testing, hydro pneumatic testing

- f.* Structural testing

- g.* Corrosion protection systems (e.g. coatings, cathodic protection, impressed current except for coating system subject to PSPC), application antifouling systems, application of protective coating for dedicated seawater ballast tanks.

- h.* Installation, welding and testing for hatch covers, doors and ramps integral with the shell and bulkheads, rudders, forging and casting, appendages, equipment forming the watertight and weathertight integrity of the ship (e.g. overboard discharges, air pipes, ventilators), freeboard marks and draft marks, safety construction certification, watertight cable transit systems.

Result During Construction Process Using BV It Tool

The project is created in a BV IT Tool called Veristar Project Management (VPM). This tool is utilized throughout the entire construction process and is accessible to internal and external stakeholders such as shipyards, designers, product suppliers, and the owner, as long as it is permitted by the client.

The purpose of the tool is to assist with the management of the project throughout every activity required for construction until delivery. This tool has been developed in compliance with the BV Quality system, design approval, and established new construction procedures.

All VPM users are provided with general information about the project, stakeholders, the follow-up of plan approval assessments, the follow-up of equipment and material certification processes, the follow-up of construction surveys, submission of drawings, and the option to reply online to comments issued during the plan approval process or construction survey, as illustrated in Fig. 2.

The tool it is divided in four main parts:

- Definition of the contract 'Project data'
- Validation of the design 'Design review' managed by Plan Approval surveyors
- Equipment & material certification 'Product certification' managed by BVN surveyors
- Survey of Construction 'Survey at shipbuilder' managed by Surveyors at Yard

Plan approval office(s) initiate drawing/documentation review of the ship itself but also to the specific equipment. As result two type of comments can be created:

- Type 'to be resubmitted' is to be cleared by design office/shipyard. It can be created for request of new revision, supporting documentation or calculation required.
- Type 'to dealt with' is to be cleared by Surveyor at Yard. It is created to perform inspection on board which ensure compliment of a specific requirement.

Additionally, some parallel projects are created in the same VPM tool based on material and

equipment certifications as identified at the Kick-off Meeting (KoM). These projects are linked to the main ship project to provide a complete overview of the certification process. The tool allows users to see the status of the process and whether any comments need to be addressed by plan approval surveyors, BVN surveyors, yard surveyors, or from the client side.

Regarding inspections at the yard, a tree is created in VPM based on the marks and notations defined, and data input available in the system at the signature of Classification Request. It can be modified if needed based on the complexity of the project or other factors. This tree lists every scheduled and unscheduled item to be inspected, trials to be performed, and quality documentation to be recorded.

VPM includes different spaces to maintain traceability of the main items to be monitored, verified, validated, witnessed, inspected and tested as far as agreed during the pre-project process at KoM. Moreover, VPM inform BV NC Team when quality documentation is missing prior to specific milestone dates. Missing documentation may be linked but not limited to shipyard review record, Kick off meeting, welding procedures specification, welding qualifications, NDT records, patrol plan agreed, sea/river quay trials procedure, reminders to client about pending comments, etc.

Prior to delivery of the project, two last process are performed by the BV Project Leader and validated

Fig. 2. Workflow during design and construction phase using VPM.

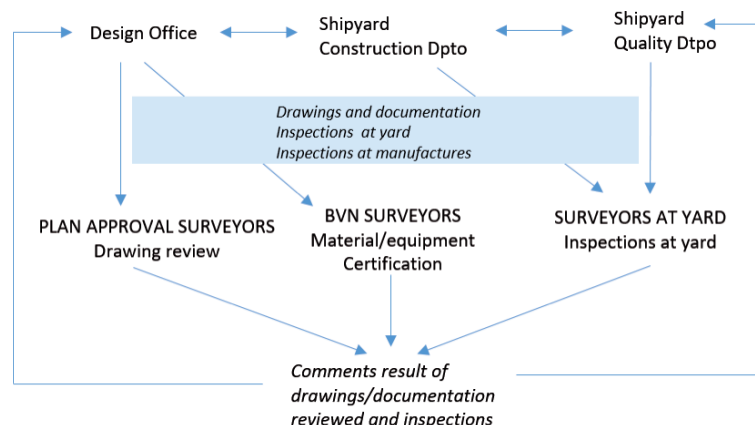
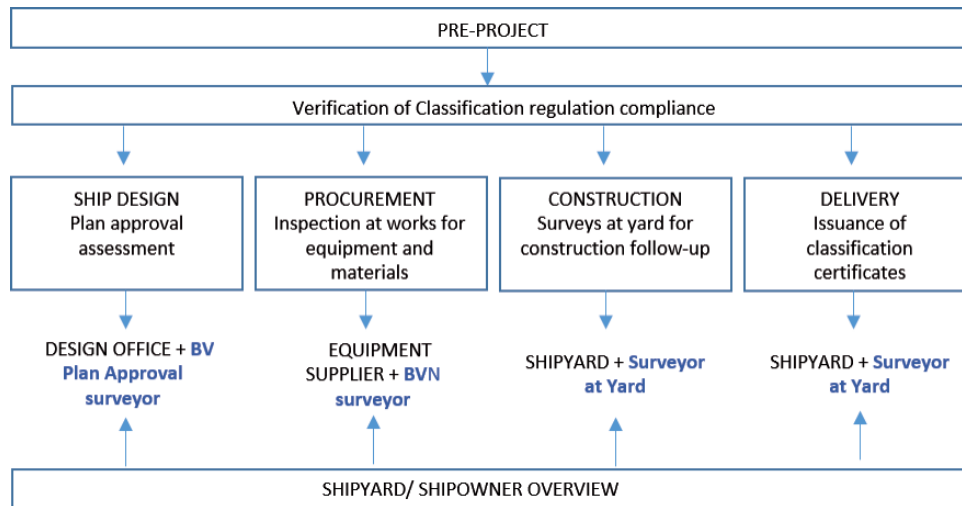


Fig. 3. Involvement of stakeholders during entire construction process.



by the new Construction local manager. Process consist to review that all required drawings have been received and reviewed, all material and equipment certificates are received, all quality documentation is received and none pending comments.

In case of outstanding point remains, agreed solution between client and BV is to be specified. Such process allow to go through the following phase, Issuance of Classification Certificate.

With proper recommendation or memoranda (if applicable) in accordance with those agreement indicated during the first phase.

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