Condition Assessment Programme for LNG Carriers (LNG CAP)

Annex to NI 465

May 2015

Guidance Note
NI 623 DT R00 E

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BUREAU VERITAS

MARINE & OFFSHORE DIVISION

GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine & Offshore Division (the "Society") is the classification (" Classification ") of any ship or vessel or offshore unit or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

The Society:

- "prepares and publishes Rules for classification, Guidance Notes and other documents (" Rules ");
- "issues Certificates, Attestations and Reports following its interventions (" Certificates ");
- "publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as " Certification ".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as " Services ". The party and/or its representative requesting the services is hereinafter referred to as the " Client ". **The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.**

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Shipbuilder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

ARTICLE 2

2.1. - Classification is the appraisement given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisement is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - **It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisement or cause to modify its scope.**

2.4. - The Client is to give to the Society all access and information necessary for the safe and efficient performance of the requested Services. The Client is the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out.

ARTICLE 3

3.1. - **The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are a collection of minimum requirements but not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.**

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - **The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.**

3.3. - The Services of the Society are carried out by professional Surveyors according to the applicable Rules and to the Code of Ethics of the Society. Surveyors have authority to decide locally on matters related to classification and certification of the Units, unless the Rules provide otherwise.

3.4. - **The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.**

ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- "reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- "conducts surveys at the place of their construction;
- "classes Units and enters their class in its Register;
- "surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.

ARTICLE 5

5.1. - **The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.**

5.2. - **The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for.**

In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.

5.3. - **The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder.**

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - **If the Services of the Society or their omission cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee. These limits apply regardless of fault including breach of contract, breach of warranty, tort, strict liability, breach of statute, etc.**

The Society bears no liability for indirect or consequential loss whether arising naturally or not as a consequence of the Services or their omission such as loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on of were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred. Time is to be interrupted thereafter with the same periodicity.

ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - **Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.**

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. here above subject to compliance with 2.3. here above and Article 8 hereunder.

7.4. - The contract for classification and/or certification of a Unit cannot be transferred neither assigned.

ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve, for the part carried out, the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. - **Overdue amounts are increased as of right by interest in accordance with the applicable legislation.**

8.3. - **The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.**

ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- "Clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the **classification file** consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit ;
- "copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society, where appropriate, in case of the Unit's transfer of class;
- "the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units, as well as general technical information related to hull and equipment damages, may be passed on to IACS (International Association of Classification Societies) according to the association working rules;
- "the certificates, documents and information relative to the Units classed with the Society may be reviewed during certificating bodies audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France, or to another Court as deemed fit by the Society.

12.3. - **Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.**

ARTICLE 13

13.1. - **These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement. They are not varied by any purchase order or other document of the Client serving similar purpose.**

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.

BV Mod. Ad. ME 545 L - 7 January 2013

GUIDANCE NOTE NI 623

Condition Assessment Programme for LNG Carriers (LNG CAP)

Annex to NI 465

May 2015

Section 1 General

Section 2 Hull

Section 3 Containment Systems

Section 4 Hull Fittings - Deck Fire Fighting Systems

Section 5 Machinery

SECTION 1 GENERAL

1 General

1.1 Scope

1.1.1 The Condition Assessment Programme (CAP) is a voluntary scheme, independent from classification, aimed at assigning a rating for the condition of defined areas, such as the Hull, Hull Fittings and Machinery.

1.1.2 The Owner's representative defines those areas that he wishes assessed, taking into consideration the type of vessel and his particular requirements, however the Hull must be assessed, as a minimum requirement for Condition Assessment.

1.1.3 Complimentary studies may be undertaken; this would include the Fatigue Analysis of the Hull and which must be clearly defined in the contract. Where the Fatigue Analysis may highlight potential 'Hot Spot' areas then sufficient time should normally be allowed for the Analysis to be completed before surveys commence as these areas would be subject to close up survey.

1.1.4 This Guidance Note has been developed specifically for Membrane and Moss type LNG Carriers and is aimed at vessels of 15 years age and above, it must be read in conjunction with the latest edition of NI465 Condition Assessment Programme (CAP), which forms the basis of the CAP surveys.

The scope of the LNG-CAP is in addition to the items listed in NI465 unless indicated otherwise and includes the Fatigue Analysis.

1.2 Merging survey

1.2.1 The LNG CAP may be spread over the period between the 2nd and 3rd Annual Surveys in line with the intermediate survey. When this is done the survey plan is to clearly indicate the method for verifying the ratings assigned to those items surveyed at the commencement of the LNG CAP Survey.

SECTION 2 HULL

1 General

1.1

1.1.1 Experience has identified specific areas within the hull where cracking could occur and are well known to the industry. With the increasing age, fatigue becomes another factor in the condition of the vessel. The LNG - CAP should take these factors into account in the survey requirements for the Hull. Similarly, the history of defects and repairs must also be considered.

This may be divided into three parts:

- Critical Areas Map
- Fatigue Analysis
- Surveys.

1.2 Critical areas map

1.2.1 The critical areas map is to be developed on the basis of:

- Typical defects for that design of vessel
- The history of defects of the individual vessel in service.

1.3 Fatigue analysis

1.3.1 If a 3D FEM analysis is to be carried out this should normally be completed prior to commencing the surveys such that potential fatigue 'hot spots' are close up surveyed and U/T gauged as necessary.

A Repair Procedure is to be defined for those 'hot spots' found with cracks or defects affecting their efficiency.

1.4 Survey

1.4.1 General

The LNG - CAP is attached to the Guidance Note NI 465 which provides further details on the Hull Survey, Ultra-Sonic Gauging Analysis and the Hull Ratings.

A Survey Plan is to be developed before commencement of the surveys. The plan is to define the scope of the survey, identify the areas for additional survey together with the means for access, lighting and safety requirements.

The CAP survey should take into account that this type of vessel could be in active service well into its thirties, i.e. the ship could be more than 30 years old. In addition, the condition of the coating could have deteriorated permitting the corrosion rate to increase.

1.4.2 Survey scope

Ships Over 15 years of age

3rd Renewal Survey + additional 30% for Close-up Survey and U/T Gauging.

Where the coating in the ballast tanks is fair or poor, the close-up survey is to be extended. Steel work renewals are to be suitably coated after repair to minimise corrosion from occurring.

Close up survey of the potential fatigue 'hot spots' and the critical areas identified in the Critical Area Maps.

Hydrostatic testing of ballast tanks is to be conducted, when these are due for the classification

1.4.3 Suspect areas

Suspect areas cannot be accepted, they are to be investigated to ascertain their extent and cropped out and renewed.

1.4.4 Photographs

A library of photographs taken during the CAP survey is to be established. Photographs are to be taken in the tanks to show the general condition of that tank. Where repairs are conducted, before and after shots should be taken. Defective fatigue hot spot areas and critical areas are to be photographed as well, if no defects are found in these areas, sample photographs are to be taken. Photographs are to be identified in the report.

SECTION 3 CONTAINMENT SYSTEMS

1 General

1.1

1.1.1 In general the containment system will need to be examined in service in loaded condition, in heel condition and also with the vessel gas free with cargo tanks open and in dry air.

2 Rating criteria

2.1

2.1.1 Rating Criteria are given within various sections of this document. The Criteria are to be used in conjunction with operational testing and taking into consideration the results of non destructive tests. They are broadly defined in NI465, Sec 1, [1.6], and are given below for convenient reference. (See Tab 1)., For Membrane type containment systems the rating criteria is given in Tab 2. and for Moss Type systems the rating criteria is given in Tab 3.

3 Membrane type containment systems

3.1 Tank covers external examination

3.1.1 Surveyor to examine the upper surface of the tank cover for cracking and signs of temporary repair especially under the flange drip pans, suspect areas should be subject to hammer test and NDT. Visually inspect the membrane inter-barrier space safety valves for condition and leakage. Examine the vapour and pump dome covers for leakage. Condition of the safety rails around the tank cover to be examined. The external condition of the cargo tank safety valves should be checked. Foundation of the vent mast to be examined and connection to the riser examined for corrosion. The connection of the tank cover to the main deck is to be checked for cracking and suspect areas should be subject to NDT.

3.2 Cofferdam internal examination

3.2.1 The cofferdams should be internally examined for structural condition, coatings and corrosion. Internal equipment, heating coils, purge pipes, bilge arrangements, etc,. should be inspected and where possible functionally tested

3.3 Cargo tank internal examination

3.3.1 The records of existing dents at bottom should be reviewed and compared with earlier records.

When accessing the tank some pump masts are designed with the ladder going directly to the bottom; make sure harness is available. The tank should be provided with powerful lighting and necessary safety and escape equipment. Whilst descending make a visual check of the pump mast structure, temperature sensors and their attachments and the cargo lines. Special protection is to be worn at the tank bottom, to prevent damage to the membrane.

Table 1 : CAP Ratings definition

1	Superior condition	Examination and/or measurements carried out with the results showing either minimal or no deterioration from the 'as new' condition. Superior maintenance condition exists. No preventive or corrective maintenance is required.
2	Good condition	Examination and/or measurements carried out with the results showing a level of deterioration from the 'as new' condition. No requirement for preventive or corrective maintenance.
3	Acceptable condition	Examination and/or measurements carried out with the results showing that condition would be acceptable for class rules requirements. No imminent corrective maintenance is required. Preventive maintenance may be required to halt deterioration.
4	Poor condition	Examination and/or measurements carried out with the results showing defects, deficiencies or condition, below what would be acceptable for class rules requirements. Imminent corrective maintenance is required.

Table 2 : General rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Items and systems examined and function tested, only superficial reductions from as new or current rule scantlings, found with no deficiencies affecting safe operation and/or performance.	Items and systems examined and function tested, found with some minor deficiencies which do not affect the safe operation and/or normal performance, thickness' significantly above class limits.	Items and systems examined and function tested, found with deficiencies not affecting safe operation and/or performance, thickness' whist generally above class renewal limits found with substantial corrosion.	Items and systems examined and function tested, found with deficiencies significantly affecting operation and/or performance, thickness' at or below class limits.
Documentation and maintenance practices considered good. No maintenance or repairs required.	Documentation and maintenance practices considered adequate. No immediate maintenance or repair considered necessary.	Documentation and maintenance practices considered to be of a minimum standard. Some maintenance and repair may be considered necessary.	Documentation and maintenance practices considered inadequate. Maintenance and repair required to re-instate serviceability.

A visual examination should be made of the cargo pumps, the securing of the electric cables, and the non return valves. When possible check the free rotation of the impeller of the cargo pumps. Closely inspect the area at bottom of the mast for dust and local corrosion. Check the expansion arrangements for the mast foot and the connection of the membrane to the mast support plate.

A visual examination of the bottom should be made, existing dents should be already marked with their date of recording nearby. If not, the dent should be recorded and its geometry agreed with the "GTT" representative. This is especially important for the "Gaz transport design" where the longitudinal automatic welds of the Invar strakes can be subject to damage during bottom inspection. New damage should be reported and the data recorded close to the damaged area.

Examine areas at bottom and hoppers side which might be covered by dust coming from the storage tanks ashore (perlite, sand etc,.) Check after smooth cleaning if corrosion remains by magnifying glass, dye check or helium test according the defect.

Check the colour of the membrane. Technigaz stainless corrugated plates might turn dull with the time. Gaz transport invar plate might turn orange brown (general surface corrosion). Check if the membrane is tightly fitted onto the faces of the tank without waves that might indicate insulation problems.

3.4 Membrane tightness

3.4.1 Membrane tightness will be investigated during the last loaded and heel voyages before docking and compared with existing earlier operational records and the records from when the vessel was new. Recordings of N2 daily consumption, gas detection in inter-barrier spaces and possibly temperature sensors will be reviewed and studied to assess the general overall operating condition of the membranes. Note that inter- barrier gas readings should be taken both on the loaded and heel passages.

If nitrogen usage is excessive or if gas in the membrane spaces is high then consideration should be given to carrying out a global vacuum test at the docking period to determine the size of leakage. If necessary a helium test will give the location of the leaks and their seriousness in view of repairs. The ratings assigned are to be according to the rating criteria.

4 MOSS - Type containment system

4.1 Tank void space covers external examination

4.1.1 Surveyor to examine the upper surface of the void space cover for cracking and signs of temporary repair especially under the flange drip pans, suspect areas should be subject to hammer test and NDT. Visually inspect the void space safety valves for condition and leakage. Condition of the safety rails around the dome to be examined. The rubber bellows between the tank dome and the void space cover is to be examined for cracking and for leakage, if necessary sections of the shield are to be removed to make examination easier.

The external condition of the cargo tank safety valves should be checked. Foundation of the vent mast to be examined and connection to the riser examined for corrosion.

The connection of the void space cover to the main deck is to be checked for cracking and suspect areas should be subject to NDT. Particular attention should be paid to external brackets between the void cover and the main deck, these frequently suffer cracking or detachment but may propagate cracks into the main deck. Void space doors should be checked for air leakage (soap solution) whilst void spaces are pressurised. A visual examination of the nitrogen supply and exhaust piping should be made.

4.2 Void spaces internal examination

4.2.1 Before entry into the void spaces it is essential to ensure that they are properly ventilated with dry air to ensure that build up of nitrogen is reduced to normal atmospheric levels. The necessary safety precautions should be taken for entry into enclosed spaces. Powerful lighting should be available.

The tank insulation can be of two different types, either the spiral wound type, recognized by an unbroken outer surface like duct tape or the panel system where it is easy to identify the mosaic of panels. With the wound system there will be a support structure of straps and springs holding up the system on the southern hemisphere, these should be examined to ensure that they are still providing the necessary support. The insulation should be examined for signs of cold spots (icing) that would indicate moisture in the void atmosphere. It should also be examined for sagging and other forms of damage or detachment from the sphere. Consideration should be given to removing sections of the insulation to examine and test the material and to check the attachment to the sphere.

In particular the wedge space between the skirt and southern hemisphere should be checked to ensure that the insulation is intact. The nitrogen supply and exhaust lines should be checked for security and sealing where they enter and leave the insulation.

The skirt should be visually examined for signs of cracking or buckling especially where it is attached to the sphere and at the foundation deck. On aluminium tanks, the transition joint from the aluminium part of the skirt to the steel part should be especially examined for signs of failure. The connection of the ballast tank bulkheads to the foundation deck should also be examined for signs of cracking and signs of weeping. Inside the skirt, depending upon the age of the vessel, there will be different "secondary barrier" arrangements, these can range from complete insulation and sheathing in stainless steel of the hull double bottom inside the skirt to just a small drip pan underneath the sphere. The secondary barrier should be examined for damage. The pressure relief devices at the lower part of the southern hemisphere should be examined and checked for freedom of operation. The condition of the sump, void space eductors and piping should be checked and consideration should be given to blowing through the lines with air. The condition of the blanking devices between cargo and sea water driving medium should be checked.

The general condition of the void space paint work should be examined and assessed as this can give a good indication as to the efficiency of the dry air system.

4.3 Cargo tank internal examination

4.3.1 The cargo tank to be examined should be gas free and safe for entry. The necessary safety precautions should be taken for entry into enclosed spaces. Powerful lighting should be available.

The condition of the upper part of the tower should be checked especially expansion arrangements (sliding shoes). Locking and securing devices for clamps, nuts and bolts, cabling for cargo pumps and measuring systems should be examined. As much as possible the upper part of the sphere and the connection to the dome should be visually examined from the upper gallery for sign of corrosion or fatigue. The spray rails and securing devices should also be examined as far as possible from the upper gallery. The tower should be visually examined for sign of damage, buckling, cracking etc. The mid level gallery should be examined in preparation for the mounting of the tank inspection boom. The base of the tower should be especially examined depending upon type. Those where the expansion takes place at the base by way of diaphragm plates or other arrangements should be specially examined for cracking; those where the aluminium tower rests upon a steel foundation should be examined for failure of the contact points; those where the tower is connected directly to the shell of the sphere should be examined for cracking.

Location of the cargo and spray pumps should be checked for security. Piping should be checked for security of fittings, clamps and locking devices.

If considered necessary and if available the cargo tank inspection boom should be deployed and an examination made of the internal welds of the sphere.

NDT should be carried out on the tower and sphere as considered necessary.

Table 3 : MEMBRANE type - Tecnigas and Gaz Transport

N°	Element	Component/ Characteristic	Inspection	Criterion
1	Primary barrier	Membrane	Visual checking: absence of deformations, waves, impacts, cracks, cleanliness: Examination of the bottom (notably around liquid dome and gas dome [falling objects]), the lower slopes and the transverse bulkhead behind the pump tower. Visual examination as in depth as possible of high areas (if no scaffolding).	1: no visual defect as new 2: slight indentations or waves, no effect on performance 3: heavy indentation but no signs of cracking or deterioration in performance 4: heavy deformation and damage, signs of cracking or membrane failure
2	Primary membrane	Tightness test	Global test carried out in accordance with builders or designers instructions.	Results of the Global test will determine the need for repairs Pass: 1, Fail: 4
3	Primary membrane	Tightness monitoring	Measurement of gas content in inter-barrier spaces	1: No gas detected in Primary Barrier or readings as new or better than new 2: Gas present but less than 30% by volume with normal Nitrogen operation and readings steady 3: Gas present but kept successfully below 30% by volume by Nitrogen sweeping 4: Gas above 30% by volume even with Nitrogen sweeping
4	Secondary membranes	Thightness monitoring	Gaz Transport / Technigaz: The tests to be conducted in accordance with the latest instructions from the engineering designer	Secondary Barrier - Global Test Ratings: 1: No Gas detected 3: Gas detected but below 30% LEL 4: Gas above 30% LEL
5	Insulation	Aspect	Gaz transport: moisture presence / plywood condition / staples / anchoring system Technigaz: Glue / failure PUF or balsa	
6	Pump mast	Visual inspection	Visual examination of ladders expansion arrangements, and locking devices	1: As new connections in place no wear, deformation or cracking of expansion arrangements. 2: Tower used regularly for tank access, connections in place and effective but obviously used and worn. 3: Tower fittings and locking devices should be replaced, risk of them failing and broken parts ending up in the tank. 4: Locking devices poor or not fitted, heavy wear on expansion arrangements
7	Pump mast	Welds NDT	NDT (10 %) of structure 100% of pump mast support	
8	Connection of the pump mast on the support	Sliding pads	Visual examination measurement of gap	
9	Liquid dome cover	Welding of liquid dome on the ship's structure	NDT (100%)	
10	Gas dome	Welding of junction ring between gas pipe and membrane on tank top	NDT (100 %)	
11	Gas dome	Welding of gas dome on the ship's structure	NDT (100 %)	

Table 4 : MOSS types

N°	Element	Component/ Characteristic	Inspection	Criterion
1	Void Space Cover	Visual inspection	Examination of steel void cover for surface cracks, signs of temporary repair, coating condition. Condition of void space relief valves, of vent mast and foundations, Condition of rubber seal between dome and void cover. Condition of junction boxes and instrumentation cabinets in dome area. Condition of safety rails and platforms in dome area. Examination of connection between void cover and deck for cracks especially in way of brackets. Test of void space doors for tightness	1: As new no deterioration, no leakage, no cracks, coatings good 2: Coatings fair, minor cracks on main deck brackets, minor leakage of safety valves and doors not affecting operation 3: Coatings require attention, cover cracks temporary repaired, noticeable leakage from safety valves and doors. 4: Unacceptable, void space unable to be pressurised, large cracks in cover requiring immediate action, cracks in brackets could lead to main deck cracking. Coatings poor
2	Void Spaces	Visual inspection	Examination for cleanliness, coatings, corrosion, cracking, secondary barrier, cargo/bilge eductors, sump and alarms	1: As new condition coatings good, no corrosion, no cracks, eductors as new, secondary barrier without defects 2: Coatings generally good, signs of crack repairs in hull structure, equipment functional. 3: Coatings showing signs of breakdown, corrosion present, signs of weeping from ballast tanks but no leakage. 4: Coatings poor, secondary barrier poor signs of leakage from ballast tanks, eductors poor blanks missing
3	Tank insulation	Visual inspection, Samples for test if considered necessary	Examination of insulation for integrity & security of fastenings. Checks for sagging, cold spots surface abrasion. Check support system, straps & springs on wound type insulation, check for panel gaps & cracking of seals on panel systems. Areas that indicate break down remove core sample core testing. Samples should ideally be taken in way of the equatorial ring, tank dome & bottom area. Samples to be analysed in a laboratory for density, water content, compressive strength, PH value, chemical analysis of leachable chloride ion & thermal impact (boil-off rate). Wherever cargo tank insulation is removed, supporting structure & secondary barrier configuration shall be examined. If in doubt about the security of the panels, key panel to be removed for examination of the fixing system. Examination of the space between the tank & the skirt for signs of loosening of the insulation. Examination of the bursting disc & the drain away system	1: As new condition no sign of damage or cold spots, insulation secure. 2: Insulation shows signs of wear and possible previous repair but is in good condition, insulation secure, surface free of frost 3: Insulation shows surface indications of frost, signs of wear and requires minor repairs and shows small cold spots, samples may be called for. May also show signs of sagging 4: Insulation shows signs of failure, heavy cold spots, severe sagging and indications of touching the tank surface insulation between the tank and skirt falling out.
4	Cargo Tank	Visual internal inspection	Presence of cracks, corrosion of welds, pitting	1: As new condition no signs of cracking corrosion or build up of dust. 2: No signs of cracking, no signs of corrosion, slight build up of dust on surfaces. 3: No signs of cracks, possible corrosion of welds or heavy build up of dust deposits 4: Cracks may be detected, corrosion of welds and other internals, very heavy build up of deposits.

N°	Element	Component/ Characteristic	Inspection	Criterion
5	Cargo tank NDT	Weld NDT	Dome to upper hemisphere: NDT from inside (if possible - if not, from outside after removal of insulation) 360° or as near as possible Pipe tower to lower hemisphere: NDT from inside, 360° or as near as possible Circumferential welds (zone 1 to zone 4L): NDT from inside, 360° Circumferential welds (zone 4U to zone 7): NDT from inside, 360° Circumferential welds (equator to upper/lower hemisphere): NDT from inside, port and starboard forward quadrants as allowed by gantry access. (Or 360°) Meridional welds: NDT from inside Circumferential welds (equator to skirt) NDT from outside over a length about 10° around three positions 0°, 90° and 270° (0° = forward), according to removal of insulation.	
6	Pump Tower	Visual Inspection	Visual examination of welds, piping, cables, ladders hatches and double fastening devices. Examination of expansion arrangements, shoes or diaphragm plates for wear or deformation and cracking. Examination of spray rails from the upper gallery.	1: As new connections in place no wear, deformation or cracking of expansion arrangements. 2: Tower used regularly for tank access, connections in place and effective but obviously used and worn. 3: Tower fittings and locking devices should be replaced, risk of them failing and broken parts ending up in the tank. 4: Locking devices poor or not fitted, wear on sliding shoes and or deformation of diaphragm plates
7	Cargo tank skirt	Structural transition joint	Visual examination to ensure no de-lamination or corrosion. NDT over a length about 10° around four positions 0°, 90°, 180° and 270° (0° = forward).	
8	Cargo tank skirt	Skirt	Aluminium part, visual and DP checks on welds of stiffeners top skirt, particularly at their upper end, and the continuing bracket just below the equator. lengths about 10° around three positions 0°, 90° and 270° (0° = forward) according to removal of insulation. Steel part visual examination and thickness measurement	

SECTION 4 HULL FITTINGS - DECK FIRE FIGHTING SYSTEMS

1 General

1.1

1.1.1 The items detailed within this section are in addition to the those identified within Guidance Note NI 465.

In general, it is not required to request that the units are to be dismantled for the CAP survey unless:

- it is due to be opened up for overhaul for Class, or in accordance with the vessel's planned maintenance system, or
- the functional test demonstrates that the equipment is not working correctly.

Readings taken during the last dismantling should be examined in conjunction with the results of the operational tests. However, for some of the equipment, dismantling has been specifically requested or specific tests are to be performed e.g. vibration measurement.

1.2 Rating criteria

1.2.1 The Criteria are to be used in conjunction with operational testing and the results of non destructive tests such as vibration measurements. See Sec 3, Tab 2.

1.3 Dry powder units

1.3.1 The vessels may have large central dry powder systems, smaller individual deck systems or a combination of the two. The systems work on exactly the same principal as large dry powder extinguishers with a pressure vessel containing the powder and driving nitrogen cylinders.

The central units will also have, at the dry powder stations, an activation cylinder. Nitrogen cylinders should be examined for corrosion and the weight checked. The powder cylinders should be examined for corrosion externally and if the powder is removed internally also. Safety valves should be checked and relief setting proven. High pressure flexible hoses should be examined and a pressure test carried out if in doubt. The powder should be examined for caking and sample should be taken and a test made to ensure that the correct powder is used and the moisture content is satisfactory. The deck powder piping should be examined for corrosion as should the activation piping. The hose boxes should be examined for condition. The hoses should be flaked out and examined for cracking and other damage. The guns should be checked for freedom of operation.

The individual units should be examined and tested in the same way. A representative functional test of at least one unit should be carried out.

1.4 Deluge system

1.4.1 The deluge system will consist of one or more deluge pumps and the necessary pipework and spray nozzles for the bridge front, deck houses, domes and the cargo valves. The system may be zoned with a manifold and control valves, manual or remote controlled. The pumps should be examined and the performance checked if dismantling then clearances should be taken and adjusted as necessary. The piping system in the engine room and on deck should be checked for corrosion a hydro test should be considered if there is doubt about the integrity. Clamping sliding feet joints and welds should be examined. The nozzles should be examined and a functional test carried out to ensure none are blocked with shell or other debris. The nozzles should be checked for proper positioning.

SECTION 5 MACHINERY

1 Steam turbine and gear box systems

1.1 General

1.1.1 The CAP survey for the Machinery is to be conducted when the plant is in operation, both before and after the maintenance stop and when the plant is shut down for access to the boilers, turbines and ancillary machinery. The surveys conducted prior to the maintenance stop are to determine which machinery is to be opened up for Survey- taking into account Class survey requirements and the Vessel's Planned Maintenance. The surveys after the maintenance stop are operational tests of the machinery and to verify the settings of alarms and safety devices such as the boiler safety valves.

In general it is not required that machinery be dismantled for the CAP survey unless it is due to be opened up, for Class/Owners requirements, or the functional test demonstrates that the equipment is not working correctly.

Readings taken during the last dismantling should be examined in conjunction with the results of the operational tests. Similarly, the log books should be reviewed at the start of the CAP survey to determine the overall condition of the plant, reports of excessive vibration etc. However for some specific equipment dismantling and/or additional testing has been specifically requested.

1.2 Machinery general rating criteria

1.2.1 The Criteria are to be used in conjunction with operational testing and the results of non destructive tests such as vibration measurements. See Sec 3, Tab 2 for reference.

Specific rating criteria for various individual items of machinery, heat exchangers and fittings are also specified within this document.

1.3 Vibration measurements

1.3.1 Please refer to NI 465, Sec 3, [7.3] Vibration analysis.

1.4 Turbines

1.4.1 It is not necessary to open a turbine for a CAP survey. Alternately, if opening up has been foreseen, advantage should be taken to examine the rotor, stator, bearings and the coupling etc. and to assign the ratings accordingly.

Where the casing is not lifted, a file review is to be conducted that would include the readings recorded when last it was opened, review of the lub oil analyses as well as the operating conditions of the turbines.

Turbine bearings need not be opened for survey unless they are required to be opened for Class. However where these are opened up the bearing clearances and the fore and aft thrust clearances are to be measured. The rating is based on the bearing wear, the fore and aft movement and the condition of the collar, journals, pads and bearings.

In addition, sea trials are to be conducted to observe the turbines under operational conditions. These trials should be done preferably at the time the vibration measurements are being conducted.

Trips, alarms and safety devices to be tested.

Rating Criteria - Refer to Tab 1 and Tab 2.

1.5 Main condenser

1.5.1 The condenser should be opened for the LNG-CAP survey. The steam space is to be examined for signs of corrosion, vibration of the tubes in the support baffles and signs of erosion.

Rating Criteria - Refer to Tab 3.

1.6 De-aerator

1.6.1 The de-aerator should be open for internal examination of the shell and nozzles.

Rating Criteria - Refer to Tab 4.

Table 1 : Turbines - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
This is assigned where the casings are lifted and overhaul conducted and the items placed in an as new condition. That is to say that the remaining tolerances are between 75 - 100%. A rating 1 cannot be assigned unless the casings have been opened.	This is assigned where the casings are not lifted, but the item is well maintained and free from obvious defects with the insulation in satisfactory condition and no evidence of leakage. Or, where the casing is lifted and there is evidence of wear but it is well within the prescribed tolerances. The remaining tolerances is between 75-25%.	This is assigned where the casing is not lifted but the item is showing signs that maintenance will soon be required and that the insulation will need of repair. Or, where the casing has been lifted and the wear found within the prescribed tolerances. The remaining tolerance is between 25 - 0%.	This is assigned where the casing is not lifted but the item is beyond tolerance and outside class limits. Or, where the casing has been lifted and the wear found outside the prescribed tolerance.

Table 2 : Turbine bearings - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Clearances are 25% of the defined tolerances. No grooving or surface damage to the bearing, journals, collar or pads. White metal free from damage or inclusions.	Clearances are between 25 - 75% of the defined tolerances. Slight grooving of the surface of the journals and collar, no attention required. White metal free from damage or inclusions.	Clearances are between 75 - 100% of defined tolerances. Slight grooving on the journals and/or collar requiring polishing. White metal scratched and grooved particularly on the trailing edge of the ahead pads.	Clearances are outside tolerances. Grooving of the journals and bearing requiring machining. White metal in poor condition requiring re- metalling.

Table 3 : Tube type heat exchanger - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Shell and water boxes free from leaks. No tubes plugged. Steam dump pipe and baffle without signs of corrosion and erosion.	Shell and water boxes free from leaks. Less than 5% tubes plugged. Steam dump pipe and baffle showing slight signs of corrosion and erosion	Shell and water boxes free from leaks, with permanent repairs. Less than 10% tubes plugged. Steam dump pipe and baffle corroded and eroded but still acceptable	Leaks in shell and water boxes, not permanently repaired. More than 10% of the tubes plugged. Steam dump pipe and/or baffle are corroded and eroded and not acceptable.

Table 4 : De-aerator - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Shell external and internal free from corrosion and pitting. Spray nozzles intact and showing no evidence of erosion.	Shell external and internal showing slight corrosion and pitting with less than 75% of the corrosion allowance. Spray nozzles intact but with erosion not affecting the operation.	Shell external and internal showing corrosion over 75% of the corrosion allowance but less than 100%. Spray nozzles intact with erosion affecting seriously the operation	Shell external and internal showing corrosion over 100% of the corrosion allowance. Spray nozzles missing or eroded seriously affecting the operation.

1.7 Pumps

1.7.1 It will not be necessary to open the pumps for the LNG - CAP Certification if a functional test is conducted and the pump is capable of meeting the flow and pressure requirements. Shaft seals should be free from leakage and the pump should operate without undue vibration. The foundations and holding down bolts should be checked.

The motors need not be opened unless the loading and operation is questionable, however the rotating pumps are to be subject to vibration measurement.

Where the pumps incorporate an auto change over arrangement this is to be tested as well as low pressure alarms.

Maintenance should be in-accordance with the maintenance system. Records should be reviewed and taken into consideration in determining the rating.

There are various types of pumps involved and inspected and tested accordingly.

1.8 Vacuum pumps and air ejectors

1.8.1 These need not be opened provided they are capable of drawing the required vacuum taking into account the sea temperature. Review of the ER log is to be made to see the extent of the vacuum achieved and the rating defined accordingly.

1.9 Reduction gear box

1.9.1 Reduction gearboxes need not be opened for examination provided that the results of a vibration analysis show that the vibration has not deteriorated, however the inspection doors are to be removed for inspection. Photographs are to be taken of representative teeth of the accessible wheels for records especially where the teeth have been tested for contact using a marker dye. Attention is to be paid to the teeth for evidence of cracking.

Flaking and pitting can occur, where this is found a more detailed examination would be required, particularly where the pitting is progressive

In addition, a lub oil analysis is to be conducted and compared with the results from the last two or more previous results.

The lub oil pump should be started to verify the condition of the nozzles, where possible.

(Rating Criteria - Refer to Tab 5.

1.10 Main thrust block and plummer blocks

1.10.1 The main thrust block and plummer blocks need not be opened for survey unless they are required to be opened for Class. However where these are opened up then bearing clearances and the fore and aft thrust clearances are to be measured. The rating is based on the bearing wear, the fore and aft movement and the condition of the collar, journals, pads and bearings.

Rating criteria as per Tab 2.

Table 5 : Reduction gear box - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Vibration analysis with results close to the as new condition. Tooth contact along the length with no evidence of tooth damage. Lub oil analysis free of metal particles.	Vibration analysis with satisfactory results within the tolerance. Tooth contact along the length. Slight evidence of arrested pitting. Lub oil analysis free of metal particles	Vibration analysis still within the tolerance. Tooth contact along the length. Extensive evidence of arrested pitting. Lub oil analysis free of metal particles	Vibration analysis outside the tolerance. Tooth contact over partial length. Evidence of tooth damage and progressive pitting or flaking and spalling.

1.11 Propeller shaft and bearing

1.11.1 It is not necessary to withdraw the propeller shaft unless it is due for survey. However, as the CAP survey is done in drydock shaft clearances should be measured and compared with previous results. If it is not withdrawn the rating is based on the measured clearance and the oil consumption. Where the shaft is withdrawn or a partial survey conducted, the rating is to take into account the condition of the taper, keyway, journals and bearing.

A lub oil analysis, recently conducted, is to be provided and compared with the results of the analyses taken since the last tail shaft withdrawal. The comparison is to be made in conjunction with a check on the lub oil consumption.

Rating Criteria - Refer to Tab 6.

1.12 Turbo generators

1.12.1 These need not be opened for examination but must be operationally tested to the rated electrical load including testing of the ancillary equipment. The readings taken at the last overhaul are to be reviewed in conjunction with readings, if any, taken during the CAP survey. Vibration measurements are to be taken. Fabricated bedplates and casings are to be examined for evidence of defects.

A lub oil analysis, recently conducted, is to be provided and compared with the results of the last two analyses.

Rating Criteria - Refer to Tab 7.

1.13 Diesel generators

1.13.1 These need not be opened for examination but must be operationally tested to the rated load and results compared with original figures. The test includes testing of the ancillary equipment. Readings taken at the last overhaul are to be reviewed. Maintenance records to be reviewed to verify that the maintenance has been conducted in accordance with the maintenance plan and that there have been no re-occurring problems.

Rating Criteria - Refer to Tab 8.

Table 6 : Propeller shaft and bearing - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Shaft and stern tube bearing free from grooving. Liner seal free from grooving and original size. Stern tube clearance within 25% of the allowable tolerance. No evidence of removal of cracks by grinding.	Shaft and stern tube bearing free from grooving. Liner seal free from grooving. Stern tube clearance between 25 - 75% of the allowable tolerance. No evidence of removal of cracks by grinding.	Shaft and stern tube bearing with slight grooving. Liner seal free from serious grooving. Stern tube clearance between 75 - 100% of the allowable tolerance.	Shaft and stern tube bearing with grooving. Liner seal with grooving and close to minimum dimensions. Stern tube clearance over 100% of the allowable tolerance.

Table 7 : Turbo generator drive side - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Vibration measurement results as original readings. Trips operational. Generator able to hold the rated electrical load. Readings taken at last overhaul are within 25% of the allowable tolerance. Insulation without damage. No leakage observed.	Vibration measurements and readings taken at the last overhaul are between 25 - 75% of the allowable tolerances. Trips operational. Insulation without damage. No leakages observed. Generator able to hold the rated electrical load.	Vibration measurements and readings taken at the last overhaul are between 75 - 100% of the allowable tolerances. Trips operational. Insulation without significant damage. Minor leakages observed. Generator able to hold at least 90% of the rated electrical load	Vibration measurements and readings taken at the last overhaul are over 100% of the allowable tolerances. Some trips not operational. Insulation with significant damage. Leakages observed. Generator not able to hold at least 90% of the rated electrical load

Table 8 : Diesel generator drive side - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Trips are operational. Generator able to hold the rated electrical load. Liner calibrations taken at last overhaul are within 25% of the allowable tolerance. Insulation and double wall piping without damage. No leakage observed.	Liner calibrations taken at the last overhaul are between 25 - 75% of the allowable tolerances. Trips are operational. Insulation and double wall piping without damage. No leakages observed. Generator able to hold the rated electrical load.	Liner calibrations taken at the last overhaul are between 75 - 100% of the allowable tolerances. Trips are operational. Insulation and double wall piping without significant damage. Minor leakages observed. Generator able to hold at least 90% of the rated electrical load	Liner calibrations taken at the last overhaul are over 100% of the allowable tolerances. Some trips not operational. Insulation and/or double wall piping with significant damage. Leakages observed. Generator not able to hold at least 90% of the rated electrical load.

Table 9 : Pipe lines subject to U/T gauging - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Wall thickness reduction less than 25% of the corrosion allowance	Wall thickness of reduction between 25 - 75% of the corrosion allowance	Wall thickness of reduction between 75 - 100% of the corrosion allowance	Wall thickness reduction over the corrosion allowance

1.14 Evaporators

1.14.1 These need not be opened for inspection. The maintenance records are to be reviewed and the log of the condition of the water produced is to be reviewed. The General Rating Criteria (see Sec 3, Tab 2) is to be applied taking into account the condition of the water produced.

1.15 Air compressors and air receivers

1.15.1 These need not be opened for inspection. The maintenance records are to be reviewed.

The General Rating Criteria is to be applied taking into account the liner wear readings of the compressors.

Relief valves and/or bursting discs are to be visually inspected and dismantled, if deemed necessary.

1.16 Heat exchangers

1.16.1 These need not be opened for inspection. Maintenance records are to be reviewed for plugging of tubes.

For tube type coolers the Main Condenser Rating Criteria (see Tab 3) is to be applied for the percentage of plugged tubes.

For the others the General Rating Criteria is to be applied.

For heaters, the safety devices are to be visually inspected and dismantled, if deemed necessary.

1.17 Purifiers and separators

1.17.1 These need not be opened for examination and are to be tested, as deemed necessary. Maintenance records are to be reviewed, General Rating Criteria to be applied.

1.18 Automation

1.18.1 The automation equipment is to be randomly tested and inspected. The testing is to include the calibration, settings, alarms, auto change over/start of the stand by equipment and the auto control of valves, pumps etc.

1.19 Pipes lines

1.19.1 Pipe lines are to be inspected under pressure. Main superheat steam, saturated steam, feed water lines and ballast lines are to be randomly ultra-sonically tested. Insulation is to be examined for condition and intactness. The General Rating Criteria (see Sec 3, Tab 2) is to be applied except for those lines that are subject to ultra-sonic gauging. (See Tab 9).

1.20 Fire pumps and fire main

1.20.1 A functional test is to be conducted, if satisfactory, it is not necessary to dismantle the pump. The rating criteria that is to be applied is same as that for pumps and pipe lines respectively.

1.21 Fire and smoke detection, extinction systems and extinguishers

1.21.1 Random testing to be conducted and a valid service certificate is to be available. The General Rating Criteria is to be applied.

1.22 Breathing apparatus and emergency escape breathing apparatus

1.22.1 The General Rating Criteria is to be applied.

1.23 Emergency generator engine and emergency fire pump

1.23.1 A functional test is to be conducted, this includes testing of the remote starts. It is not necessary to open these for examination unless the results of the functional test are not acceptable. The survey scope and rating to be applied is the same as that for the diesel engines and pumps as required.

Table 10 : PMS - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Maintenance performed in a timely manner. Overdue or postponed items, few in number or of minor importance, not affecting class and documented. No items postponed to Drydock unless the docking is imminent and these are planned in the repair specification. No items subject to class recommendations. No ISM Non Conformities against Maintenance.	Maintenance performed in a timely manner. Overdue or postponed items, few in number, or of minor importance, not affecting class and documented. Items postponed for docking due within 3 months and clearly planned in the repair specification. No items subject to class recommendations. No ISM Non Conformities against Maintenance.	Maintenance performed generally in a timely manner with some overdue and postponed items not affecting class. Items postponed for docking due within 3 months and clearly planned in the repair specification. Items subject to class recommendations but within the limit date. Pending ISM Non Conformities against Maintenance	Maintenance generally performed with overdue items and postponed items some of which affect class. Overdue Class recommendations and ISM Non Conformities against Maintenance

Table 11 : Spare parts - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Adequate spares properly stowed and protected and correctly documented in the inventory.	Adequate spares, properly stowed and protected, listed in the inventory.	Spares stowed and protected but showing signs of deterioration. Listed in the inventory.	Spares showing signs of heavy deterioration that affect their fitness for use. Inventory is incomplete.

1.24 Deck spray and drenching system

1.24.1 The pumps and associated pipe lines are to be functionally tested. It is not necessary to dismantle them unless the results of the functional test are not acceptable. The survey scope and rating to be applied is the same as that for pumps and pipe lines respectively.

1.25 Vessel's planned maintenance system (PMS)

1.25.1 The vessel's planned maintenance system is to be audited. The audit is to cover the timely implementation, frequency, scope and results of the maintenance. Postponements and overdue items are to be included in the audit and reporting and follow up actions are to be reviewed. Note: The PMS is not restricted to the Machinery but should include Hull Fittings, Cargo Installation, Navigation Equipment etc.

The Machinery Rating will not normally be higher than the rating applied to the Vessel's Planned Maintenance System. However for borderline cases where the PMS system rating is not significantly different from the rating given to the machinery installation in general, and vice versa, then the higher rating may be applied at the surveyor's discretion.

Rating Criteria - Refer toTab 10.

1.26 Machinery spares

1.26.1 To be randomly inspected and audited against the inventory.

Rating Criteria - Refer to Tab 11.

Note 1: It is possible that some spares are kept onshore with contractors/suppliers.

2 Electrical installations

2.1 General

2.1.1 An overall survey of the installation is made at the start of the CAP survey with a detailed survey as indicated below. The scope of the survey may be extended or reduced according to the results of the overall survey.

2.2 Megger testing

2.2.1 Megger tests are to be conducted in accordance with the Class requirements and the Rating Criteria below should be applied.

Rating Criteria - Refer to Tab 12.

Note 1: The overall rating assigned for an item cannot be higher than the Megger test rating if a rating 4 is assigned for the megger results,.

2.3 Cabling

2.3.1

- Power, Main and Emergency Lighting
- Controls
- Instrumentation
- Communications

The surveyor shall check the condition of the cables of power, lighting and emergency circuits and pay special attention to hot and humid compartments, feeders to forced draught fans, cables in the holds, particularly at the upper grating levels, and cables in the galleys. He shall likewise examine the circuits exposed to salt air, particularly those on the outside of the superstructure.

Table 12 : Megger testing - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Over 100 Meg ohms	20 - 100 Meg ohms	Over class requirements but less than 20 Meg ohms	Below minimum Class requirements

Table 13 : Cabling - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results with Rating 1. Cables in original situation, sheathes and connections clean. Labels well readable and not damaged No action required	Insulation test results with Rating 2 or better. Cables moved or changed, without apparent damage. Labels without apparent damage Minor maintenance required.	Insulation test results with Rating 3 or better. Sheathes with surfaces scratched or armour slightly damaged, clamps missing. Labels missing or unreadable. Maintenance required but no overdue recommendations	Insulation test results with Rating 4 or better. Sheathes scratched, conductors are bare, clamps are missing, corrosion on connectors. No labels. Out class standards.

Table 14 : Earthing - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Cables in original situation. Sheathes and connections clean. No action required	Cables moved or changed, without apparent damage. Equipment changed and connections modified correctly.	Sheathes with surfaces scratched or armour slightly damaged, clamps missing. Connections corroded. Links in poor condition	Sheathes scratched, conductors are bare. Links and clamps are missing. Connections are corroded. Electric continuity poor.

If there are cable runs inside conduits, the Surveyor shall check, as far as possible, that these conduits are free from moisture. He will check the cable ends, and the intermediate junction boxes. If the neutrals are earthed, he will check the earthing clamps.

The Surveyor shall require a preliminary set of insulation readings for the circuits as soon as possible, to locate leakage to earth. If there are records of the insulation tests on board, he will examine them to compare the results, keeping in mind that the state of the insulation of a circuit is not sufficient in itself. The important factor is how the insulation condition has varied with time.

Rating Criteria - Refer to Tab 13.

2.4 Earthing

2.4.1 The earthing circuits are to be checked in the same way as general cabling. Particular attention will be paid to the electric continuity of earthing and the corrosion of earthing connections of the electrical components.

Rating Criteria - Refer to Tab 14.

2.5 Power generation

2.5.1 External examination of the generators, including shaft driven generators and emergency generator is to be made. Running tests shall be carried out when testing both the mechanical trips and functioning of electrical circuit breakers, alarms and instrumentation. Refer to the Machinery for the diesel engines, turbines and power take off units.

The most important being:

- Parallel operation and load sharing, etc.
- Over-speed trips
- Lubrication oil low pressure trips
- Reverse power trip of circuit breaker
- Generators, main and emergency.

The generators are to be verified in operating condition. If deemed necessary, the Surveyor shall require that (where fitted):

- Protection plates and brush carriers are removed, field coil and armature windings vacuum cleaned
- The brushes are renewed, if worn. The brushes may have to be adjusted to have good contact on the slip rings
- Thyristors checked as necessary.

The Surveyor shall:

- Examine the slip rings which are machined, as necessary
- Require, if necessary, the re-varnishing of armature windings and field coils
- Examine the air filters for cleaning and leaks for totally enclosed type generators
- Check the bearings.

The Surveyor also shall verify the air gaps (top/bottom/port/starboard) readings taken by the work shop.

Rating Criteria - Refer to Tab 15.

Table 15 : Generator electrical side - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Performance tests reach the rated values. Capable of operating at rated electrical load without abnormal temperatures & vibration. No maintenance required	Performance tests reach the rated values. Capable of operating at rated electrical load without abnormal temperatures and vibration. Minor maintenance required	Performance tests are below the rated values. Capable of at least 90% rated electrical load. Temperatures and vibration close to limits. Maintenance required.	Performance tests are below the rated values. Generator not able to hold at least 90% of the rated electrical load or system is not working properly. Vibrations and temperature out of tolerances. Overdue maintenance and class recommendations

Table 16 : Batteries - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Performance tests reach the rated values. No corrosion and battery location in clean condition. No action required	Insulation test results Rating 2 or better. Performance tests reach the rated values. Slight corrosion, battery location requires cleaning Minor maintenance required, not affecting class.	Insulation test results Rating 3 or better. Performance tests are below the rated values but still acceptable. Presence of corrosion on batteries and supports. Battery location dirty Maintenance required	Insulation test results Rating 4 or better. Performance tests are below the rated values or system is not working properly. Supports and trays very corroded. Battery location very dirty Overdue class recommendations

2.6 Batteries

2.6.1 The following are to be checked:

- Visual aspect, age of elements
- Voltage and Autonomy with regard to service (starting batteries, emergency power source, radio communications …)
- Verification that servicing of batteries for emergency, transitional or supplying other essential services has been done (connections, bars, tightness of trays and electrolyte levels)
- Verification that when charging source is disconnected that batteries hold their charge as required by the installation
- Battery room installation and ventilation
- Check that only the same type of batteries are present in the battery locker.

Rating Criteria - Refer to Tab 16.

2.7 Switchboards and electrical sub distribution panels

2.7.1 The Surveyor shall survey the following:

a) Main switchboard:
   - Examination of maintenance logbook
   - Switchboards dust freeing, vacuum cleaning and electrical chemical cleaning, connections and assemblies which may slack to be tightened. The Surveyor checks that the locking devices are properly fitted (locking washers, varnish between threaded spindles, nuts, etc.)
   - Cleaning and tightening of bus-bars, examination of circuit breakers and various types of switches and fuses
   - Reconditioning or replacement of contacts and arc screens. Checking of setting, adjustments and fuses
   - Examination in a repair shop and calibration of measuring instruments considered to be inaccurate by the ship's engineers
   - Servicing of breakers
   - An infrared analysis to identify bad connections or elements creating hot spots.

b) Emergency switchboard:

   Same as main switchboards

   Testing of the automatic start of the emergency generators, if applicable.

c) Sub-distribution panels:

   Same as main switchboards

Rating Criteria - Refer to Tab 17.

2.8 Rotating machines

2.8.1 This paragraph applies to alternators and electrical motors. For general scope of work, refer to the power generation paragraph.

The motors of essential services are to be verified in operating condition at the time of the vibration measurements.

If deemed necessary, the Surveyor shall extend his surveys to bearings, induced circuits, rotors, windings, etc.

The Surveyor shall check, at random, the insulation condition of the feed conductors penetrating into the terminal plate.

Rating Criteria - Refer to Tab 18.

Table 17 : Switchboards and electrical sub-distribution panels - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Performance tests reach the rated values. No infra-red hot spots. No maintenance or cleaning required	Insulation test results Rating 2 or better. Performance tests reach the rated values. No infra-red hot spots. Minor adjustment and cleaning required.	Insulation test results Rating 3 or better. Performance tests are below the rated values. Minor hot spots detected by infrared analysis. Adjustment and cleaning required but not affecting class No overdue recommendations.	Insulation test results Rating 4 or better. Performance tests are below the rated values or system is not working properly. Important hot spots detected by infrared analysis. Overdue class recommendations.

Table 18 : Rotating machines - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Performance tests reach the rated values. No action required	Insulation test results Rating 2 or better. Performance tests reach the rated values, with no abnormal temperatures and vibration. Minor cleaning required.	Insulation test results Rating 3 or better. Performance tests reach rated values with no abnormal temperatures and vibration. Minor cleaning required with no overdue recommendations.	Insulation test results Rating 4 or better. Performance tests are below the rated values or system is not working properly. Vibrations and temperature out of tolerances. Overdue class recommendations.

2.9 Transformers

2.9.1 The following are to be verified.

For transformers:

- Check visual aspect, quality of connections. Measures of voltages and currents, insulation resistance
- Induced voltage test
- Check cooling system (if applicable)

For liquid cooled transformers (if fitted):

- Analysis of liquid coolant.

Rating Criteria - Refer to Tab 19.

2.10 Battery chargers/inverters

2.10.1 The surveyor is to verify:

- Visual aspect checked, quality of connections, measurements of voltages and currents
- Cooling system in good operation (if applicable)
- Insulation test and insulation resistance measurement.

Rating Criteria - Refer to Tab 20.

2.11 Main lighting

2.11.1 Visual examination of the lighting appliances (cleanness, fastening, cabling…)

Lighting appliances and their switches are to be functionally tested on a random basis.

Rating Criteria - Refer to Tab 21.

2.12 Emergency lighting

2.12.1 The survey scope is the same as for the Main lighting.

Batteries of self-powered lighting are to be checked, as well as the spare lamps.

Rating Criteria - Refer to Tab 22.

2.13 Control of propulsion and steering - Engine telegraph

2.13.1 The Surveyor shall test the means of communication and order transmissions between the bridge and the machinery control positions, as well as for the bridge and the alternative steering position, if fitted.

Rating Criteria - Refer to Tab 23.

2.14 Automation control systems

2.14.1 The following items are to be examined:

- Remote control devices to allow the starting, stop, speed adjustment or other operations from one or several control positions fitted for this purpose. e.g. Remote control system or automatic control system for propulsion plant
- Automatic regulating devices to maintain satisfactory operating conditions for machinery which avoid foreseeable interventions, the periodicity of which could be less than 24 h
- Automatic monitoring systems to warn the engineer in charge, in case of failure (this optical and acoustic alarm is activated where permanent watch is assumed)
- Automatic safety devices intended to take immediate action to protect the monitored machine or to allow restart of the installation without waiting for engineers' intervention

- Local, or remote indications to show the position of machinery parts (when this position cannot be directly monitored) to indicate the value of several parameters
- Automatic start of stand-by pumps
- Electric driven pumps
- Driven pump
- Sequential restart of plant after power failure.

The automation systems are made of panels containing electrical equipment; verifications recommended for switchboards should be applied in the same way.

Furthermore the surveyor will proceed to the following:

- Visual examination of internal parts (presence of dust, quality of connections, condition of components
- Log book review, in order to identify the failures which have been occurred, with the corresponding actions of correction (interventions, equipment replaced, software updating…)
- Verification of equipment identified as repaired
- Functionalities review
- Assessment of performances, running time.

Rating Criteria - Refer to Tab 24.

2.15 Alarm system

2.15.1 Rating Criteria and verification scope refer to [2.14] and Tab 24.

2.16 Navigation equipment

2.16.1 This category of equipment is within the competence of the flag authorities. Special attention will be paid in case of **SYS-NEQ** notation.

Rating Criteria and verification scope refer to [2.14] and Tab 24.

2.17 Radio equipment

2.17.1 Rating Criteria refer to Tab 24.

2.18 Navigation lights

2.18.1 As the navigation equipment, the navigation lights are within the competence of the flag authorities.

However, the following verifications should be performed:

- Visual examination (presence of corrosion, quality of cabling and connections)
- Functional test and alarm checking
- Insulation test.

Rating Criteria - Refer to Tab 25.

2.19 Fire alarm system, Panels/Detectors

2.19.1 Refer to Automation system for fire alarm panel.

A satisfactory function test of the fire detection system is to be carried out.

Rating Criteria - Refer to Tab 24.

2.20 Instrumentation (liquid level gauges, pressure and temperature gauges and remote, gas detection equipment)

2.20.1 Visual inspection

Check at random the operation of liquid level gauges.

Check at random the operation of pressure and temperature gauges by comparison between different sensors and indicators.

Check at random the operation of gas detection system using span gas.

Rating Criteria - Refer to Tab 26.

Table 19 : Transformers - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Performance tests achieve rated values, high voltage test. Temperature rise well within tolerances. No action required	Insulation test results Rating 2 or better. Performance tests above minimum rated values. High voltage and temperature rise tests within tolerances. Minor maintenance is required, no class recommendations.	Insulation test results Rating 3 or better. Performance tests are close to the minimum rated values. High voltage test is at limit of tolerance. Maintenance required but no overdue class recommendations.	Insulation test results Rating 4 or better. Performance tests are below the minimum rated values or system is not working properly. High voltage test and temperature rise test outside of tolerances.

Table 20 : Battery chargers/inverters - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Performance tests achieve rated values. No action required	Insulation test results Rating 2 or better. Performance tests achieve rated values. Minor maintenance required. No class recommendations.	Insulation test results Rating 3 or better. Performance tests are close to the minimum rated values. Maintenance required but no overdue class recommendations	Insulation test results Rating 4 or better. Performance tests are below the minimum rated values or system is not working properly.

Table 21 : Main lighting - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Fittings and protections are satisfactory. No action required	Insulation test Rating 2 or better. Fittings and protections are generally satisfactory. Minor maintenance required not affecting class.	Insulation test results Rating 3 or better. Fittings and protections meet minimum class requirements. Maintenance required, no overdue class recommendations.	Insulation test results Rating 4 or better. Defective fittings and/or missing protections. Maintenance and/or renewals urgently required. Overdue class recommendations

Table 22 : Emergency lighting - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Fittings, protections and functional tests satisfactory. Battery condition of self powered lights satisfactory. No action required	Insulation test results Rating 2 or better. Fittings, protections and functional tests satisfactory. Battery condition of self powered lights satisfactory. Minor maintenance required.	3 or better. Fittings, protections and functional tests are at minimum class requirements. Battery condition of self powered lights is near minimum class requirements. Maintenance and/or renewals required, no overdue class requirements	Insulation test results Rating 4 or better. Defective fittings and/or missing protections. Batteries of self powered lights are out of service. Maintenance and/or renewals urgently required.

Table 23 : Control of propulsion and steering - Engine telegraph - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Performance tests achieve the rated values. No action required	Insulation test results Rating 2 or better. Performance tests achieve the rated values. Minor maintenance and adjustment required.	Insulation test results Rating 3 or better. Performance tests are close to minimum rated values. Maintenance and adjustment are required. No overdue recommendations.	Insulation test results Rating 4 or better. Performance tests are below the rated values or system is not working properly.

2.21 Emergency shutdown system

2.21.1 The surveyor shall test at random before and after cargo operations the emergency stops that activates an emergency shutdown.

Rating Criteria and operation checks refer to [2.14] and Tab 24.

2.22 Internal communication means

2.22.1 For these systems, a visual examination is to be carried out (presence of dust, corrosion, quality of cabling and connections):

a) PA/GA System:
- loud speakers are to be tested individually
- The sound level will be measured (reference will be made to LSA code 7.2.1 requirements)

b) Self-generator telephone
- Functional test
- Automatic telephone

Rating Criteria - Refer to Tab 27.

2.23 Electrical equipment in hazardous areas

2.23.1 A general visual examination is to be made. The file for this equipment is to be randomly checked to ensure that it is up to date and contains copies of the certified maintenance. Equipment identified as repaired or replaced is to be especially checked for proper certification and installation.

Doubtful fittings are checked and defective parts are to be repaired to the standards applicable to the certified item in question.

Rating Criteria - Refer to Tab 28.

2.24 Cargo handling system

2.24.1 The electrical bonding of cargo tanks and cargo piping shall be checked and is to be repaired as necessary.

The Surveyor may require opening up and overhaul of the electrical equipment.

Defective wiring is to be renewed in its entirety. If junction boxes are used these should be of the required safety type appropriate to the zone. Splicing kits are not accepted in gas dangerous zones.

Rating Criteria - Refer to Tab 26.

Table 24 : Automation control systems - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Performance tests reach the rated values. No action required	Performance tests reach the rated values. Minor maintenance, calibration and cleaning required.	Performance tests are on the rated values. Presence of corrosion on electronic cards. Maintenance, calibration and cleaning required.	Performance tests are below the rated values or system is not working properly. Defective and/or missing instrumentation, poor calibration.

Table 25 : Navigation lights - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Lighting, alarms and indicator panels working correctly, cabling satisfactory. No action required	Insulation test results Rating 2 or better. Lighting, alarms and indicator panels working correctly, with superficial damage to cabling. Minor maintenance, cleaning required	Insulation test results Rating 3 or better. Lighting, alarms and indicator panels working correctly, damage to cabling and fittings, still within class requirements. Maintenance is required.	Insulation test results Rating 4 or better. Some lighting, alarms and/or indicator panels not working correctly. Cabling is damaged.

Table 26 : Instrumentation - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Instruments regularly calibrated and reading correctly. No action required	Instruments regularly calibrated and reading within the defined tolerances. Minor maintenance and adjustment required	Instruments are reading close to limit of the defined tolerances. Calibration performed when needed. Presence of corrosion of cable glands and boxes. Maintenance and re- calibration required	Instruments are reading outside the defined tolerances or systems are not working properly. Calibration not conducted. Presence of corrosion on cable glands and boxes. Major maintenance and re-calibration required

Table 27 : Internal communication means - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Performance tests reach the rated values. Loud speakers are properly working with sound clarity and levels at the as new condition. No action required	Performance tests reach the rated values. Loud speakers are generally working. Sound clarity and levels close to as new condition for the speakers. Minor maintenance required.	Performance tests are at minimum rated values. Loud speakers are working though clarity and levels at minimum acceptable levels. Presence of corrosion. Maintenance, repair and renewal required.	Performance tests are below the minimum rated values. Some loud speakers are not correctly working. Sound clarity and levels of some speakers below minimum requirements. Presence of corrosion. Major maintenance, repairs and/or renewals required.

2.25 Heating and cooking appliances

2.25.1 A general visual examination is to be made. The electrical protection devices will be checked.

Rating Criteria - Refer to Tab 29.

2.26 Documentation

2.26.1 General check of documentation on board: existence, location, consistency.

A special attention will be paid to the modification and maintenance logs (preventive and corrective).

Rating Criteria - Refer to Tab 30.

2.27 Insulation measurement tests (on completion of survey)

2.27.1 On completion of the survey, the insulation measurements are to be taken.

a) Main and emergency switchboards

For the main and emergency switchboards, the outputs being open, the bus-bar sections closed, and the measuring and monitoring instruments disconnected, the insulation resistance between the isolated bus-bars and the hull, and between isolated bus-bars (if feasible) should be at least equal to 1 megohm.

b) Generator

The readings are taken while the machines are hot if possible, and with the equipment and circuits normally connected between the generator and the first isolating switch coupled in. The resistance of the insulation should be more than 1000 times the nominal voltage. In addition, the resistance of the insulation of the exciters, separate from the generators, if applicable, should not be less than 250 000 Ohms.

c) General installation

Circuit breakers and protective equipment having been set in the closed position (with the exception of those of the generators), the resistance of the insulation of the whole electrical installation is checked.

This installation resistance should not be less than 100 000 Ohms.

However, it is not so much the absolute value of the resistance as its variation over a period of time which is important. This is why the value obtained is compared with the previous ones. In the event of a sudden fall or of too low a value of the resistance of the insulation, a search shall be made for defective circuits.

d) Working tests

The Surveyor shall also carry out operational tests of the essential service and equipment related to safety.

He checks that the navigation lights as well as their signalling and alarm devices are working and checks the operation of the various remote trips (transfer pumps, forced draught fans, and engine room ventilation fans, etc.).

The emergency generator and the emergency or transitional batteries are tested.

A general check of performances and a blackout test will be also carried out.

2.28 Electrical installation spares

2.28.1 To be randomly inspected and audited against the inventory. On older ships the availability of the spares will have to be discussed with the owners and taken into account. Note: It is possible that some spares are kept onshore with contractors/suppliers.

Rating criteria as per Tab 11.

3 Water tube boilers

3.1 Safety

3.1.1 It is to be reminded that boilers may be considered as confined spaces and that entry should only be made under controlled conditions. In addition, if other boilers are 'on line' boiler entry should never be made until the surveyor has satisfied himself of the arrangements for isolation.

Table 28 : Electrical equipment in hazardous areas - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Performance tests achieve the rated values. Safety certificates are available No action required	Insulation test results Rating 2 or better. Performance tests are within the defined tolerances. Safety certificates are available. Minor maintenance and cleaning required.	Insulation tests results Rating 3 or better. Performance tests are close to minimum requirements. Envelopes, cable glands with minor defects not affecting the explosion proof characteristics. Maintenance and cleaning required.	Insulation test results Rating 4 or better. Performance tests are below the minimum defined levels or system is not working properly. Installation no longer complies with the rule requirements. Envelopes, cable glands damaged. Explosion proof characteristics cannot be confirmed.

Table 29 : Heating and cooking appliances - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Insulation test results Rating 1. Performance tests achieve the rated values. No action required	Insulation test results Rating 2 or better. Performance tests are within the defined tolerances. Minor maintenance and cleaning required.	Insulation test results Rating 3 or better. Performance tests are close to the minimum defined tolerances. Important maintenance and cleaning required.	Insulation test results Rating 4 or better. Performance tests are below the defined tolerances. Numerous items not working correctly.

Table 30 : Documentation - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Available and complete, at post	Existing, but not readily available at post, correctly up-dated.	Not complete, but essential parts available and correctly	Inconsistent and not available at post or not updated.

3.2 General

3.2.1 Water tube boilers are high pressure, high temperature boilers (Superheat pressure and temperature normally around 62 bars, 515oC with a steam drum pressure around 78 bars) producing large quantities of superheated steam for main turbines, auxiliary machinery such as turbo alternators, cargo pumps, feed pumps etc. Whereas the tank boiler most frequently seen is a low pressure boiler producing saturated steam around 6 bars.

In general, the boilers are to be reported on separately. Similarly, where there is more than one water drum or header, these are to be reported on separately using the formats below.

The survey is to be supported by non destructive testing as necessary. In addition, a boroscopic internal survey of a selection of the various types of tube is to be conducted based on the examination of the tube ends made during the survey of the headers and drums.

In principle, as this is a heated, high temperature pressure vessel, the lowest grade that can be accepted for the drums and headers is Grade 3, i.e., minor deficiencies not requiring repair.

Weld repairs can only be done under controlled conditions by approved welders using approved procedures and materials.

The CAP survey for Water Tube boilers may be broadly divided into two parts:

- Document Review
- Survey

3.3 Document review

3.3.1 The following documents are to be reviewed:

- Engine Room Log Book
- Water Treatment Log Book
- Evaporator Log Book
- Maintenance Records for:
  - Boilers and ancillary machinery
  - Evaporators.

3.4 Survey

3.4.1 Boiler room

General examination of the boiler room in connection with the points listed with particular attention to boundaries of fuel tanks.

General criteria to be applied: see Sec 3, Tab 2.

3.4.2 Boiler external

This comprises of a general examination of the boiler casings for damage and gas leakages. Verification of the tightness of the foundation bolts, the arrangements for expansion and the anti-rolling struts and supports are in order. The furnace sight glasses and smoke detectors are to be inspected.

General criteria to be applied: see Sec 3, Tab 2.

3.4.3 Steam drum

The steam drum is to be examined externally and internally. If necessary, internal fittings are to be removed to facilitate the survey of the inside of the drum plating. Particular attention is to be paid to the feed pipe end spray arrangement as these can become severely eroded.

Particular attention is to be paid to the areas between tubes for evidence of pitting and cracking, if considered necessary NDT examination to be conducted. No cracking can be tolerated and only slight pitting can be accepted. The drum longitudinal and circumferential welds are to be examined for cracking.

The inside of the boiler, including fittings, should be coated with a thin layer of black scale and/or slight dusting of black or dark brown powder material (i.e. FE O3 or Magnetite) This is a reliable indication that the water treatment of the boiler water is correctly being applied. The presence of a magnetite layer also indicates that no active corrosion of the area in view is occurring.

If corrosion or salts scale is present internally and/or there are corrosion deposits externally these are to be removed to enable an accurate survey of the drum to be conducted. Scale build up inside the drum will indicate a problem with the boiler water treatment and could be detrimental to the operation of the boiler; this will also require increased scope in the examination of the tubes

Access doors, studs and strong back are to be examined for corrosion, wastage and distortion. The drum ends, in way of the flanged end for the door, are to be examined for wastage and cracking. Similarly the joint faces are to be inspected for wastage and erosion/grooving due to steam leakage.

Openings to the various boiler mountings should be examined and verified clear of obstruction or scale build up.

Rating Criteria - Refer to Tab 31.

The boiler cannot be assigned a rating higher than the one assigned to this item.

3.4.4 Tubes and tube ends, including down comer tubes and ends

Tube ends are to be inspected internally for corrosion and pitting. This examination is used to select those tubes to be submitted for Boroscopic examination for assessment of the internal condition of the tube. Particular attention should be paid on the side closest to the furnace.

Scale build up will lead to the overheating of the tube and its eventual failure if de- scaling is not performed. It will indicate poor boiler feed water treatment.

Poor feed water treatment can lead to pitting due to the presence of oxygen. Where screen tubes have been subject to excessive heat due to poor combustion circumferential cracking can occur. This can be exacerbated through rapid thermal cycling.

Negligible scale is to be present and only slight surface pitting should be accepted.

Rating Criteria - Refer to Tab 32.

Where repairs are conducted the grading should be brought back to Rating 2 or better.

Where tubes are renewed the rating of the tubes is based on the overall condition of the remaining tubes of that bank.

Table 31 : Steam drum - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
No maintenance or repair required. No pitting or corrosion	Minor deficiencies to internal fittings not requiring repair. No pitting or corrosion	Minor deficiencies to internal fittings not requiring repair. Slight pitting or corrosion within class requirements.	In principle, rating 4 cannot be assigned as deficiencies are outside of class requirements

Table 32 : Tubes - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
No scale or pitting observed	Slight hard scale and/or surface pitting on less than 10% of the internal surface	Scale build up or pitting deeper than 5% of the tube thickness over less than 25% of the internal surface	In principle, a rating 4 cannot be assigned as deficiencies are outside of class requirements

Table 33 : Water drum(s) - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
No maintenance or repair required. No pitting or corrosion present.	No maintenance or repair required. Slight pitting or corrosion present, not requiring action.	Slight pitting and corrosion within class requirements	In principle, a rating 4 cannot be assigned as deficiencies are outside of class requirements

3.4.5 Water drum(s)

The water drum(s) are to be examined internally and externally, generally in the same manner as the steam drum. Particular attention is to be paid to the area between the tubes for cracking, internally and externally. The drum longitudinal and circumferential welds are to be examined for cracking. Depending on the size it may not be possible to access the drum therefore mirrors and other visual aids may also be used to assist this inspection.

If considered necessary NDT examination is to be conducted. No cracking can be tolerated and only slight pitting can be accepted.

Access doors, studs and strong back are to be examined for wastage, corrosion and distortion. The drum ends, in way of the flanged end for the door, are to be examined for wastage and cracking. Similarly the joint faces are to be inspected for wastage and erosion/grooving due to steam leakage.

Sludge build up inside the drum(s) will indicate a problem with the boiler water treatment and/or the blow down regime and could be detrimental to the operation of the boiler.

Rating Criteria - Refer to Tab 33.

The boiler cannot be assigned a rating higher than the one assigned to this item.

3.4.6 Headers

Headers are to be inspected internally and externally.

The external examination is to examine the surface for corrosion and cracking between the tubes. Due to the headers' size the internal examination will usually be undertaken from external therefore a sufficient number of hand-hole doors are to be removed to allow for adequate internal examination of the header, tube ends and the areas between the tubes, mirrors and other visual aids may also be used to assist this inspection. As with the drums the tube ends are to be sighted and tube selected for boroscopic inspection.

Negligible scale is to be present and only slight surface pitting should be accepted.

Door faces and their corresponding faces in the headers are to be examined for distortion and damage due to steam leakage. Internal division plates where fitted are to be examined.

Rating Criteria as per Tab 33.

The boiler cannot be assigned a rating higher than the one assigned to this item.

3.4.7 Furnace

The furnaces will usually be of mono-wall construction. Poor flame control can lead to flame impingement and tube damage and, when in conjunction with poor boiler water control, can cause tubes to distort and even rupture. The tubes are to be externally examined for distortion, bulging, burning and corrosion.

Floor, wall, roof and screen tubes should be examined.

The 'hot' gas passages through the screen tubes to the uptakes is to be examined and is to be free from carbon deposits and slag build up. No 'bridging' of the spaces between the screen tubes should be evident.

The refractory material in way of the drums and headers should be examined. If this is in poor condition, damage to the drums could occur.

Rating Criteria - Refer to Tab 34.

When repairs are conducted this should bring the grading up to a Rating 2 or better.

Table 34 : Furnace - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Superficial defects, no maintenance or repair required	Minor defects, slight maintenance to the brickwork.	Defects that do not require immediate attention	In principle, a rating 4 cannot be assigned as deficiencies are outside of class requirements

Table 35 : Superheater tubes - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
No bowing or surface defects to the tubes and internally free from pitting and deposit is. Support plates free from damage.	Slight bowing of tubes with no surface defects or internal deposits or pitting. Support plates slightly burnt.	Bowing of tubes within manufacturer's limits. Slight surface defects and indications of internal pitting and deposits. Support plates burnt but within manufacturer's limits.	In principle, a rating 4 cannot be assigned as deficiencies are outside of class requirements

Table 36 : Economiser - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Tubes and fins free from carbon deposits. No pitting or corrosion internally or externally.	Tubes and fins with slight carbon deposits. Slight pitting and corrosion externally. No pitting or corrosion internally.	Tubes and fins with carbon deposits. Pitting and corrosion present internally and externally but within manufacturer's limits.	In principle, a rating 4 cannot be assigned as deficiencies are outside of class requirements

Table 37 : Soot blowers - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Soot Blowers and nozzle free from defects and able to be easily operated. Automatic sequential operation is working.	Some Soot Blowers showing minor nozzle erosion. Operation a little stiff for some blowers. Automatic sequential operation is working.	Significant nozzle erosion to most blowers. Stiff to operate but still extend. Automatic sequential operation is working.	Heavy nozzle erosion. Difficult to operate, some soot blowers do not completely extend. Automatic Sequential operation is problematical.

Table 38 : Safety valves - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Valves and seats within 25% of manufacturer's original tolerance, no machining required, valves and seats require only lapping.	Valves and seats required machining now between 25% and 75% of the manufacturer's original tolerance.	Valves and seats required machining, now between 75% and 100% of the manufacturer's original tolerances.	In principle, a rating 4 cannot be assigned as deficiencies are outside of class requirements

3.4.8 Superheater tubes

The superheater tube ends are to be sighted at the time the header is inspected. As with other tube banks a selection of tubes is to be made for boroscopic internal inspection. This is particularly important for these tubes as boiler water 'carry over' could have a detrimental affect on them.

Slight distortion of the superheater tube nest is not uncommon with the boiler in the cold condition however the external appearance of the tubes is to be examined for bowing and/or distortion and for indications of local overheating. The superheater support plates and tubes are to be examined for distortion, cracking and/or burning; damage to these could lead to distortion or bowing of the superheater tubes. No 'bridging' of the spaces between the tubes should be evident

Rating Criteria - Refer to Tab 35.

3.4.9 Economiser

Economiser tube banks consist of a series of finned tubes. The fins are fitted for better heat transfer but these tend to cause soot to build up that can lead to high corrosion and a loss of efficiency. The outside of the tubes should be examined for localised pitting. Internally the tubes ends are inspected as with other tube bundles. A selection is to be made for boroscopic internal inspection. The elbow connections are to be thickness checked at random, approximately 10%.

Rating Criteria - Refer to Tab 36.

3.4.10 Steam air heater

The combustion air is preheated using steam tubes. As with other tube bundles the tubes are to be inspected internally and externally. Internally, the tube ends are inspected via the headers with boroscopic examination of a selection of tubes. Externally, they are inspected along their length for bowing and corrosion.

Rating Criteria as per Tab 36 to apply.

3.4.11 Soot blowers

These are steam lances that are extended into the tube banks of the boiler. Using steam they blast off lose carbon deposits on the tubes and avoid scale build up externally.

These are automatically operated using a programme control system which should be inspected for correct sequential operation. The soot blowers are to be checked for ease of operation, condition of the nozzle and for distortion.

If the soot blowers are not working, the surveyor will find carbon build up on the tubes. This carbon build up can be dangerous and lead to up-take fires that, in turn, can lead to a melt down of the boiler tube stacks when the fire temperature is extremely high; uncontrollable Hydrogen fires can result due to this. It is of the upmost importance that soot blowers are working correctly.

Rating Criteria - Refer to Tab 37.

3.4.12 Safety valves

The safety valves are very important to the safety of the boiler and operating personnel, as such their condition is of prime importance. The valves must be dismantled for inspection. Where pilot valves are fitted these must be dismantled and inspected.

Where the valves are overhauled by the manufacturer or recognized workshop the scope of the survey may be reduced. Valves are to be dismantled for inspection. The valve and the seat are inspected for signs of wear and wire drawing. High pressure steam leakage can cause very high erosion of the valve and seat. The profile of the valve and seat are critical to the operation of the valve, not just to its opening but also the closing. Consequently, the valve and seat must be checked against the manufacturer's tolerances.

In addition, the spindles, springs and castings are to be checked. The drain arrangement must be checked to ensure that it is not blocked as this could allow water to build up in the waste pipe and affect the valve setting. On completion, when steam is raised, the valves are to be floated in the presence of the class surveyor and checked against the required setting pressures.

The hand easing gear is to be checked and verified that it is free to operate the valve in the event of an emergency.

On completion of the floating of the safety valves, the settings are locked.

Rating Criteria - Refer to Tab 38.

3.4.13 Gauge glasses

Gauge glasses are to be opened for inspection. Gauge glass shut off valves, cocks and drain valves are to be checked to ensure that they are tight and that the spindles have not been twisted. The glass and castings are to be checked for damage.

The boiler nozzles are to be checked to ensure that there is no reduction in diameter of the bore due to scale or other obstructions.

On assembly the operation of the gauge glass cocks are to be checked. In addition, the level in the gauge glass is to be compared to that of the remote indicators to ensure that they are indicating the same level of water in the boiler.

The gauge glass lighting is to be checked on assembly to ensure that it is working.

Rating Criteria - Refer to Tab 39.

Due to the importance of the gauge glasses a rating 3 or 4 is not acceptable

3.4.14 Boiler water level control

There are several different types of control in service. They are to be examined in operation and inspected for defects and abnormal wear if necessary the sensors and valves should be opened for examination.

General criteria to be applied: see Sec 3, Tab 2.

3.4.15 Main & auxiliary stop valves and other stop valves

Valves are to be opened up for inspection. A selection are to be removed from the drum to verify the condition of the holding down studs.

The scum and blow down valves are to be checked to ensure that there is no blockage in the valves or in the overboard piping.

Rating Criteria - Refer to Tab 40.

3.4.16 Oil fuel system

It is necessary to dismantle the burner units for the CAP survey, particular attention should be paid to the registers, electrodes, nozzles and the vanes.

The piping and associated valves should be examined under pressure and the various valves manually and automatically tested. The Quick Closing valves and re- circulating valves should be tested as well.

The burners are usually steam assisted to improve the atomisation of the fuel and the efficiency of combustion. The steam valves and associated pipes should be inspected as well. The operation of the burners is automatic this is to be checked, in particular, the operation of the registers and the igniters. The purging and lighting sequences are to be tested.

The steam has two functions, to assist in atomisation and to cool the burner nozzle when not in use. The steam is turned on manually when the boiler is flashed up. A non return valve and drain are fitted in the steam line to prevent oil from passing back into the system. The drain is led to a drain tank with float alarm. During the survey this tank should be checked for signs of leakage.

Various alarms, switches and shut downs are incorporated into the systems. These should be tested. In addition for 'roof fired' boilers the burner front forms a 'save all' with drains leading to the drain tank.

Rating Criteria - Refer to Tab 41.

Table 39 : Gauge glasses - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
No leakages or defects present, cocks and valves easy to operate, without leaking	No leakages or defects present, cocks and valves stiff to operate, without leaking.	In principle, a rating 3 cannot be assigned.	In principle, a rating 4 cannot be assigned.

Table 40 : Main & auxiliary stop valves and other stop valves - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Valves are tight, free from gland leakage and easy to operate	Valves have slight leakage but free from gland leakage, stiff to operate	Valves have slight leakage and stiff to operate.	In principle, a rating 4 cannot be assigned as deficiencies are outside of class requirements

Table 41 : Oil fuel system - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
Valves and pipe lines are tight, free from leakage. Valves easy to operate. Alarms, switches and shut downs adjusted and functioning correctly. Shields and insulation in order.	Valves and pipe lines are tight, free from leakage. Valves stiff to operate. Alarms, switches and shut downs functioning. Shields and insulation in order.	No rating 3 can be assigned as leaks, defects or mal functioning would incur a rating 4.	In principle, a rating 4 cannot be assigned as deficiencies are outside of class requirements.

Table 42 : Gas fuel system - Rating criteria

Rating 1	Rating 2	Rating 3	Rating 4
As new condition, no corrosion or damage.	Good condition, slight corrosion, fittings acceptable and working, and functional.	Acceptable condition fittings working, limited signs of wear and break down, some standby items not functional.	Heavy corrosion, signs of cracking, items missing, gas detected in double trunk, failure of safety and control systems.

3.4.17 Gas fuel system

A functional test of the gas burning system and the relevant change over to and from oil burning are to be performed along with a test of alarms and shut downs. This may be carried out on passage before the docking survey of the vessel.

The surveyor shall visually inspect the fuel gas line running from the LNG room on deck to the engine room bulkhead for condition, special attention shall be given to the seating of the pipe on the pipe supports and pipe clamps for signs of wear, corrosion and possible leakage. The nitrogen purge lines should be similarly examined. The deck main gas valve should be opened for examination to ensure the seats are in acceptable condition; similarly, the nitrogen purge valve should be examined.

The double trunk in the engine room shall be examined for signs of corrosion, cracking and failure of access door seals. Similarly the gas hood and gas burner double pipes at the boilers should be examined along with expansion arrangements. Access doors should be removed for examination of the gas pipe for wear and corrosion.

The double trunk vent fans should be examined and run on test to ensure satisfactory operation, special care should be taken regarding the venting of these fans if they are located in the engine room.

Boiler gas isolation and control valves and flame arrestors should be examined and consideration should be given to opening for internal examination the individual boiler gas stop valves. Similarly the nitrogen purge valves should be examined.

The calibration of instrumentation should be made randomly to gauge the overall condition of the control systems. Alarms and shut downs must be functionally tested including the trunk vent fan failure and gas detection trips.

The burner registers should be removed from the furnace and the gas burners examined for signs of erosion, corrosion and general wear.

Rating Criteria - Refer to Tab 42.

3.4.18 Boiler automation, combustion control, alarms and safety systems

Rating Criteria and verification scope refer to [2.14] and Tab 24.

4 Cargo handling system

4.1 General

4.1.1 In general it is not required to request that the machinery to be dismantled for the CAP survey unless:

- It is due to be opened up for overhaul for Class or in accordance with the vessel's planned maintenance system, or
- The functional test demonstrates that the equipment is not working correctly.

Readings taken during the last dismantling should be examined in conjunction with the results of the operational tests. Similarly, the log books should be reviewed at the start of the CAP survey to determine the overall condition of the plant, reports of excessive vibration etc. For some of the equipment dismantling has been specifically requested or specific tests are to be performed such as vibration measurement.

4.1.2 Rating criteria

General criteria to be applied, see Sec 3, Tab 2, for reference. Except where specific Rating Criteria is given for individual items. The Criteria are to be used in conjunction with operational testing and the results of non destructive tests such as vibration measurements.

4.1.3 LNG Room /Motor Room

Depending upon the type of machinery fitted there may be only an LNG Compressor room if the plant is steam driven or there may be an electrical motor room as well with shaft drive through the intervening bulkhead. In some older cases the machinery may be on the open deck. In the case that rooms are fitted then the structures should be examined for corrosion, damage, safety of walkways railings, stairs etc. Particularly the roof should be checked where often ventilation machinery is fitted and where water can collect causing wastage where people may walk. The airlocks on the motor rooms should be checked for function ensuring that whatever alarms and shut downs are fitted work. The ventilation systems need to be examined for corrosion on the trunks, and whatever interlocks are fitted to prevent starting of electrical equipment without proper ventilation of the spaces should be proven operational. Electrical equipment in the gas hazardous area should be examined for integrity including the lighting fixtures.

4.1.4 Cargo compressor

Cargo compressors may be of different types.

These machines should be visually examined for condition and obvious defects and a running test should be made to ensure that associated equipment such as suction mist separators and stand by lub. oil pumps are functional. Records of lub. oil testing should be reviewed. Control gear should be examined and tested as far as possible, especially the isolation valves, NR. valves, nitrogen sealing and surge control on radial compressors. When fitted, the electric motors should be examined and megger tested, results of regular vibration monitoring would be useful. Bulkhead seals should be examined for proper functioning. Alarms and shut downs should be tested and found working. For gas burning the compressors should be functionally tested and the operation of the controls, alarms and shut downs confirmed.

4.1.5 Vaporisers, cargo and fuel gas heaters

The units, should be visually examined for general condition and obvious defects. Flanges, joints, and welded connections should be checked for corrosion and signs of leakage. The condition of the insulation should be assessed. Relief valves should be examined as well as the drain away arrangements, especially for cargo liquid. The unit should be functionally tested if possible. The temperature controls should be examined and functionally tested, alarms and shut downs should be tested and resulting actions confirmed. Electrical bonding arrangements should be confirmed.

4.1.6 Steam and drains piping in the cargo area

The piping should be visually externally examined for the presence of corrosion and wastage in particular the drains piping should be tight. Joints, valves, welds and insulation should be assessed.

The gas detector fitted in the drain return line to the machinery spaces must be assessed for condition and proven functional the alarm and subsequent shut downs must be tested and found operational.

The grading given to the cargo vaporising system can not be higher than that of the drains gas detection arrangements.

4.1.7 Cargo pumps/ spray pumps /emergency cargo pumps

The function of cargo pumps should be checked during a discharge whereby the running may be monitored. The starting arrangements should be checked soft or otherwise, the running current checked, vibration assessed, alarms and shut downs tested. During tank entry the pumps and associated equipment should be visually examined. If the pumps are open for survey or for repair/bearing renewal then the internals should be examined and assessed. Bear in mind that most cargo pumps will have very low running hours compared with other ship machinery. Megger test readings should be taken in both the cold condition and warm gas free state.

4.1.8 Cargo Switchboards/distribution boards

The switchboards may be in separate switchboard rooms or they may be distribution boards in the engine control room. They should be examined taking into consideration the guidelines in the main electrical part of the CAP. However as a review, visually examine the paneling for condition and security, check the tightness of the bus bar connections and their security. Check the condition of the starters and starter panels and Isolator breakers. Check the condition of the instrumentation. Functionally test the alarms and shut downs especially the emergency isolation arrangements. Megger test the board and view the thermal imaging of the panels and cabling.

4.1.9 Junction boxes on deck

The junction boxes should be checked for proper location according to the hazardous area rating. Boxes should be checked for fastening and security, cable entries the condi-

tion of the explosion protection arrangements e.g. Ex.e, Ex.d, Ex.p etc. should be examined and assessed. Condition of identification plates should be assessed. Cable glands should be checked for tightness and the condition of the cables at the glands assessed.

4.1.10 Electrical cables on deck

There will be many types of cables on deck from power supply for compressors and cargo pumps to intrinsic control and instrumentation cabling. These should be assessed for general condition.

The cable trays should be examined for condition and for security, corrosion of the main tray itself, water drainage arrangements, condition of clamps, loose old cables, condition and security of new cable runs.

The cables should be examined for sign of cracking, breakdown, or failure of the armouring and especially where the cable runs are subject to strong sunlight. Particular attention should be paid to the tank penetrations for the cargo pump cables. Cables should be megger tested.

4.1.11 Cargo Monitoring and Control Systems

The visual condition of transmitters, cables, sounders, light signals and cabling should be assessed. Control systems and circuits should be functionally tested where ever possible, the records of regular testing, maintenance and repair may be taken into consideration. Particular attention should be paid to local isolated control loops. A functional test of the emergency shut downs shall be carried out. Random calibration test of transmitters pressure/temperature shall be carried out and a functional test of the alarms. The general condition of the control spaces should be examined.

4.1.12 Safety Systems

A visual examination should be made of the safety valves, liquid and vapour. Special attention shall be paid to the escape and drain arrangements. The liquid drain chamber level alarm shall be functionally tested. Where valves are operated by pilots the pilots and the connection piping shall be especially checked. A random test of bursting discs in a workshop can be considered. Relief valves should be bench tested for lift pressure in a specialised workshop. The vent masts should be examined. The foundations for corrosion and security, the ladders to ensure they are secure and that the safety hoops are properly fitted, the condition of the flame screen should be sighted and assessed and the fire extinguishing arrangements should be examined and if possible functionally tested.

4.1.13 Cargo Piping and accessories

The cargo liquid and vapour pipes are to be examined visually for general condition. The condition of joints, welds, supports, sliding feet, clamps, electrical bonding, and insulation is to be assessed. Bellows and expansion arrangements are to be examined for corrosion cracking and wear. The condition and correct position of liquid line drip trays is to be examined. The condition of cargo pipe accessories, flexible hosed, blanks, reducers etc is to be examined, pressure test to be considered and storage conditions assessed.

Consideration should be given to the removal of selected insulation to check for pitting, especially on the stainless steel pipes.

4.1.14 Cargo valves and actuation systems

The cargo valves both manual and remotely operated shall be examined and functionally tested, the general condition of the valve body and actuator shall be assessed. The valve indicators both local and remote shall be tested for proper operation. Indication of valve leakage such as additional frosting of a pipe beyond the valve should be investigated and workshop repair followed by tightness test considered.

In the case of power operated valves the connection for hydraulic oil and or compressed air shall be checked for leakage. The condition of the main valve hydraulic or air pipes on deck shall be checked for leakage.

The condition of the valve power system supply shall be checked, hydraulic aggregate unit, or cargo compressed air system, auxiliary systems such as stand by pumps, dryers etc shall be examined and tested. The alarms and shut down systems shall be tested for correct operation. The condition of the hydraulic oil shall be tested and records of such tests reviewed. If compressed air the dew point of the air shall be tested at the furthest point of the system. An ESD test shall be carried out and the timing of the closing of the valves checked.

4.1.15 Cargo Tank Spray System

During tank entry the spray rails should be examined as far as possible for damage, missing clamps or perhaps missing nozzles. A review of the cool down records should be made, if these are available.

4.1.16 Membrane Evacuation System

A visual examination of the pumps for general condition shall be made. The piping system shall be checked for corrosion and potential leaks. Special attention shall be paid to the pump exhaust and flame arrestors. An examination and functional test of the control systems, alarms and shut downs should be made.

4.1.17 Cofferdam Heating System

The heating system may consist of steam heating coils on older vessels or warm glycol circulation on more modern ships.

A general examination of the heating coils in the heated spaces shall be made for signs of leakage, corrosion, damaged or missing supports and clamps. A hydraulic test of the pipes should be considered if in doubt as to the integrity. Isolation valves shall be examined and steam traps checked. Gas detection on the steam drain lines shall be checked and functionally tested. Alarms and shutdowns shall be proven operational.

Glycol circulating pumps shall be examined and functionally tested, alarms and shut downs shall be tested and proven operational, motors shall be megger tested. Glycol heaters shall be examined and megger tested, if electric, if these are steam then the drains gas alarm shall be proven operational along with associated shut downs.

A functional test of the system shall be made.

4.1.18 Nitrogen System

The nitrogen system can be considered in different parts, production and storage, systems on deck for membrane/wedge spaces, gland sealing and fire extinguishing, and in the gas burning system for purging and inerting.

The production units shall be visually examined externally for general condition, compressors, stacks, piping, monitoring equipment and storage tanks. A functional and capacity test should be carried out to show proper operation special attention should be paid to the oxygen content of the gas produced. The storage tanks should be internally examined and the relief valves tested. Alarms and shut downs should be tested and proven operational.

The deck supply piping should be visually examined externally for corrosion and a sample of nitrogen taken from the farthest point in the system to confirm the oxygen content, the electrical bonding should also be checked.

The barrier space / wedge space pressure control system and valves for the tanks should be visually examined for general condition and leakage and should be functionally tested to prove correct operation. Alarms should be functionally tested and shut downs proven operational. The sealing supply system should be examined and functionally tested. The alarms and shut downs should be proven operational.

The purge piping and valves for the gas burning system should be examined for general condition. A functional test should be carried out to show correct operation. The alarms and gas burning shut downs due to low nitrogen pressure should be tested and found operational.

4.1.19 Inert Gas System

The Inert gas system, if fitted, should be visually examined for general condition of the generation plant, the cooling plant, the drying plant, and the pipework and fittings, both in the machinery spaces and on deck. The system should be functionally tested to ensure correct leak free operation and the ability to provide, dry inert gas of low oxygen content and dry air, to the deck. The safety systems and control systems should be tested and proven functional, the alarms and shut downs should be tested and proven operational.

The condition of the furnace, fuel system, controls and water supply should be checked, the condition of the cooler, refrigerant compressor condenser and normal refrigerant trips and alarms should be examined and functionally tested. The condition of the desiccant dryer should be assessed along with its ability to regenerate on the heating cycle. The final dew point should be measured at the end of the working cycle before change over to ensure that it is still satisfactory. The oxygen content monitor and alarm setting should be examined spanned and tested for proper operation and response to the alarm. The recirculation to the funnel at high oxygen content should be tested and proven operational. The IG piping and valves but especially those in the machinery spaces should be checked for condition corrosion and leakage. The non-return valves on deck shall be tested for operation. Valves, at random, in the IG/Dry Air lines to void spaces shall be checked for freedom.

4.1.20 Gas Detection system

There may be a central gas detection system, individual gas detector heads or both.

The system should be visually inspected for general condition and the availability of spare parts. The individual gas detector heads should be spanned and calibrated. The central detector should be spanned and calibrated and the alarms and shut downs proven operational. The results of the alarms on the cargo system should be checked to see if they are correct and that the right sequence operates. For the central system, the lines should be proven clear and leak free and the no flow alarms should be proven operational. Records of calibration and maintenance should be reviewed.

4.1.21 Custody Transfer System

A visual examination of the system including gauging system should be made. A functional test of the alarms such as high and low levels should be made. Operational testing should be carried out by the makers representatives.