

GENERAL SPECIFICATION

FIELD OPERATIONS

GS EP EXP 311

Plant integrity - Minimum inspection requirements
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03	10/2012	Addition of minimum inspection requirements for flexible hoses and life saving appliances
02	01/2012	Review of minimum inspection requirements for containers
01	01/2011	Review of minimum inspection requirements for storage tanks, gas cylinders and floating units
00	10/2009	Change of GS codification (old reference GS EP EXP 211) Classification societies' document references added
Rev.	Date	Purpose of the revision

Owning entity: OPS/EXP	Managing entity: OPS/EXP
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Contents

1. Objectives and scope	5
1.1 Objectives	5
1.2 Scope and application.....	5
2. Reference documents.....	6
3. Inspection principles	7
3.1 Inspection Phases in Projects and Operations	7
3.2 National Legislation.....	9
3.3 Risk Based Inspection.....	9
3.4 Floating Units Classification	9
4. Pressure Systems Equipment.....	11
4.1 Pressure Vessels	11
4.2 Heat Exchangers	14
4.3 Steam Boilers and Fired Heaters	17
4.4 Gas Cylinders	19
4.5 Piping.....	22
4.6 Flexible Hoses	24
4.7 Corrosion Monitoring.....	28
4.8 Pressure Safety Devices	28
4.9 Flares.....	31
5. Storage Tanks	34
5.1 Storage Tanks (fixed roof and floating roof)	34
5.2 LNG Cryogenic Tanks.....	36
6. Well Control Equipment.....	41
7. Surface structures	41
7.1 General.....	41
7.2 Inspection Strategy	41

8. Sub-sea structures	42
8.1 Offshore Jackets	42
8.2 Inshore or Swamp Sub-Sea Structures	45
8.3 Other Sub-Sea Structures and Equipment	47
9. Lifting equipment	47
9.1 General Lifting Equipment	47
9.2 Cranes and Forklifts	50
9.3 Drilling Related Lifting Equipment	53
10. Helicopter Refuelling Stations and Portable Tanks	53
10.1 Helicopter Refuelling Stations - Pressure System Inspection	53
10.2 Portable Tanks	53
11. Marine terminal facilities	55
11.1 Jetties	55
11.2 Loading Arms	57
11.3 Offloading Buoys	59
11.4 Offloading Hoses	62
12. Pipelines	64
12.1 General	64
12.2 Design Review	64
12.3 Inspection Strategy	65
13. Dynamic Riser Systems (deep offshore)	73
13.1 Top Tension Risers	73
13.2 Riser Towers	75
13.3 Steel Catenary Risers	78
13.4 Unbounded Flexible Risers and Pipelines	81
14. Subsea Umbilical Systems (deep offshore)	86
14.1 Dynamic Umbilical Sections	86
14.2 Static Umbilical Sections & Distribution Units	88

General Specification		GS EP EXP 311
Plant integrity - Minimum inspection requirements		
Rev.: 03	Effective date: 10/2012	Page: 4 of 113

15. Manifolds & foundations (deep offshore)	90
15.1 Design review	90
15.2 Inspection Strategy	91
16. Xmas Tree & Well Jumper (deep offshore)	94
16.1 Design review	94
16.2 Inspection Strategy	94
17. Oil Offloading Lines (deep offshore)	97
17.1 Design review	98
17.2 Inspection Strategy	98
18. Mooring Systems	99
18.1 Classification of Floating Units' mooring systems	100
18.2 Design review	100
18.3 Inspection Strategy	100
19. Floating Production and/or Storage Units	105
19.1 Classification Society requirements	105
19.2 Additional Company requirements	106
20. Life Saving Appliances	109
20.1 National legislation and international regulation	109
20.2 Inspection Strategy	109
20.3 Personnel and Qualification	109
20.4 Reports and Records	109
Bibliography	113

1. Objectives and scope

1.1 Objectives

This General Specification provides the basis for defining the minimum inspection requirements necessary to assure the integrity of plant and structures.

It is the responsibility of each operational subsidiary to determine and apply the optimum level of inspection to assure plant integrity and therefore these minimum requirements should only be seen as a safety net below which integrity standards shall never fall.

1.2 Scope and application

The scope of this document covers the following Plant and Structures:

- Pressure Systems (Pressure Vessels, Heat Exchangers, Steam Boilers, Fired heaters, Gas Cylinders, Piping, Pressure Safety Devices).
- Storage Tanks.
- Well Control and Drilling Equipment.
- Surface and Sub-Sea Structures.
- Lifting Equipment.
- Helicopter Refuelling Systems and Portable Tanks.
- Marine Terminal Facilities.
- Pipelines, Flowlines, Risers (including deep offshore facilities).
- Umbilical systems (deep offshore facilities).
- Manifolds, Xmas Tree, Well Jumpers (deep offshore facilities).
- Oil Offloading Lines (deep offshore facilities).
- Mooring Systems.
- Floating Production, Storage, Offloading Units.

The requirements of this document apply to:

- All new projects planned, designed and constructed by and for the Company.
- All oil and gas installations, operated by the Company.

Any deviation from the minimum inspection requirements stipulated hereafter must be cleared through a formal Request for Exemption.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
API 620	Design and Construction of Large, Welded, Low-Pressure Storage Tanks
API 653	Tank Inspection, Repair, Alteration and Reconstruction
CODRES Division 2	Recommendations for Maintenance of Vertical Cylindrical Storage Tanks
BS EN 12079	Offshore containers and associated lifting sets-Periodic inspection, examination and testing
EN 1968	Transportable gas cylinders. Periodic inspection and testing of seamless carbon steel gas cylinders.
EN 1802	Transportable gas cylinders. Periodic inspection and testing of seamless aluminium alloy gas cylinders.
EN 1803	Transportable gas cylinders. Periodic inspection and testing of welded carbon steel gas cylinders.
CAP 437	Offshore Helicopter Landing Areas: A guide to Criteria, Recommended Minimum Standards and Best Practice
ICAO	Annex 14 Volume II: heliports
DNV-RP-F206	Riser Integrity Management: Recommended Practices
OCIMF	Guidelines for the Handling, Storage, Inspection and Testing of Hoses in the field
Energy Institute	Guidelines for the management of Flexible Hose Assemblies

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP COR 002	Corrosion control on production facilities: Field operations
GS EP PLR 109	Design, fabrication and testing of submarine unbounded flexible pipes and risers

3. Inspection principles

3.1 Inspection Phases in Projects and Operations

All along this GS, the minimum inspection requirements in order to assure the equipment integrity are detailed in tables where the different types of inspection activities are described.

The different types of inspection are as follows:

- Construction Inspection.
- Installation, Commissioning & Baseline Inspection.
- First in-Service Inspection.
- Sub-sequent In-Service Inspections that can be split into:
 - Major (intrusive) inspection.
 - Intermediate (non-intrusive) inspection.

Complementary information on best practises for implementing these various inspections and interpreting their results are provided elsewhere in professional documents and Company Guides and Manuals.

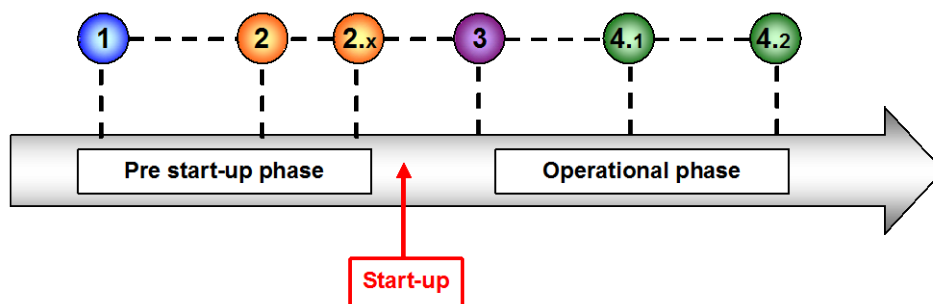
Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 8 of 113

The graphic below represents the inspection phases during the equipment lifespan.



1	Construction Inspection	QA / QC records	Purpose: to ensure that new equipment is manufactured and tested in accordance with the COMPANY Specifications and Design Codes. This is achieved by implementing an adequate Quality Assurance and Control (QA / QC) programme during the construction phase.
2	Commissioning and Baseline Inspection	Reference condition	Purpose: to ensure that the equipment is in accordance with as-built drawings. It should be seen as a final check prior to start-up that all works are complete and that the plant is ready for operation. The result of this inspection shall be used as a reference for future in-service inspections. It shall not be confused with the first in-service inspection.
3	First in-service Inspection	Essential step in the inspection programme	Purpose: to ensure both the design and manufacture of the equipment are compatible with the actual operating conditions experienced and any corrosion prevention is effective.
4	Subsequent in-service Inspection (intermediate and major)	Planned inspections	Purpose: to ensure the equipment remains in a condition fit for service and can be safely operated until the next inspection date. Major inspections should be visible in the Long-Term Plan of the asset as they have a significant impact on the business.
	Ad-hoc Inspection	Un-planned inspections	The Ad-hoc inspections will be carried out when specific event occurs. They can be planned when the opportunity arises like installation of new equipment, programmes shut-down. They can be triggered on unexpected event like defect observation, incident, environmental or 3rd party damage.

Requirements during the Project Phase (particularly for deep offshore developments):

Inspection strategies to be implemented in operation are influenced by the SOR (Statement of Requirements) established during the Project phase.

In particular:

- **Basic Engineering phase:** requirements for in-service monitoring activities shall be established for critical items.
- **EPCC phase:** Contractor shall design the monitoring systems to be installed according to the identified modes of failure, together with operating and maintenance recommendations from Manufacturers.

- **MIEC (Maintenance and Inspection Engineering Contract) phase:**

MIEC Contractor shall:

- Collect all relevant Technical Documents and Drawings issued by EPCC Contractors and Suppliers.
- Develop the Facility Inspection Plan according to this Specification.
- Participate in the commissioning of the monitoring systems and collect the Technical Records.
- Perform the Baseline Inspection.
- Develop the strategy for the management of monitored data during the operational phase (data collection and transfer, trend analyses, assessment studies, definition of correctives measures).

3.2 National Legislation

In many Countries National legislation may both dictate which items of plant are subject to statutory inspection and, the inspection programme which must be adhered to. In such cases the Head of Inspection-Corrosion **must** comply with these requirements to ensure the plant can operate within the law of the land.

In the case where there is a conflict between national legislation and this General Specification, it is the more stringent requirement that **must** apply.

In the case where national legislation falls short of these minimum Company inspection requirements, it is the Company's requirements that **must** apply.

3.3 Risk Based Inspection

In order to focus inspection effort in the most efficient manner, a Risk Based Inspection (RBI) approach may be elected by Company for certain specific categories of plant and structures. Where an approved formal Risk Based Inspection (RBI) approach is taken, its output replaces the minimum requirements specified in this General Specification.

However where an approved formal RBI approach is NOT applied then the minimum inspection requirements identified within this General Specification **must** be adhered to.

Attention is raised that an inspection plan designed according to RBI may be more stringent for some equipment and less for others depending on their criticality, than the requirements in this General Specification.

3.4 Floating Units Classification

Floating Units are submitted to Classification Society's Rules and International Maritime Conventions which may both dictate which items of plant are subject to third party inspection for certification purposes and the inspection programme which must be adhered to. In such cases the Head of Inspection-Corrosion **must** comply with these requirements to maintain the certificates.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 10 of 113

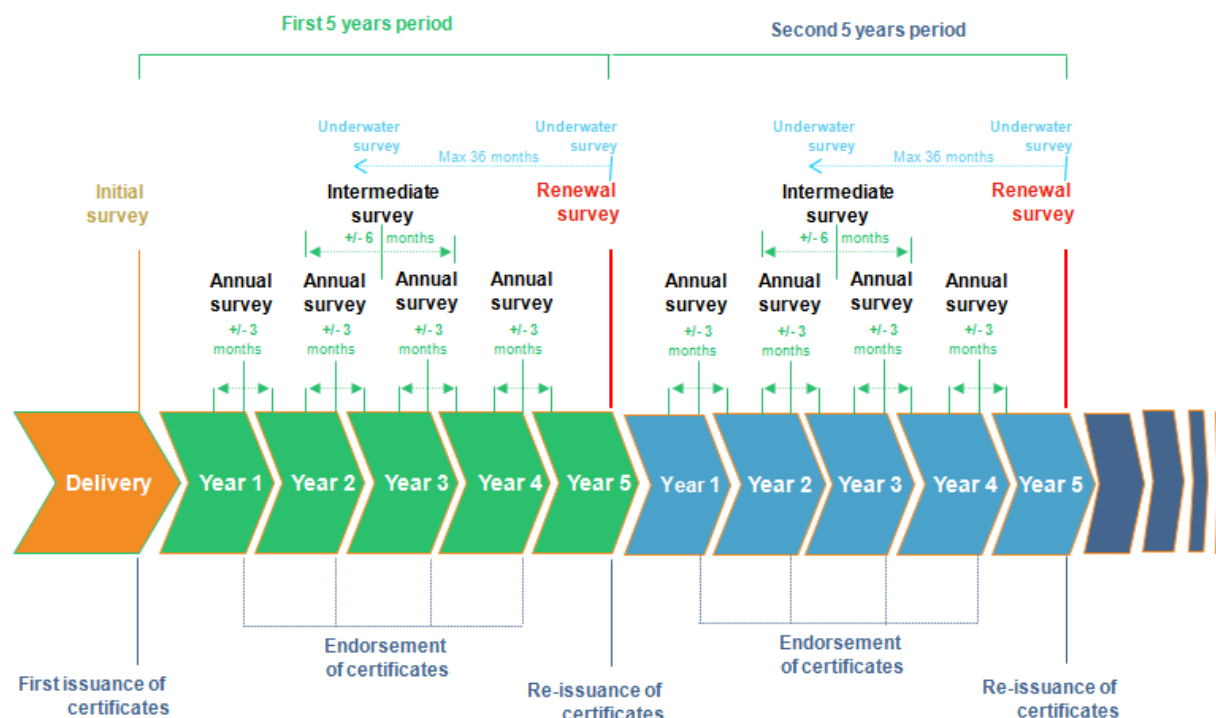
In the case where there is a conflict between Classification Society's Rules/International Maritime Conventions and this General Specification, it is the more stringent requirement that **must** apply.

The validity of certificates is subject to periodical surveys of structures, equipments and systems by the Classification Society:

- Annual survey.
- Intermediate survey.
- Renewal survey.
- Underwater survey.

The scope of any class survey depends upon the age and condition of the Floating Unit and associated equipments. The exact scope of class surveys is displayed in the Classification Society's Rules (e.g. for Floating Units classed with Bureau Veritas, the "BV Rules for the classification of Offshore Units" - NR 445 - shall apply).

The class periodical surveys are performed at the intervals laid down here after:



A Continuous Survey System is implemented in order to allow the Renewal survey to be spread over the 5 years cycle. Any given part or item under Continuous Survey shall be surveyed at least once during the 5 years cycle.

Classification Surveys are considered as "Third Party" Inspections and shall be included in the Company Inspection Plans.

4. Pressure Systems Equipment

Pressure Systems Equipment is the collective term for all Pressure Vessels, Heat Exchangers, Steam Boilers, Fired heaters, Gas Cylinders and their associated Piping and fitting including Pressure Safety Valves.

4.1 Pressure Vessels

4.1.1 General

For the purpose of this General Specification Pressure Vessels shall mean Unfired Pressure Vessel, Heat Exchangers and Boilers.

Process Tanks (excluding storage tanks on terminal facilities and structural tanks on Floating Units) are also considered in the scope of Pressure Vessels.

4.1.2 Design Assessment

All pressure vessels must be designed to allow internal inspection. Where physical entry is not possible due to the vessel size, 12" head-holes (as a minimum) should be fitted. Where vessels are large and complex (separators, columns, etc.) the provision of multiple manholes should be considered, in particular where vessel internals render thorough internal inspection difficult.

The design of pressure vessel insulation shall take into account the need for inspection access. Insulation for personnel protection shall be minimised and alternative means of protection such as guards and warning signs shall be provided where safety permits. This will both allow inspection and avoid under insulation corrosion which is a major industry concern.

On systems which must be insulated for process reasons, removable sections of insulation shall be designed and fitted to allow access to monitor internal corrosion. These shall be specifically positioned at areas most at risk such as boots, other low points, dead legs, areas of high flow areas, etc.

4.1.3 Inspection Strategy

The minimum inspection requirements to be applied to Pressure Vessels in general are given in Table 4.1.a (Table numbering identical to paragraph one)

They shall be used to prepare specific written schemes of examination (WSE) for each individual Pressure Vessel.

Internal inspection will clearly require the shutdown, isolation and depressurisation of the Pressure Vessel. This task will require detailed planning, preparation of isolation and spading procedures and the purchase of gaskets. Although this will normally be performed by production and maintenance/facilities engineering personnel, it shall be driven by the Inspection-Corrosion Department.

Vessel internals shall also be removed as necessary to facilitate internal inspection. Again this will need careful planning and preparation. For complex separators and columns this may involve many days of effort. It may also require the replacement of internal components like filter cartridges.

General Specification		GS EP EXP 311
Plant integrity - Minimum inspection requirements		
Rev.: 03	Effective date: 10/2012	Page: 12 of 113

Subsequent major or internal inspections shall be performed off-line both before and after any cleaning. The tasks to be carried out are the same as the ones during the first in-service inspection but frequency is different, as per Table 4.1.a.

4.1.4 Exceptions

- Where detailed internal inspection of Pressure Vessels is considered impossible or impractical or detrimental to safety or detrimental to the integrity of the vessel (some cryogenic equipment for example), their integrity MUST be proven by other means such as comprehensive NDE or pressure testing. Moreover, assistance and feedback from the Vendor will be taken into account to design the inspection strategy.
- Where Pressure Vessels are buried such as NGL Bullets, Cathodic Protection (CP) levels shall be monitored at a maximum frequency of three monthly. Internal inspections shall be performed as per non-buried vessels except that ultrasonic techniques shall be deployed internally to identify external corrosion. Acoustic Emission (AE) can be used as an alternative to internal inspection.
- Pressure vessels covered by Classification Society's Rules (e.g. compressed air bottles) are subject to internal inspection or pressure test at max 5 years intervals. The Class Surveyor must attend when opening or pressure testing classed pressure vessels.

4.1.5 Sample inspection

Sample inspection can apply for those items which contain:

- Non production water.
- Compressed air.
- Inert gas.
- Lube/synthetic oil.
- Non flammable heating/cooling fluids.
- Diesel.
- Or oil field chemicals.

These vessels do not have the complexity of process or utility vessels and are normally 'standard or off the shelf items' generally not designed to meet the specific requirements of a particular asset or oil Company. By principle, they are designed in the same way and are operated in similar condition. For inspection planning and management, such vessels will be grouped according to the effluent they are subjected to.

Generic WSE shall be prepared for such grouped vessels. Their inspection strategy is defined in Table 4.1b.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 13 of 113

Table 4.1.a - Pressure Vessels (General)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of Pressure Vessels shall be the responsibility of Project. This section is therefore limited to modification and repairs of Pressure Vessels. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Pressure Vessels. Any modification or repair shall be carried out in compliance with national legislation, international standards and/or Classification Society's Rules as applicable.			
Design Assessment	Before Start-up	R	As per paragraph 4.1.2
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before Start-up	R	
External General Visual Inspection and Photography		R	
Wall Thickness Measurements to verify nominal values and consistency with as-built drawings		R	Buried vessels: WT to be measured from the inside
Preparation of Vessel Inspection Drawings with inspection points.		R	
Internal General Visual Inspection and Photography	With Comm. Team	R	
Operational Phase			
First In-Service Inspection			
Detailed External Inspection of shell, nozzles, piping and trim, supports, foundations, associated access platforms and structures	Not > 2 years	R	
Wall Thickness Measurements (where internal corrosion is identified as a possible mode of failure) at key points on Shell and Nozzles		R	
Detailed Internal Inspection prior to any cleaning including the assessment and analysis of debris		R	Exceptions as per paragraph 4.1.4
Detailed Internal Inspection after any cleaning		R	
Surface NDT of internal seam welds and shell attachment welds		R	
Holiday detection of internal linings		R	
Removal of selected sections of insulation to identify Under Insulation Corrosion or Stress Corrosion Cracking Ad-hoc NDT when practicable		R	Only when operating conditions can trigger these damages
Where vessels are internally clad, Dye Penetrant on cladding seam and nozzle welds		R	
Subsequent In-Service Inspection (Intermediate)			
Detailed External Inspection of Shell, nozzles, piping and trim, supports, foundations, associated access platforms and structures	Not > 2 years	R	
Subsequent In-Service Inspection (Major)			
As per First In-Service Inspection	Not > 4 years	R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 14 of 113

Table 4.1.a - Pressure Vessels (General)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, leaks, plant upsets, extreme environmental events, etc.			
Where unexpected inspection results are reported which could affect other plant			

Table 4.1.b - Sample inspection

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
First In-Service Inspection			
ALL Vessels: GVI to identify external threats	Not >2 years	R	
33% of vessels: wall thickness checks on low spots and main inlet / outlet nozzles to determine internal threats		R	
Subsequent Major Inspections			
ALL Vessels: GVI	Not >4 years	R	Subsequent inspections shall alternate to other 33% of vessels
Another 33% of vessels: wall thickness checks on low spots and main inlet/ outlet nozzles		R	
Ad Hoc			
Scope to be determined by specific event	As required		

4.2 Heat Exchangers

4.2.1 General

Heat Exchangers are generally designed according to Pressure Vessel codes and sometimes complemented by an additional standard such as TEMA (Tubular Exchanger Manufacturers Association).

4.2.2 Inspection Strategy

In addition to the general requirements of Table 4.1, Heat Exchangers shall be subject to requirements as specified in Table 4.2 (a-e) depending on their individual design. It must be stressed that these requirements are in addition to and NOT as an alternative to the general requirements of Table 4.1.

What make exchangers unique from Pressure Vessels are their tubes or their plates. Depending on their structures, inspection tasks can be different for each type of heat exchanger.

Where corrosion is noted, Ad Hoc inspection has to be performed according to Table 4.2.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 15 of 113

In addition to external corrosion, exchanger tubes may be susceptible to fatigue cracking at tube sheets and impingement baffles, and fretting at baffle plates.

4.2.3 Exceptions

On those plate exchangers

- Which are not possible to dismantle.
- Or where dismantling/retightening may be detrimental to the integrity of the exchanger.
- Or where effluents on both sides are in the list of paragraph 4.1.5.

Inspection may be performed by a combination of borescope / fiberscope inspection, external inspection and pressure test in accordance with Vendor's instructions.

Table 4.2(a-e): ADDITIONAL requirements to Table 4.1

Table 4.2.a - Heat Exchangers - Fixed Tube sheet

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
First In-Service and Subsequent Major Inspections			
Internal inspection of tubes: - first, at tube ends by borescope / fiberscope - where corrosion or fretting is observed, Eddy Current or Internal Rotating Inspection System (IRIS) inspection of complete tubes	First in-service Not >2 years, Subsequent Not > 4 years	R	This will require the shutdown, isolation, depressurisation of the exchange and removal of channel end. Special cleaning may be required and this shall be performed by the inspection Vendor to avoid dispute
External inspection of tubes, impingement and baffle plates and internal shell		R	Removal of shell inlet and outlet piping
Check for: - cracking at tube sheet - cracking and fretting at baffle plates		R	
Leak test for exchanger tubes		R	
Leak test of gasket on gas part		G	
Ad Hoc			
Following poor thermal efficiency or leakage	As required		

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 16 of 113

Table 4.2.b - Heat Exchangers - Removable Bundle

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
First In-Service and Subsequent Major Inspections			
Internal inspection of tubes: - first, at tube ends by borescope / fiberscope - where corrosion or fretting is observed, Eddy Current or Internal Rotating Inspection System (IRIS) inspection of complete tubes	First in-service Not >2 years, Subsequent Not > 4 years	R	
External inspection of bundle and baffle plates Internal inspection of shell		R	Withdrawal of tube bundle from shell
Check for: - cracking at tube sheet - cracking and fretting at baffle plates		R	
Leak test for exchanger tubes		R	
Leak test of gasket on gas part		G	
Ad Hoc			
Following poor thermal efficiency or leakage	As required		

Table 4.2.c - Heat Exchangers - Air Coolers

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
First In-Service and Subsequent Major Inspections			
Internal inspection of tubes and header boxes: - first, at tube ends by borescope / fiberscope - where corrosion or fretting is observed, Eddy Current or Internal Rotating Inspection System (IRIS) inspection of complete tubes	First in-service Not >2 years, Subsequent Not > 4 years	R	Removal of header plugs (10%) Special cleaning may be required and this shall be performed by the inspection Vendor to avoid dispute
Ad Hoc			
Following poor thermal efficiency or leakage	As required		

Table 4.2.d - Heat Exchangers - Plate Type

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
First In-Service and Subsequent Major Inspections			
All plates shall be fully dismantled and thoroughly cleaned to allow detailed close visual inspection of the plates for pitting.	First in-service Not > 2 years, Subsequent Not > 4 years	G	Great care is needed to ensure the plates are correctly replaced and re-tightened to the correct position. Exceptions as per paragraph 4.2.3
Draw bolts shall be inspected for elongation by checking the overall length and using thread gauges. They shall also be checked for possible cracking.		G	
Ad Hoc			
Following poor thermal efficiency or leakage	As required		

Table 4.2.e - Heat Exchangers - Cryogenic

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
First In-Service and Subsequent Major Inspections			
Inspection programmes for specialist heat exchangers shall be prepared in conjunction with the Manufacturer's instructions	First in-service Not > 2 years, Subsequent Not > 4 years	R	
Ad Hoc			
Following poor thermal efficiency or leakage	As required		

4.3 Steam Boilers and Fired Heaters

4.3.1 General

Steam Boilers generally fall into two categories, Fire Tube or Water Tube. The majority of the Steam Boilers in use in the Oil and Gas Industry are Fire Tube where the heat source or fire is contained within the boiler tubes and the outer boiler shell is a pressure vessel. For the purpose of this referential Glycol regenerators shall be considered as Fire Tube Boilers (Table 4.3.a).

Large Water Tube Boilers are generally used for power generation but small "package" water tube boilers can also be found in the Oil and Gas Industry. Water tube boilers are normally gas or oil fired and the internal walls are lined with refractory brick (Table 4.3.b).

Fired heaters are normally used as part of oil or condensate stabilisation plant or glycol re-boiling. Their design is similar to a water tube boiler where heat is applied to the outer skin of the tubes and the process fluid is contained within the tubes.

Boilers and heaters can be dangerous! There have probably been more accidents relating to boilers than to any other single item of plant within a Pressure System. For this reason the inspection of boilers is heavily regulated in the majority of countries.

Because of this heavy regulation there is limited value in performing formal criticality assessment of Steam Boilers. However the criticality process should be run to identify the likely modes of failure and therefore the optimum inspection techniques. Frequency of inspection will almost always be determined by national legislation and Classification Society Rules as applicable.

4.3.2 Inspection Strategy

In addition to the general inspection requirements of Table 4.1, Steam Boilers and Fired Heaters shall be subject to requirements as specified in Table 4.3 (a-b) depending on their individual design. It must be stressed that these requirements are in addition to and NOT as an alternative to the general inspection requirements of Table 4.1.

It should be noted that steam boilers may be started-up long before the actual Oil and Gas Plant to provide steam for well clean-up or other utility services. The date of first in-service inspection shall therefore be 18 months from the **initial commissioning** of the boiler.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 18 of 113

Pressure Safety Valves (PSV's) are integral to the safety of steam boilers. Again it is likely that their inspection and overhaul is subject to national legislation and Classification Society Rules. Unless directed by more stringent legislation, Steam Boiler PSV's shall be subject to overhaul and inspection in coincidence with Major inspections to the Boiler.

4.3.3 Exceptions

Boilers covered by Classification Society's Rules are subject to internal inspection at max 2.5 years intervals. The Class Surveyor must attend when opening or pressure testing classed boilers.

Table 4.3(a-b): ADDITIONAL requirements to Table 4.1
Table 4.3.a - Steam Boilers - Fire Tube

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Inspection review			
Check for inspection requirements as per national legislation and Classification Society's Rules as applicable. In the case where there is a conflict between national legislation and this General Specification, it is the more stringent requirement that MUST apply.			
Continuous monitoring			
Feed water chemistry: oxygen content, pH	Daily	R	
Fuel gas composition	As Required	R	
Example of Classification Society's survey (according to BV Rules)			
Internal examination and functional test	Not > 30 months	R	BV Pt A, Ch 2, Sec 1.4.5
Additional Company Inspection			
First In-Service and Subsequent Major Inspections			
Detailed internal and external examination of the furnace chamber to identify overheating, deformation and cracking	Not > 18 Months from commissioning and Not > 36 Months thereafter	R	Exceptions as per paragraph 4.3.3
External visual examination of boiler tubes for blisters and other deformation together with wall thickness measurements		R	
Visual examination of stay tubes for elongation, buckling and deformation		R	
Partial removal of insulation to check for Corrosion Under Insulation		R	
Internal examination of exhaust/flue box structure and tubes		R	
Pressure Safety Valves: overhaul and inspection		R	
Subsequent In-Service Inspection (Intermediate)			
Detailed External Inspection of Shell, nozzles, piping and trim, supports, furnace, flue, foundations, associated access platforms and structures	Not > 18 Months	R	Including a 36 monthly partial removal of thermal insulation
Ad Hoc			
Following problems with the control of BFW and fuel gas supply	As Required		

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 19 of 113

Table 4.3.b - Steam Boilers - Water Tube Boilers, Fired Heaters and Reboilers

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Inspection review			
Check for inspection requirements as per national legislation and Classification Society's Rules as applicable. In the case where there is a conflict between national legislation and this General Specification, it is the more stringent requirement that MUST apply.			
Continuous monitoring			
Feed water chemistry: oxygen content, pH	Daily	R	
Fuel gas composition	As Required	R	
Example of Classification Society's survey (according to BV Rules)			
Internal examination and functional test	Not > 30 months	R	BV Pt A, Ch 2, Sec 1.4.5
Additional Company Inspection			
First In-Service and Subsequent Major Inspections			
Thermographic survey of outer shell to identify any damage to the refractory lining	Not > 18 Months from commissioning and Not > 36 Months thereafter	R	Exceptions as per paragraph 4.3.3
Detailed External and Internal examination of steam drums		R	
External visual examination of boiler tubes for blisters and other deformities		R	
Pressure test of steam coil		G	
Internal examination of exhaust/flue box structure and tubes		R	
Overall measurement of Fired heater and Reboiler tube bundle lengths to identify creep		R	
Ultrasonic Wall Thickness measurement of Fired heater and Reboiler tubes		R	
Pressure Safety Valves: overhaul and inspection		R	
Subsequent In-Service Inspection (Intermediate)			
Detailed External Inspection of Shell, nozzles, piping and trim, supports, furnace, flue, foundations, associated access platforms and structures	Not > 18 Months	R	
Ad Hoc			
Following problems with the control of BFW and fuel gas supply	As Required		

4.4 Gas Cylinders

4.4.1 General

Gas Cylinders are generally small, enclosed metal vessels used to store and transport compressed gases or gas liquefied under pressure. They are mainly used in the Oil and Gas Industry for storage of inerting and purging gas, testing gases, cutting, heating and welding gas.

Gas Cylinders may also be used as part of fixed fire fighting appliances and for the storage of air in breathing apparatus.

Sample Cylinders are also included within the scope of Gas Cylinders. They are used for the collection and transportation of various fluids and gases prior to laboratory analysis.

Air cylinders for diving breathing apparatus and portable fire extinguishers are not covered by this General Specification.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 20 of 113

Due to the large variety of usage, Gas Cylinders are managed by several actors within and outside a subsidiary: **in all cases the responsibility for the integrity and for the examination of all gas cylinders shall be formally agreed and recorded within each subsidiary.**

4.4.2 Rented Gas Cylinders

In the majority of cases Gas Cylinders used in the Oil and Gas Industry are rented from the Gas Supply Company. In this case it is the responsibility of the Gas Supply Company to inspect the Gas Cylinders they fill and supply and thus to assure their integrity.

Where Gas Cylinders are rented it shall be the responsibility of the Company to ensure that the supply VENDORS are performing their inspection duties. This shall be controlled by the Supply Contracts and Purchase Orders, by Company audit and by certification of incoming cylinders.

4.4.3 Company-owned Cylinders

For Company-owned cylinders, the Inspection Department shall be accountable for their inspection and integrity.

The initial task shall be the setting-up of a register of all Company owned cylinders and the safe storage of their original certification. Gas Cylinders shall either be registered by Serial Number or alternatively by allocated Tag Numbers.

The followings shall be recorded as a minimum: Manufacturer name and mark, original serial number and any other identification number, fabrication specification, maximum working pressure and original test pressure, tare weight, dates and details of any damage, date of initial manufacture, date of initial and subsequent inspection and nature of the contained gas.

4.4.4 Inspection Strategy

The minimum acceptable inspection requirements to be applied to Company-owned Gas Cylinders are given in Table 4.4.

Three categories of inspection shall be performed on Gas Cylinders:

- General Visual Examination at filling (the main objective is to detect any damage or corrosion on shell, threaded connections and fittings).
- Thorough Examination (detailed internal and external inspection).
- Hydro Testing (hydraulic pressure test).

Thorough Examination and Hydraulic Pressure test shall be performed in accordance with international Standards (European Standards [EN 1968](#), [EN 1802](#), [EN 1803](#) as relevant or equivalent), by a qualified competent Contractor, and audited by the Inspection Department.

Hydraulic Pressure testing will not apply for acetylene cylinders.

Note: survey and maintenance of fire-extinguishing equipment and systems on board Floating Units must be checked by service suppliers approved by the Classification Society.

4.4.5 Exemption for fixed fire-fighting systems

Gas Cylinders that are used for fire fighting purposes may be exempted from 5 yearly Thorough Examinations providing that they are subject to full external examinations every year. Subject to satisfactory annual external examinations and satisfactory drying facilities audit (CO₂ cylinders), the frequency of Thorough Examination and Pressure test may be extended to 20 years.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 21 of 113

However, Gas Cylinders that are used for fixed fire fighting purposes **on board Floating Units** shall be submitted to periodical tests by approved service suppliers at intervals not exceeding 10 years. At the 10-year inspection, at least 10% of the total number provided should be subject to an internal inspection and hydraulic pressure test. If one or more cylinders fail, a total of 50% of the onboard cylinders shall be tested. If further cylinders fail, all cylinders shall be tested.

Table 4.4 - Company-owned Gas Cylinders

Inspection Type/Integrity Tasks		When	Rule or Guidance	Comments
Pre Start-up Phase				
Construction Inspection				
Manufacture and hence QA of Gas Cylinders shall be the responsibility of Project. Gas Cylinders shall never be modified or repaired.				
Commissioning/Baseline Inspection				
Verification of Technical Records and Registration in Plant Inventory	Before Start-up	R	According to paragraph 4.4.3	
Wall Thickness Measurements to verify nominal values and consistency with as-built drawings		R		
Preparation of Written Scheme of Examination according to European Standard EN 1968, EN 1802, EN 1803 or equivalent		R	Including inspection drawing and insp. points	
Operational Phase				
Sample Cylinders				
External visual Inspection of shell, threaded connections and fittings	Prior to Filling	R		
Detailed Internal and external Inspection prior to any cleaning including the assessment and analysis of debris	Not > 3 years	R	As per paragraph 4.4.4	
Detailed Internal and external Inspection after any cleaning		R		
Wall Thickness Measurements (where internal corrosion is identified as a possible mode of failure)		R		
Thread Inspection using GO/NO GO Gauges		R		
Hydro Testing for 2 minutes < 130 litres capacity and 10 minutes > 130 litres capacity		R		
Gas Cylinders				
External visual Inspection of shell, threaded connections and fittings	Prior to Filling and Not > 1 year	R		
Detailed Internal and external Inspection prior to any cleaning including the assessment and analysis of debris	Not > 5 years for Corrosive Service or Permanent Liquefied Gas and Breathing Air Cyl. Not > 10 years for Non Corrosive Service	R	As per paragraph 4.4.4	
Detailed Internal and external Inspection after any cleaning		R		
Wall Thickness Measurements (where internal corrosion is identified as a possible mode of failure)		R		
Thread Inspection using GO/NO GO Gauges		R		
Tare Weight Test				
Hydro Testing for 2 minutes < 130 litres capacity and 10 minutes > 130 litres capacity	Not > 5 years for Corrosive Service or Permanent Liquefied Gas and Breathing Air Cyl.	R	Exemption conditions in paragraph 4.4.5	

Table 4.4 - Company-owned Gas Cylinders

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Hydro Testing for 2 minutes < 130 litres capacity and 10 minutes > 130 litres capacity	Not > 10 years for Non Corrosive Service	R	
Ad-Hoc			
Scope to be determined by specific event	As required		
Inspection Reviews			
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, leaks, etc.			
Where unexpected inspection results are reported which could affect other plant			

4.5 Piping

4.5.1 General

For the purpose of this General Specification, Piping shall mean all pipes, fittings, valves, supports but **excluding** Pipelines and Risers.

4.5.2 Design Assessment

4.5.2.1 Access

Piping requires extensive monitoring and therefore shall be installed at ground level. Where this is not possible due to equipment layout, access platforms shall be installed.

4.5.2.2 Investigation of welds

Selective internal corrosion of weld roots is a recognised problem in both hydrocarbon and water injection lines. Although this should be designed out by avoiding excessive velocities, balanced weld root metallurgy and effective chemical treatment, it remains a serious potential area of risk and as such shall be included in the inspection programme.

In order to facilitate future inspection of line weld roots, it is recommended that welds most at risk have their weld caps partially ground flush thus allowing monitoring of the root area by ultrasonic compression wave - this shall be done during fabrication.

4.5.2.3 Insulation design

The design of piping insulation shall take into account the need for inspection access. Insulation for personnel protection shall be minimised and alternative means of protection such as guards and warning signs shall be provided safety permits. This will allow both inspection and avoid corrosion under insulation which is a major industry concern.

On insulated piping systems which are susceptible to internal corrosion, there will be a need to routinely remove sections of insulation to facilitate inspection. In such cases consideration shall be given to incorporating removable sections of insulation into the initial design. These shall be specifically positioned at areas most at risk such as boots, other low points, dead legs, areas of high flow areas, etc.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 23 of 113

Note: where removal insulation sections are installed, care shall be taken to ensure such designs do not pose an additional risk to the piping integrity by allowing water ingress and subsequently Corrosion Under Insulation.

4.5.2.4 Piping supports

Piping supports often receive little design attention in relation to allowing water ingress especially where insulated or fitted with PFP. Commissioning inspection shall carefully address this matter.

4.5.2.5 Vibration review

Small bore pipework are locations where fatigue cracking is currently experienced, especially when they are fitted with heavy instrumentation equipment and located close to machinery. Piping where flow rate is high are critical as well.

It is strongly recommended that a vibration survey is carried out by a specialised Contractor during Commissioning in order to identify those small bore connections where resonance can take place and to implement preventative solutions at the early stage.

4.5.3 Inspection Strategy

The minimum inspection requirements to be applied to Piping are given in Table 4.5.

Table 4.5 - Piping Systems

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of piping systems shall be the responsibility of Project. This section is therefore limited to modification and repairs of piping systems. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Piping.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before Start-up	R	
Wall Thickness Measurements to verify nominal values and consistency with as-built drawings		R	
Preparation of piping isometric Inspection Drawings with inspection points.		R	
Preparation of Written Schemes of Examination		R	
Buried piping: witness Cathodic Protection baseline survey together with commissioning of impressed current transformer rectifiers		R	
Carry out a design review as per paragraph 4.5.2		G	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 24 of 113

Table 4.5 - Piping Systems

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
First In-Service Inspection			
Selective Internal Inspection of choke valves and adjacent downstream piping	As Required	G	Specific inspection programme should be prepared
Detailed External Inspection of piping, fittings, valves, supports, foundations and associated structures	Not > 2 years	R	Look for evidence of coating or insulation breakdown
Wall Thickness Measurements (where internal corrosion or erosion is identified as a possible mode of failure) at key points		R	
Surface NDE of Small Bore piping welds where vibration is observed		R	
Removal of selected sections of insulation to identify Corrosion Under Insulation or Stress Corrosion Cracking Ad-hoc NDT when practicable		R	Systematic inspection ports or windows are NOT recommended
Cathodic Protection (CP) survey of complete piping system, where applicable		R	
Subsequent In-Service Inspection (Intermediate)			
General External Inspection of piping, fittings, valves, supports, foundations and associated structures	Not > 2 years	R	
Subsequent In-Service Inspection (Major)			
As per First In-Service Inspection	Not > 4 years	R	
Internal and external examination of in-line Flame Arrestors (where fitted)			
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, leaks, plant upsets, extreme environmental events, etc.			
Where unexpected inspection results are reported which could affect other plant			

4.6 Flexible Hoses

4.6.1 Field of application

For the purpose of this General Specification, Flexible Hoses shall mean hoses assemblies such as rubber type reinforced with textile and wire, thermoplastic type, stainless steel braided, used for the following services:

- Hydrocarbon process and utilities, chemicals transfer.
- Bulk loading (methanol, diesel oil, water...),.
- Sampling.

- Hydraulic fluid.

This section does not apply to the following hoses:

- Flexible Risers and Flexible Jumpers.
- Oil Offloading Lines.
- Offloading Floating Hoses, Submarine Hoses.
- Breathing Apparatus hoses.
- Fire fighting hoses.
- Jet Fuel hoses.
- Instrument hoses.

Flexible hoses which are part of machine package (cranes, pumps, compressors, generators...) are not covered by this General Specification provided that they have management programmes developed by the manufacturer.

“[Guidelines for the management of flexible hose assemblies](#)” published by [Energy Institute](#) may be used as a reference for general recommendations related to design, supply, storage, handling, installation and commissioning of Flexible Hoses.

4.6.2 Supply and storage

Any new Flexible Hose shall be delivered with its certificate of conformance and pressure test certificate.

The Hose certificate shall include the following as a minimum:

- Manufacturer’s name.
- Manufacturer’s hose batch number.
- Date of manufacture.
- Nominal size (diameter, length).
- Materials.
- Design Pressure / Design Temperature.
- Test pressure.
- Service.

These data should be marked on the hose end-fittings.

Storage of Flexible Hoses shall be carried out according to Manufacturer recommendations, including recommendation for maximum storage life. Rubber type or thermoplastic type flexible hoses shall be protected from direct sunlight.

4.6.3 Installation

Any new Flexible Hose shall be submitted to the following verifications prior to first utilisation:

- Identification and registration.
- Conformance of hose certificate and marking.
- Adequacy of operating conditions against design conditions.
- Examination in order to check the condition of hose body and end-fittings.
- Verification of proper installation in order to make sure there is no over-bending, torsion, axial extension or compression.
- Verification of electrical and earth continuity if applicable.

4.6.4 Inspection Strategy

Inspection strategy applicable to Flexible Hoses is based on prescriptive requirements for periodic visual inspection and systematic replacement at pre-defined frequencies.

Minimum requirements are given in Table 4.6.

Frequencies for inspection and replacement are defined considering the following flexible hoses classification:

Service Conditions	Flexible Hose Class
Utilities ≤ 600# (non flammable fluids)	A
Utilities > 600# (non flammable fluids) Hydrocarbon / Chemicals ≤ 600#	B
Hydrocarbon / Chemicals > 600# Bulk loading hoses (methanol, diesel oil) Sampling hoses	C

4.6.5 Conditions for flexible hoses life extension

Replacement frequencies in Table 4.6 may be extended on condition that:

- A qualification programme formally validated by relevant TEC experts (PVV, PLR) has been successfully completed.
- A dedicated inspection plan has been developed and is duly implemented.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 27 of 113

Table 4.6 - Flexible Hoses

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Although the purchase of the initial Flexible Hoses shall be the responsibility of Project, replacement flexible hoses will require to be purchased by the subsidiary. It shall therefore be the responsibility of the Head of Inspection & Corrosion to provide inspection and Quality Control Support Services to the Procurement Department for the replacement purchase of any Flexible Hose. Individual Quality Plans shall be prepared for each Purchase Order.			
Repair or modification of flexible hoses is not permitted.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before Start-up	R	
Check for proper installation (over-bending, torsion, axial extension, axial compression not permitted)		R	
Check for electrical continuity if applicable		R	
Operational Phase			
Detailed visual inspection of flexible hoses over the full length, including hose body, end-fittings, supports and associated accessories. Verification of: - proper installation: over-bending, torsion, axial extension, axial compression are not permitted. - condition of hose body (outer cover or braid...): detection of bulge, crack, cut, kink, abrasion, corrosion, dents, broken braid wires. - condition of end fittings: detection of mechanical damage or corrosion. - electrical continuity when applicable.	Not > 1 year (Class C) Not > 2 years (Class B) Not > 3 years (Class A)	R	
Replacement of flexible hoses	Not > 6 years (Class C) Not > 8 years (Class B) Not > 10 years (Class A)	R	Replacement frequency may be extended on conditions defined in §4.6.5
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, leaks, plant upsets, extreme environmental events, etc.			
Where unexpected inspection results are reported which could affect other plant			

4.7 Corrosion Monitoring

It is the responsibility of the Head of Inspection-Corrosion to ensure that corrosion monitoring activities are implemented according to **GS EP COR 002**.

He will also ensure that:

Corrosion Monitoring readings and subsequent analysis are performed by either the Inspection-Corrosion Department or the Laboratory/Treatment Department.

The results of all corrosion monitoring are put together with all other inspection results to produce an overall consolidated assessment of corrosion and recommend changes as necessary to any treatment procedures.

4.8 Pressure Safety Devices

4.8.1 General

For the purpose of this General Specification Pressure Safety Devices shall mean Pressure Safety Valves (PSVs), and Bursting Discs. The term PSV shall include Pressure Safety Valves, Thermal Safety Valves, Stream Safety Valves, Relief Valves and Vacuum Breakers. Spill valves and relief valves integral to machine package and located on hydraulic systems shall be maintained along with their associated equipment under the responsibility of Maintenance Department.

4.8.2 Design Reviews

PSVs need to be overhauled on regular basis. Duplicate PSV with locked open isolation valves should therefore be installed on equipment that cannot be shutdown in normal production mode. This could be particularly important where PSV's inspection intervals do not fit associated equipment major inspection ones.

4.8.3 Inspection Strategy

The minimum inspection requirements to assure the safe operation of such devices are given in Table 4.6.

The minimum requirements specified in Table 4.6, together with national legislation **and** their service history shall then enable the formulation of a written scheme of examination for each PSV.

Prior to dismantling, PSV's shall be subject to a pre-pop test to determine how they would have performed in-service. The results of the pre-pop shall be recorded in the PSV overhaul report. A satisfactory test is one where the PSV lifts within +10% and -10% of set pressure. Since the pre-pop results will be used to partly determine the date of next inspection, care shall be taken whilst handling the PSV to ensure the condition at pre-pop remains representative of how it would have performed in-service.

If heavy fouling is observed when the PSV is removed, no pre-pop test shall be performed. In this case the pre-pop shall be automatically determined to be unacceptable. The nature of the fouling shall be investigated and measures taken to prevent future occurrences.

Following the pre-pop test, each PSV shall be dismantled and overhauled. Any damage to the valve body or any of its components shall be brought to the attention of the Inspection-

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 29 of 113

Corrosion Department. All consumable part shall be replaced and non-consumable parts replaced as necessary. A satisfactory PSV is one where the overall condition is good and no non-consumable spares are needed.

PSV's shall be reassembled, calibrated and function tested in the presence of the Inspection-Corrosion Department. The PSV overhaul report shall be prepared by the Valve Technician and signed off by the Inspection-Corrosion Department.

Unless a formal RBI Approach has been adopted, the date of next inspection shall be determined by the current interval modified by +/- One year depending of the observed condition and performance of the PSV during overhaul. When a PSV is found to be in a generally satisfactory condition, did not require non-consumable spares and performed satisfactorily during pre-pop, its date of next inspection shall be increased by one year up to a maximum ceiling value of four years where permitted by national legislation.

When a PSV is found to be in a generally poor condition, or required the replacement of non-consumable spares, or was found to be out with +10% and -10% of set pressure during pre-pop, its date of next inspection shall be reduced by one year down to a minimum of one year. When the condition of a PSV or its performance is found to be borderline, its overall interval of inspection shall remain the same.

In situ testing of PSV's such as Trevitest can be considered subject to the competence of the Contractor and their testing procedures. Adoption of such a strategy should be approved by EXP.

4.8.4 Exceptions for PSDs on systems covered by the Classification Society's Rules

On board Floating Units, Pressure Safety Devices belonging to classed systems in machinery spaces and storage area are subject to internal inspection and/or pressure test every 5 years.

The Class Surveyor must be informed prior to overhaul and calibration of classed Pressure Safety Devices.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 30 of 113

Table 4.6 - Pressure Safety Devices

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of Pressure Safety Devices shall be the responsibility of Project. This section is therefore limited to modification and repairs of Pressure Safety Devices. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Pressure Safety Devices.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before Start-up	R	
General External Visual Inspection		R	
Internal Visual Inspection and Witness of Function Test	With Comm. Team	R	
Operational Phase			
First In-Service Inspection (General PSVs)			
General External Inspection	Not > 2 years	R	Exceptions as per paragraph 4.8.4
Witness Pre Overhaul Test (pre-pop test)		R	
Internal Visual Inspection		R	
Witness Final Function Test		R	
Subsequent In-Service Inspection (General PSVs)			
As per First In-Service Inspection	Previous interval plus 1 year up to a max. of 4 years	R	Exceptions as per paragraph 4.8.4
First and Subsequent In-Service Inspection (Steam Boiler PSVs)			
As per general PSVs	Not > 18 Monthly	R	Date is fixed
First and Subsequent In-Service Inspection (Bursting Discs)			
General External Inspection	Not > 4 years	R	Date of Bursting Disc inspection may be extended based upon Manufacturer's recommendations for the specific service.
Internal Visual Inspection		R	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Damage assessment for replacement of bursting disc	Not > 10 years	R	
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, leaks, plant upsets, extreme environmental events, etc.			
Where unexpected inspection results are reported which could affect other plant			

4.9 Flares

4.9.1 General

Flare systems comprise of piping, pressure vessels, support structures, ignition systems and finally flare tips. Since the majority of these components are included within other sections of this General Specification, this section shall only focus on the inspection requirements for flare tips and its surrounding piping and structure.

4.9.2 Design Review

The repair and eventual change-out of flare tips is almost inevitable over the life of the field. Flare tips must therefore be designed to be replaced. The operation and test of flare tip replacement handling equipment shall therefore be tested as part of the flare pre-commissioning works. Since this will involve various items of lifting and structural equipment, the Head of Inspection-Corrosion Department shall pay special attention to this activity.

4.9.3 Inspection Strategy

Flare tips may be either atmospheric or sonic type. For either type the inspection strategy and frequency shall be the same. The minimum inspection requirements to assure the safe operation of Flare Tips and their associated components are given in

General Specification		GS EP EXP 311
Plant integrity - Minimum inspection requirements		
Rev.: 03	Effective date: 10/2012	Page: 32 of 113

Table 4.7 - Flares

For “Cold” Flares which do not continuously burn, detailed thorough inspections shall only be performed where a problem has been identified during in-service inspections.

Great care must be taken to assure any access structure including gratings and handrails are safe and suitable for use prior to performing the actual tip inspection. These preliminary structural inspections may be performed by specialist abseiling teams.

Once access to the flare tip is considered safe, it shall be thoroughly inspected both visually and by supplementary NDE. This shall include any equipment associated with flare tip handling. In situ repairs of lifting/handling points may be required PRIOR to the removal of the tip.

As part of any flare tip major inspection, in-line flame arrestors where fitted shall be dismantled to allow cleaning and internal examination.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 33 of 113

Table 4.7 - Flares

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of Flares shall be the responsibility of Project. This section is therefore limited to modification and repairs of Flares. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Flares.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before Start-up	R	
External General Visual Inspection and Photography	With Comm. Team	R	
Witness commissioning and function test of flare tip change-out handling equipment		R	
Preparation of Vessel Inspection Drawings with inspection points	Before Start-up	R	
Operational Phase			
First In-Service Inspection			
Detailed External Visual of support structure, floor grating, ladders and handrails.	Prior to any inspection	R	Done during plant shutdowns
Internal and external examination of in-line Flame Arrestors (where fitted)	Within 2 years	R	
Thorough visual examination of flare tip including measurement of any damage or distortion noted		R	
Surface NDT of flare tip welds and major support structure welds		R	
Visual inspection of refractory tiles where applicable		R	
Visual inspection associated pilot and ignition equipment		R	
Subsequent In-Service Inspection (Intermediate)			
Remote Visual Inspection using binoculars or telescopic equipment	Not > yearly	R	Helicopter can be used if access is insufficient to confirm defects
Subsequent In-Service Inspection (Major)			
As per First In-Service Inspection	Not > 4 years	R	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, leaks, plant upsets, major plat blow-downs, extreme environmental events, etc.			
Where unexpected inspection results are reported which could affect other plant			

5. Storage Tanks

For the purpose of this General Specification, Storage Tanks include Fixed Roof Tanks, Floating Roof Tanks and Cryogenic Tanks for storage function on onshore terminal facilities.

Structural Tanks on Floating Units are not in the scope of this section; they are covered by paragraph 19.

Inspection specifications applicable to LNG Cryogenic Tanks are given in paragraph 5.2.

5.1 Storage Tanks (fixed roof and floating roof)

The inspection strategy applicable to Storage Tanks (fixed roof and floating roof) is based on the following periodic tasks:

- Routine in-service surveillance.
- External Inspection (Intermediate External inspection and Major External Inspection).
- Internal Inspection.

Checklists for visual inspection (external and internal) are defined referring to the following codes: [API 653](#) (appendix C) or [CODRES Division 2](#).

5.1.1 Routine in-service surveillance

Routine in-service surveillance is under the responsibility of Operators.

The checks to be performed as part of the routine in-service surveillance are detailed in a dedicated Guide.

5.1.2 External Inspection

External inspections are performed when the tank is in operation.

Two categories of external inspections are defined:

- Intermediate External Inspection.
- Major External Inspection.

Refer to Table 5.1 for the detailed scope of these external inspections.

The scope of Major External Inspection is reinforced in order to assess the general condition of the tank and to anticipate the works to be carried out during the next overhaul.

In addition, the inspection data and findings resulting from the Major External Inspection will be assessed in view of optimizing the interval for the next Internal Inspection / Overhaul as specified here after.

5.1.3 Internal Inspection

5.1.3.1 Interval for Internal Inspection

The interval for Internal Inspection and Overhaul shall not exceed 10 years as a base case.

Plant integrity - Minimum inspection requirements

Rev.: 03

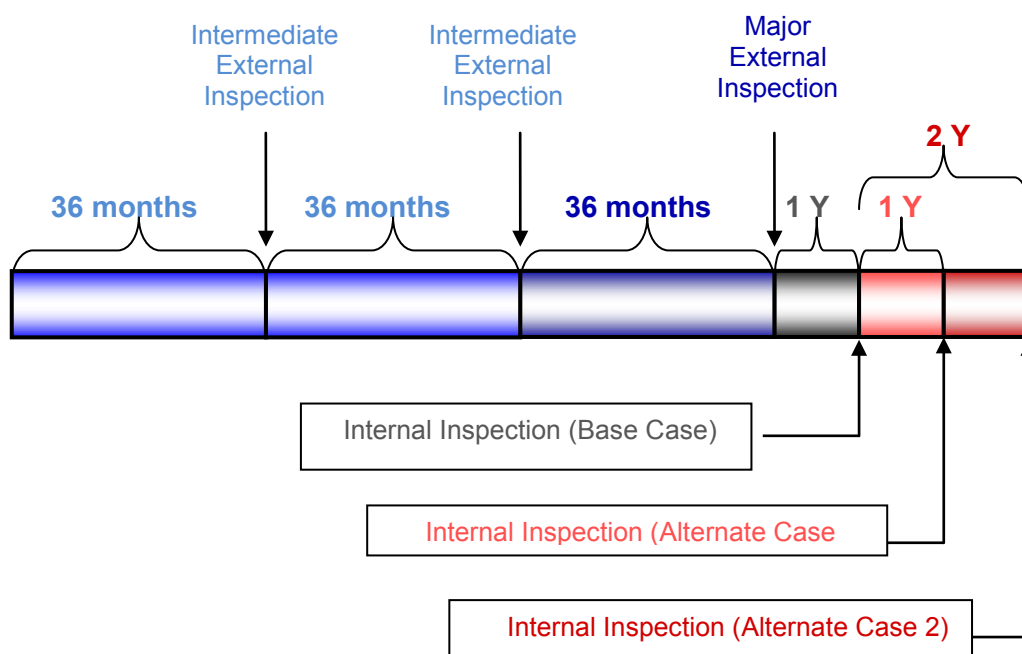
Effective date: 10/2012

Page: 35 of 113

Alternatively, the optimization of the internal inspection interval may be considered, subject to the following conditions:

- The scope of the Major External Inspection shall be fully completed in time as per **Table 5.1** including Acoustic Emission.
- A formal Technical Review shall be performed based on the inspection data and findings resulting from the Major External Inspection. Specific attention shall be paid to the evaluation of the floor plating corrosion rate. The Technical Review shall be formally validated by the Head of Inspection.
- The maximum interval to be considered shall be 12 years based upon satisfactory Major External Inspection findings and depending on the Technical Review conclusions.

This prescriptive inspection strategy applicable to storage tanks is illustrated by the graphic below, considering Base Case (10 years), Alternate Case 1 (11 years) or Alternate Case 2 (12 years):



5.1.3.2 Preparation for Internal Inspection

Preparation procedures shall include extensive cleaning together with safe removal and disposal of the tank debris. It is recommended that a tank debris survey is undertaken prior to commencement of the intervention work to select the optimum cleaning and disposal strategy. Sampling of deposit should be carried out prior to cleaning as well.

Preparation works must also involve the overhaul of vacuum breakers, flame arrestors, roof seals, water drainage system, fire fighting system and the replacement of anodes and coatings. The provision for procurement and replacement of floor plates should be considered.

For floating roof tanks the integrity of roof supports and the dryness of roof buoyancy spaces shall be confirmed as part of the preparatory works.

The preparation of Tank internal inspection and overhaul will require detailed scope of work, planning, preparation of isolation and spading procedures and the purchase of gaskets and spare parts. Although this will normally be performed by production and maintenance/facilities engineering personnel, it shall be driven by the Inspection-Corrosion Department.

5.1.3.3 Scope of Internal Inspection

Refer to Table 5.1 for the detailed scope of Internal Inspection.

5.2 LNG Cryogenic Tanks

5.2.1 Design review

LNG Cryogenic Tanks are typically designed with inner metallic tank for containment, outer concrete shell for protection and thermal insulation in between.

Materials are selected with regards to resilience properties in order to suit the low operating temperature (-160°C).

Design and construction of LNG Cryogenic Tanks shall be carefully performed referring to the relevant international codes and standards (API 620 or equivalent), applying a stringent QA/QC system, in order to ensure permanent operation during the whole life cycle.

Specific attention shall be paid to the design and construction of the soil heating system in order to ensure reliability and availability.

5.2.2 Inspection Strategy

Due to the operating conditions (very low temperature, low pressure, non corrosive fluids, steady conditions), there is no degradation modes to be considered in operation such as:

- Internal corrosion.
- External corrosion (atmospheric corrosion or Corrosion Under Insulation).
- Fatigue.

However, shutdown operations are critical for LNG Cryogenic Tanks due to the following reasons:

- Warm-up / cool-down phases will induce thermal stress (expansion / contraction) on tank floor.
- Any condensed water remaining when cooling down for start-up will produce ice blocks which may cause damage and dysfunctions in the system.

In addition, shutdown operations require several weeks for the sole process of shutdown / isolation / warm-up / inerting / cool-down / start-up with a strong impact on the tank availability.

As a consequence, considering the following:

- Low benefit expected from internal inspections (no degradation mode identified).
- High constraints and potential damage associated with shutdown operations.

The inspection strategy for LNG Cryogenic Tanks does not include **periodic** internal inspections.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 37 of 113

However, in order to allow **ad-hoc** internal inspection if needed, it is recommended to consider at early stage of design, the capability for performing intrusive inspection with a cryogenic camera: particular specifications for appropriate nozzles and access platforms on tank roof shall be developed during engineering.

As a summary, inspection strategy for LNG Cryogenic Tanks shall be based on the following periodic tasks:

- Routine in-service surveillance.
- External Visual Inspection.
- Thermographic survey in order to detect any thermal leak due to thermal insulation damage.
- Tank foundation measurement (tanks settlement measurement, shell verticality measurement) in order to monitor the soil stability.

Note: specifications for planned maintenance on cryogenic tanks and associated equipment such as LNG pumps, soil heating system, safety devices, etc, are not in the scope of this General Specification.

The minimum inspection requirements for LNG Cryogenic Tanks are summarized in Table 5.2.

Table 5.1 - Storage Tanks (fixed or floating roof)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of Tanks shall be the responsibility of Project. This section is therefore limited to modification and repairs of Tanks. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Tanks.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before Start-up	R	
External General Visual Inspection and Photography		R	
GVI and compliance verification of retention pond		R	
Preparation of Tank Inspection drawings with inspection points reported on shell, floor and roof		R	
Wall Thickness Measurements of walls and floor to verify nominal values and consistency with as-built drawings	With Commissioning Team	R	
Confirm operation of atmospheric vents, flame arrestors and vacuum breakers		R	
Internal General Visual Inspection and Photography		R	
Tank foundation and tank settlement measurement. Shell plumbness (verticality). Shell roundness		R	
Witness Cathodic Protection baseline survey together with commissioning of impressed current transformer rectifiers or sacrificial anodes		R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 38 of 113

Table 5.1 - Storage Tanks (fixed or floating roof)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
Routine in-service surveillance			
As per check-list defined in a dedicated guide, with particular attention to the following: Confirm operation and absence of debris for atmospheric vents, flame arrestors and vacuum breakers Confirm operation and absence of debris for roof drains		R	To be performed by Production or Maintenance
Continuous monitoring			
Impressed current CP system: measure and analyse transformer / rectifier output (U/ I trend)	Not > 2 weekly	R	
Intermediate External Inspection			
<u>Visual:</u> as per check-list in API 653 (appendix C) or CODRES Division 2 As part of this check-list, check general condition of: - Access to tanks (platforms, stairs, ladders, handrails...) - Tank foundation, bottom annular ring to foundation support, settlement - Tank shoe plates, bottom annular plates, shell to floor weld, bolting - Shell plates - Shell appurtenances, Manholes, Nozzles, Piping - Tank Roof plates - Roof appurtenances, roof drains, roof seal - For floating roof: - check absence of liquid in buoyancy spaces, - check level of floating roof (uneven level) - Confirm operation and absence of debris for roof drains - Confirm operation and absence of debris for atmospheric vents, flame arrestors and vacuum breakers - Earth connections - Retention pond ...	Not > 3 years	R	
<u>Wall thickness measurements (UT scanning 150x150 mm areas):</u> - First shell plates (water level) - Bottom annular plates - All nozzles and manholes located on first shell - Fixed roof plates accessible from access platforms	Not > 3 years	R	
<u>Tank foundation:</u> Shell settlement measurement in accordance with API 653 (appendix B)	Not > 3 years	R	To be performed during first in-service inspection
<u>Shell plumbness (verticality) and shell roundness</u>	Not > 3 years	R	To be performed during first in-service inspection

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 39 of 113

Table 5.1 - Storage Tanks (fixed or floating roof)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Major External Inspection			
<u>Visual:</u> As per Intermediate External Inspection	Not > 9 years	R	
<u>Wall thickness measurements (UT scanning 150x150 mm areas):</u> As per Intermediate External Inspection	Not > 9 years	R	
<u>Tank foundation:</u> Shell settlement measurement in accordance with API 653 (appendix B)	Not > 9 years	R	
<u>Shell plumbness (verticality) and shell roundness</u>	Not > 9 years	G	
<u>Acoustic Emission</u> Acoustic Emission (AE) of tank floor to detect and locate any active corrosion or leakage	Not > 9 years	G	AE is part of the deferral conditions as per paragraph 5.1.3.1
Internal Inspection (Major Inspection internal + external)			
<u>External visual:</u> as per Intermediate External Inspection	Base Case: Not > 10 years Alternate Case: Not > 12 years subject to deferral conditions as per paragraph 5.1.3.1	R	
<u>Internal visual:</u> as per check-list in API 653 (appendix C) or CODRES Division 2 As part of this check-list, check general condition of: - Access to tanks - Tank floor - Shell - Shell appurtenances, Manholes, Nozzles, Piping - Draining pipes - Tank roof including buoyancy spaces - Roof appurtenances, drains...		R	
<u>Tank floor inspection:</u> - Wall thickness measurement with MFL floor scan or equivalent for 100% of floor plates - Wall thickness UT scanning on suspected areas including draining wells/sumps and draining pipes - Check for cracking on 100% of shell to floor weld (ACFM or equivalent) - Check for cracking on suspected floor plates welds such as bulges areas and plates under legs (ACFM or vacuum box or MPI/DPI) - Assess depletion of sacrificial anodes in order to anticipate retrofitting - Check internal coating by Haliday test (as applicable)		R	
<u>Tank floor settlement measurement</u> Edge settlement measurement, Bottom depressions or bulges in accordance with API 653 (appendix B)		R	
Overhaul of vacuum breakers, flame arrestors Overhaul of fire-fighting system, water drainage system Overhaul of roof seals		R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 40 of 113

Table 5.2 - LNG Cryogenic Tanks

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of Tanks shall be the responsibility of Project. This section is therefore limited to modification and repairs of Tanks. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Tanks.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before Start-up	R	
Internal and external General visual inspection and photography during civil work, structure erection, floor, shell and roof welding progress and insulation (perlite) filling.		R	
Wall Thickness Measurements of metallic shell, roof and floor to verify nominal values and consistency with as-built drawings	With Commissioning Team	R	
Confirm operation of atmospheric vents, flame arrestors and vacuum breakers		R	
Internal General Visual Inspection and Photography before and after hydraulic testing and before final closure.		R	
Tank foundation and tank settlement measurement. Shell plumbness (verticality). Shell roundness		R	
Witness Cathodic Protection baseline survey together with commissioning for impressed current transformer rectifiers		R	
Routine in-service surveillance			
As per check-list defined in a dedicated guide		R	To be performed by Production /Maintenance
Continuous monitoring			
Impressed current CP system: measure and analyse transformer / rectifier output (U/ I trend)	Not > 2 weekly	R	
External Visual Inspection			
Check general condition of: - Access to tanks (platforms, stairs, ladders, handrails...) and structures - Tank foundation, bottom slab - Concrete shell - Nozzles, Piping - Appurtenances	Not > 3 years	R	
Thermographic Survey			
Thermographic survey (Infra Red camera) of outer shell to identify any thermal leak due to insulation damage	Not > 3 years	R	
Tank foundation			
Shell settlement measurement, Shell plumbness (verticality)	Not > 3 years	R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 41 of 113

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Inspection Reviews			
Following a significant change in the operating parameters or the environment		R	
Following abnormal incidents such as damage, cracks apparition in concrete shell, plant upsets, extreme environmental events, etc.		R	

6. Well Control Equipment

For the purpose of this General Specification, Well Control Equipment shall include all surface control equipment up to and including the Xmas Tree.

Due to its critical nature, all Well Control Equipment shall be subject to fixed prescriptive inspection and test.

Surface Wellheads and Xmas Trees (Surface Barriers), after transfer from Drilling to Field Operations shall be subject to regular tests and inspection.

While the integrity of drilling equipment is under the responsibility of Drilling and Logistic Departments and the integrity of well control equipment is under the responsibility of Production/Completion Departments, some elements of inspection may be delegated to the Inspection Department. The responsibility for integrity of drilling and well control equipment shall be formally agreed & recorded within each subsidiary.

7. Surface structures

7.1 General

Surface structures whether installed onshore or offshore shall be classified under three categories based upon their importance and their consequence of failure:

- Primary Structures (Special and First Category) - Deck and module main and secondary girders, columns, gantries, flare stacks, crane pedestals and booms, helidecks, drilling derricks, etc.
- Secondary Structures (Second Category) - Stiffening elements, supports, pipe racks and all structural elements not considered as primary
- Tertiary Structures (Non Structural) - Catwalks, hand-rails, stairs, ladders, grating, flooring, etc.

The Structural Engineering Department based either in the subsidiaries or the Head Office shall be responsible for holding and maintaining up to date the topsides structural design model together with the weight control model. These models shall be used to identify the most critical members and joints within the structure. The Head of Inspection-Corrosion Dept in conjunction with the Senior Structural Engineer shall prepare an inspection programme based upon the structural loading.

7.2 Inspection Strategy

Although detailed inspection shall be focused on primary structures, routine general visual inspections shall be performed on all structures in accordance with the minimum acceptance requirements given in Table 7.1.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 42 of 113

For surface structures on board Floating Units which are covered by the Classification Society's Rules, refer to **section 19** of this General Specification.

Table 7.1 - Surface Structures

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of surface structures shall be the responsibility of Project. This section is therefore limited to modification and repairs of surface structures. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Structures.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory.	Before Start-up	R	
Pre float-out General Visual Inspection of complete structure	Before Float-out	R	Performed at fabrication site
Comprehensive pre float-out photographic survey		R	Performed at fabrication site
Preparation of Inspection Drawings with component identification	Before Start-up	R	
Operational Phase			
First In-Service Inspection			
General Visual Inspection of complete structure	Within One year of Topsides Installation	R	Normally performed by abseiling techniques
Subsequent In-Service Inspection (Intermediate)			
General Visual Inspection of Tertiary Structure (assures personnel safety)	Not > 1 yearly	R	Pay particular attention to the splash zone area
General Visual Inspection of complete structure	Not > 2 yearly	R	
Subsequent In-Service Inspection (Major)			
Surface NDE (normally Eddy Current) of critical atmospheric structural welds	Not > 5 yearly	R	Defects shall be verified by MPE prior to repair
Ad-Hoc			
Scope to be determined by specific event	As Required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events, dropped objects, vessel collisions, observed damage, and changes in platform loading			

8. Sub-sea structures

8.1 Offshore Jackets

8.1.1 General

The Structural Engineering Department based either in the subsidiaries or the Head Office shall be responsible for holding and maintaining up to date the jacket structural design model together with the weight control model. The Head of inspection-Corrosion Dept in conjunction

with the Senior Structural Engineer shall prepare an inspection programmed based upon the structural loading.

The above models shall be used to identify the most critical members and joints within the structure. These members may be critical because of a high degree of functionality or because of a high level of stress, low-cycle fatigue or because they contain a joint which was repaired at the fabrication yard.

The output from criticality assessments or the minimum requirements specified in Table 8.1, together with national legislation shall then enable the formulation of a written scheme of examination for each offshore jacket.

8.1.2 Design Review

The jacket design shall compensate for areas such as piles sleeves and splash zones which are unable to be inspected. Nodes and riser clamps shall avoid these areas if at all possible.

Since Flooded Member Detection (FMD) is the preferred means of jacket inspection, all members should normally be designed as non-flooded. Where flooded or grouted members are incorporated in the design specific studies shall be undertaken to determine how they will be inspected in-service.

Pressio-detection may be used as an alternative to FMD. Such systems must obviously be incorporated into the original jacket design but offer the advantage of remote monitoring.

For large jackets where ROV surveys are deemed to be the primary sub-sea inspection tools, provision shall be made on the topsides for an ROV lay-down area with suitable power and services.

In areas of harsh operational environments such as the North Sea, facilities to monitor the actual environmental conditions may be installed on representative structures. These could then be used to validate and fine tune the structural loading and thereafter determine the most suitable inspection programme.

8.1.3 Inspection Strategy

The minimum acceptable inspection requirements to be applied to Offshore Jackets are given in Table 8.1.

Where excessive marine growth is noted, consideration shall be given to the installation of marine growth removal/prevention equipment but their performance will be linked to the specific local environment. Trial installations are recommended before any large-scale implementation is performed. Marine Growth cleaning may be necessary to facilitate effective inspection especially on critical components such as riser clamps and welds.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 44 of 113

Table 8.1 - Sub-Sea Structures - Offshore Jackets

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of jackets shall be the responsibility of Project. This section is therefore limited to modification and repairs of jackets. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Structures.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory.	Before Start-up	R	
Pre float-out General Visual Inspection of complete jacket plus all appurtenances	Before Float-out	R	Performed at fabrication site
Comprehensive pre float-out photographic survey		R	Performed at fabrication site
Preparation of Inspection Drawings with component identification		R	
Witness commissioning of Meteorological and Meteocean monitoring equipment.	Before Start-up		
Measurement and confirmation of Air Gap between topsides and LAT, Platform level survey, and Conformation of as-installed weight, Centre of Gravity and jacket loading		R	Performed by jacket installation CONTRACTOR and witnessed by Inspection-Corrosion Dept.
Scour survey at jacket legs/pile sleeves	After Piling	R	
Post installation General Visual Inspection of complete jacket plus all appurtenances - Inspection normally performed using an ROV and recorded on video tape		R	
Operational Phase			
First In-Service Inspection			
General Visual Inspection of complete sub-sea and atmospheric section of jacket plus all appurtenances and other sub-sea and atmospheric components: primary, secondary and tertiary structure, risers, J tubes, caissons, conductors and their associated supports	Within One year from Topsides Installation	R	Inspection normally performed using an ROV or divers with head mounted video cameras. Records on video tapes
Cathodic Protection (CP) survey of complete sub-sea section of jacket plus all appurtenances and other sub-sea components including risers:		R	Atmospheric jacket sections surveyed using abseiling techniques.
potential and anode consumption measurements			Where dropped objects are found, members above shall be checked for damage.
Seabed survey for debris or dropped objects		R	
Scour survey at jacket legs/pile sleeves		R	
Where installed, download and analysis of Meteorological and Meteocean and comparison with design parameters.			
Measurement and confirmation of Air Gap between topsides and LAT		R	
Platform differential settlement/level survey		R	
Comparison of present weight, Centre of Gravity and jacket loading Vs as-installed conditions		R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 45 of 113

Table 8.1 - Sub-Sea Structures - Offshore Jackets

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Subsequent In-Service Inspection (Intermediate)			
General Visual Inspection of complete atmospheric section of jacket plus all appurtenances and other surface components: primary, secondary and tertiary structure, risers, J tubes, caissons, conductors and their associated supports	Not > yearly	R	
Subsequent In-Service Inspection (Major)			
As per First In-Service Inspection	Not > 2 yearly	R	Frequency of Major Inspection may be extended to 5 yearly on platforms operating in a benign environment and have no history of structural damage. To be removed when in excess wrt design Inspection frequency may be extended subject to criticality assessment studies. May be waived: - if FMD is performed 2 yearly - or on completion of a detailed criticality assessment.
FMD survey or alternatively pressio-detection of all members and appurtenances where applicable			
Marine growth survey and assessment			
Surface NDE (normally Eddy Current) of critical atmospheric structural welds			
NDE (either MPE, Eddy Current or ACFM) of critical sub-surface structural welds			
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Platform stability survey: Platform level/settlement survey, measurement of the air gap and audit of the weight control process.	Not > 2 yearly	R	
Formal review of the following parameters: environment conditions (changes in wind and wave loading), excessive marine growth, dropped objects, vessel collisions, observed damage, changes in platform loading such as addition or redistribution of weight, reduction in air gap, differential settlement	Not > 5 yearly	R	The original jacket design model shall be revised accordingly and re-run. Output from this model shall be used to update the written scheme of examination as necessary.
Following a significant change in the above	As required	N/A	

8.2 Inshore or Swamp Sub-Sea Structures

8.2.1 General

Unlike Offshore structures, inshore or swamp sub-sea structures are normally relatively small and of simple design, subject to light loading and are almost always unmanned. Both the probability and consequence of failure are therefore of a difference order to that of Offshore Structures hence they are subject to significantly different inspection requirements to assure their integrity.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 46 of 113

8.2.2 Inspection Strategy

The minimum inspection requirements to be applied to Inshore Structures are given in Table 8.2. These requirements have been prepared for jackets installed in inshore or swamp environments and must not be applied for Offshore Structures.

Written schemes of examination shall be based upon the minimum requirements given within Table 8.2 together with national legislation.

Where excessive marine growth is noted, this shall be expertly assessed following each inspection to assess its effect on structural loading. Consideration shall be given to the installation of marine growth removal/prevention equipment.

Table 8.2 - Sub-Sea Structures - Inshore and Swamp Structures

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of inshore jackets shall be the responsibility of Project. This section is therefore limited to modification and repairs of inshore jackets. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Structures.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory.	Before Start-up	R	
Pre float-out General Visual Inspection of complete structure plus all appurtenances	Before Float-out	R	Performed at fabrication site
Comprehensive pre float-out photographic survey		R	Performed at fabrication site
Preparation of Inspection Drawings with component identification		R	
Measurement and confirmation of Air Gap between topsides and LAT, Platform level suvey, and Conformation of as-installed weight, Centre of Gravity and jacket loading	Before Start-up	R	Performed by jacket installation CONTRACTOR and witnessed by Integrity Dept.
Scour survey at jacket legs/pile sleeves	After Piling	R	
Post installation General Visual Inspection of complete structure plus all appurtenances		R	
Operational Phase			
First In-Service Inspection			
General Visual Inspection of complete sub-sea and atmospheric section of jacket plus all appurtenances and other sub-sea and atmospheric components	After One year from Topsides Installation	R	Normally performed by abseiling techniques at low tide.
Cathodic Protection (CP) of complete sub-sea section of jacket plus all appurtenances and other sub-sea components including risers:		R	
Potential and anode consumption measurements			
Marine growth survey and assessment		R	
Seabed survey for debris		R	Sonar equipment or if visibility use air divers.
Scour survey at jacket legs/pile sleeves		R	Sonar equipment or simple sounding.
Platform differential settlement/level survey		R	

Table 8.2 - Sub-Sea Structures - Inshore and Swamp Structures

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Subsequent In-Service Inspection			
General Visual Inspection of complete atmospheric section of jacket plus all appurtenances and other surface components	Not > yearly	R	
As per First In-Service Inspection	Not > 2 yearly	R	Frequency of inspection Major Inspection may be extended to 5 yearly on platforms operating in a benign environment
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events, dropped objects, vessel collisions, observed damage, and changes in platform loading			

8.3 Other Sub-Sea Structures and Equipment

Other sub-sea structures and equipment generally means: subsea well-heads, manifolds, templates, foundations, mooring anchors, termination units, etc which are part of Deep Offshore facilities. The applicable inspection strategies and minimum requirements are defined in this General Specification in paragraph **15 to 18**.

9. Lifting equipment

Lifting Equipment is a generic name used to describe many differing types of appliances and gear used for the function of lifting. For the purpose of this General Specification, Lifting Equipment has been split into three different categories:

- General Lifting Equipment.
- Cranes.
- Drilling Associated Hoisting Equipment.

Analysis of accidents in the Oil and Gas Industry show that a significant number are related to the failure of Lifting Equipment. Due to this high incidence of failures and because of the difficulty associated with predicting the external factors which can influence failure, a strict prescriptive inspection frequency shall be adhered to for all Lifting Equipment.

9.1 General Lifting Equipment

9.1.1 Field of application

For the purpose of this General Specification, General Lifting Equipment shall include:

- Lifting appliances (any mechanical device capable of raising or lowering a load. Examples: chain blocks, pull lifts, rope hoists, winches, etc...).
- Lifting gear (any device whatsoever which is used to connect a load to a lifting appliance. Examples are wire slings, chain slings, shackles, eyebolts, lifting and runway beams, pad eyes, davits, etc...).

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 48 of 113

- Wire Ropes.
- Elevators/Lifts/Personnel Baskets.
- Webbing/Polyester Fibre Slings.
- Transportation Containers (lifting slings and lifting points included): this category includes:
 - Enclosed cargo containers with side or end closures.
 - Containerised workshops/storage containers.
 - Open-topped cargo baskets (steel or mesh sides).
 - Open-topped or partially-enclosed garbage skips.
- Top-opening cargo transportation boxes/too trays.
- Racks for transportation of mobile tanks and gas cylinders, nitrogen or breathing-air “quads” with fixed manifold.

Note: Lifting equipment dedicated to Life Saving Appliances (lifeboats fall wires, davits and launching appliances) are considered in section 20.

9.1.2 Inspection Strategy

In the majority of Countries in which the Company operates, national legislation shall dictate both the scope and frequency of Lifting Equipment Inspection.

In addition to any national legislation, the minimum inspection requirements to be applied to General Lifting Equipment are given in Table 9.1.

Prior to first use every individual item of Lifting Equipment must be:

- Inspected for damage and where applicable function tested.
- Individually identified.
- Checked against their original load test certificates.
- Registered (including its location) and colour coded.

Colour coding shall be used to show that each item of Lifting Equipment has been inspected within its required frequency. Coloured cable markers are a good alternative to paint. As a minimum, four unique colours should be used. Care shall be taken to co-ordinate colour coding with Contractors and other operators.

It shall be the responsibility of the user to make a general visual inspection of the lifting equipment and to ensure it is correctly colour coded **prior to each use**. Defective or none colour coded equipment must **not** be used and shall be either placed in quarantine or suitably labelled “Do Not Use”.

Following re-inspection, defective equipment that is deemed non-repairable must be destroyed. It shall **never** be retained for non-lifting or alternative use. Repaired Lifting Equipment must be thoroughly examined and load tested prior to re-use. The repair of lifting equipment must be controlled by the Inspection-Corrosion Department.

Where Contractors bring their own lifting equipment to site, their inspection shall be the responsibility of the Contractor. The inspection standard applied by the Contractor shall be

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 49 of 113

equal or greater than this standard. This standard shall be monitored by regular audit by Company Inspection personnel. Audits shall be performed systematically at a frequency not exceeding 12 monthly.

Table 9.1 - General lifting equipment

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Although the purchase of the initial fixed and loose Lifting Equipment shall be the responsibility of Project, replacement Lifting Equipment will require to be purchased by the subsidiary. It shall therefore be the responsibility of the Head of Inspection & Corrosion to provide inspection and Quality Control Support Services to the Procurement Department for the replacement purchase of any Lifting Equipment. Individual Quality Plans shall be prepared for each Purchase Order and the level of Quality Control shall be determined in accordance with the General Specification for Lifting Equipment.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before First Use	R	
Load test by Manufacturer and review of test certificate by the Inspection-Corrosion Department		R	
Colour Coding		R	
Operational Phase			
In-Service Inspection			
Lifting Appliances - Thorough Inspection plus Function Test	Not > yearly	R	By competent person or qualified Third Party Representative
Lifting Gear - Thorough Inspection	Not > yearly	R	
Webbing Slings - Thorough Inspection	Not > 6 Monthly	R	
Wire ropes:			
Pre Use – Survey	Daily	R	by Crane Driver
Detailed Visual	Weekly	R	by Crane Driver
Detailed Visual including verification of all maintenance activities with specific focus on Wire Rope greasing and slipping and cutting (where applicable)	Not > 6 Monthly	R	By competent person or qualified Third Party Representative
Rope NDT Inspection for crack detection (magnetic or eddy current or dye penetrant)	Not > yearly	R	
or, Sample Strength Test (Rope slip)	Not > yearly		
or Replacement when no NDT nor Sample test	Not > 30 Monthly		
Personnel Lifts - Thorough Inspection plus Function Test	Not > 6 Monthly	R	
Brake Mechanism - Maintenance, Inspection and Test	As per Manufacturers Recommendations		

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 50 of 113

Table 9.1 - General lifting equipment

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Transportation Containers and Frames - Thorough inspection of lifting set, lifting frame and container lifting points	Not > 6 Monthly	R	
NDT for crack detection on Container lifting points (magnetic particle or dye penetrant)	Not > 2 yearly	R	NDT in accordance with BS EN 12079 NDT may be extended to 4 yearly for containers designed and built in compliance with BS EN 12079 or equ.
Load Test of Container together with Lifting Frame and Lifting Set	Not > 2 yearly	R	Load Test in accordance with BS EN 12079 Load Test is only required after substantial repair or alteration for containers designed and built in compliance with BS EN 12079 or equ.
NDT or Load Test of Container Lifting Set	Not > 4 yearly	R	as per BS EN 12079
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, extreme environmental events, etc.			
Where unexpected inspection results are reported which could affect other plant			

9.2 Cranes and Forklifts

9.2.1 Field of application

For the purpose of this General Specification, Cranes shall include Pedestal Cranes, Mobile Cranes, Overhead Travelling Cranes, Riser/Umbilical pulling rigs and also Fork Lifts.

9.2.2 Inspection Strategy

It is likely that in the majority of Countries in which the Company operates, national legislation shall exist to dictate both the scope and frequency of Crane Inspection. It should be noted that this legislation may not be dedicated to the Oil and Gas Industry but part of Construction Works or other legislation where cranes are more commonly used.

In addition to any national legislation, the minimum inspection requirements to be applied to Lifting Equipment are given in **Table 9.2**.

Where the replacement of the slew ring and associated bolting is deferred, this decision should be made based upon the satisfactory results of annual checks plus a thorough review of the cranes loading history. Such decisions should also be formally recorded. Cranes which have integral ultrasonic/eddy current crack detection equipment fitted to their slew ring bearing may have their change-out indefinitely extended providing all other inspections are performed with satisfactory results.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 51 of 113

Where cranes are hired they shall be subject to a thorough pre-hire inspection followed by 12 monthly detailed audits. The Inspection-Corrosion Department shall be responsible for performing both pre-hire inspection and routine audits.

Forklifts shall be subject to similar inspections as cranes. It shall be the responsibility of the forklift driver to perform and record daily and weekly inspections in a suitable log book.

9.2.3 Proof Load Test

Cranes shall be subject to thorough examination and Proof Load Test at max 5 years intervals in presence of a Third Party Inspection Authority (for cranes under Classification Society's Rules – e.g. pedestal cranes on Floating Units - the Class Surveyor must attend the Proof Load Test).

As a base case, Proof Load Tests shall be performed with the following overload:

- 125% SWL for cranes with SWL < 20T.
- 5T + SWL for cranes with 20T < SWL < 50T.
- 110% SWL for cranes with SWL > 50T.

Table 9.2 - Cranes

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Although the purchase of the initial Cranes shall be the responsibility of Project, replacement components will require to be purchased by the subsidiary. It shall therefore be the responsibility of the Head of Inspection & Corrosion to provide inspection and Quality Control Support Services to the Procurement Department for the replacement purchase of any Lifting Equipment. Individual Quality Plans shall be prepared for each Purchase Order and the level of Quality Control shall be determined in accordance with the General Specification for Cranes.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before First Use	R	
Witness of in-situ load test			
Commission of Crane together with full functional test of brake, limit switches, alarms and load cell			
Baseline Slew Ring Rocking Checks			
Baseline Slew Ring Grease Analysis			
Pedestal cranes: identify highly stressed welds for future NDE inspection			
Colour Coding			
Operational Phase			
In-Service Inspections (General Cranes)			
General visual inspection by Crane Driver	Daily	R	Daily results and weekly checks must be recorded in the Crane Log Book
General visual inspection of Crane moving and static wire Ropes	Weekly	R	
Function test of crane brake, limit switches, alarms and load cell		R	
Visual inspection of crane lattice structure		R	
Thorough inspection of complete crane plus all its associated Lifting Equipment	Not > 6 Monthly	R	
Thorough inspection of complete lattice structure		R	Also every boom change

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 52 of 113

Table 9.2 - Cranes

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Wire ropes:			
Pre Use – Survey	Daily	R	by Crane Driver
Detailed Visual	Weekly	R	by Crane Driver
Detailed Visual including verification of all maintenance activities with specific focus on Wire Rope greasing and slipping and cutting (where applicable)	Not > 6 Monthly	R	By competent person or qualified Third Party Representative
Rope NDT Inspection for crack detection (magnetic or eddy current or dye penetrant)	Not > yearly	R	
or, Sample Strength Test (Rope slip)	Not > yearly		
or Replacement when no NDT nor Sample test	Not > 30 Monthly		
Crane Rope Replacement	Not > 5 yearly	R	
Function test of crane at SWL to check crane brake, limit switches, alarms, load cell, etc	Not > yearly	R	
10% Inspection for crack detection (magnetic or eddy current or dye penetrant) of lattice Structure Node Welds		R	
Detailed thorough inspection including dismantling of components and subsequent NDE of load bearing components	Not > 5 yearly	R	
Proof Load Test of crane and all its components		R	See section 9.2.3
Thorough inspection and NDE for crack detection (magnetic or eddy current or dye penetrant) of highly stressed Welds		R	To be performed after Proof Load Test
100% Inspection for crack detection (magnetic or eddy current or dye penetrant) of lattice Structure Node Welds		R	
In-Service Inspections (Pedestal Cranes - Additional Requirements)			
Slew ring bearing grease analysis	Not > yearly	R	
Slew ring bearing rocking tests		R	
Slew ring bolting: torque control of 100% of bolting		R	For ROTABOLT type bolting, torque control is performed with the cap indicator located on top of the bolt (the cap indicator rotates freely in case of tension loss)
Replacement of Slew ring bearing and slew ring bolting	Not > 5 yearly	G	See Section 9.2.2 for notes on extensions
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, extreme environmental events, etc.			
Where unexpected inspection results are reported which could affect other plant			

9.3 Drilling Related Lifting Equipment

Drilling Associated Hoisting Equipment is defined as all specific lifting equipment associated with drilling activities and included within the scope of API Spec. 8A - Specification for Drilling and Production Hoisting Equipment. Examples are drawworks, crown blocks, travelling blocks, hooks, elevators, links, etc.

It should be noted that the drilling Contractor shall normally be responsible for the inspection of Drilling Associated Hoisting Equipment and the Company Drilling shall be responsible for the auditing of the drilling Contractor to ensure that their inspection programme complies with the requirements of API and any national legislation, and is being implemented. The Inspection-Corrosion Department shall verify these roles are correctly understood and effective.

10. Helicopter Refuelling Stations and Portable Tanks

Helicopter Refuelling Stations and their associated equipment shall be subject to regular inspections and checks with the involvement of other Company entities such as Maintenance and Logistics together with outside bodies such as the helicopter operator, Certifying Authorities and Aviation Authorities as necessary.

The aim of such inspections are to ensure that the Jet Fuel Systems used to refuel helicopters are safe and that there fuel is clean and free from contamination. Inspections shall be performed in accordance with [ICAO annex 14](#) or [CAP 437](#), and any additional national legislation or regulations.

Routine quality checks together with the maintenance of Helicopter Refuelling Stations shall be the responsibility of the Head of Logistics and Maintenance Departments. They shall therefore be responsible for the preparation and execution of routine inspection programmes.

Routine checks performed at daily, weekly and monthly frequencies shall be performed in accordance with [CAP 437](#) by either the Helicopter Landing Officer (HLO) or dedicated maintenance personnel appointed by the Head of Logistics.

The Head of Inspection's responsibility shall be limited to the integrity of the Jet Fuel pressure system and the Portable Fuel Tanks.

On board Floating Units, arrangements for helicopter refuelling are subject to Class surveys.

10.1 Helicopter Refuelling Stations - Pressure System Inspection

The written schemes of inspection from the Helicopter Refuelling Stations Pressure Systems shall be performed in accordance with Section 5 of this General Specification together with any recommendations in [CAP 437](#). Execution of inspections will be co-ordinated with aviation authorities as necessary.

10.2 Portable Tanks

This Section of the General Specification only covers the portable tanks and associated equipment. The inspection requirements for the tanks lifting equipment and frame are addressed in Section 9.

Portable Tanks used for the transportation of dangerous liquids as defined by the International Marine Organisation (IMO) shall be subject to regular prescriptive inspections. The scope of

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 54 of 113

these inspections shall be determined depending on the type of tank and the nature of transported fluid.

By definition:

- Portable Tanks must have a capacity of more than 450 litres and their shells must be fitted with structure and equipment suitable for transport of dangerous liquids having vapour pressure of not more than 3 bar absolute at a temperature of 50°C.
- IMO Type 1 Portable Tanks are tanks fitted with a relief device (PSV) and having a Maximum Allowable Operating Pressure (MAOP) of 1.75 bar.G or greater.
- IMO Type 2 Portable Tanks are tanks fitted with a relief device (PSV) and having a Maximum Allowable Operating Pressure (MAOP) between 1.0 bar.G and 1.75 bar.G.
- Jet Fuel Portable Tanks are tanks used for the transportation of Jet Fuel and designed and fabricated in accordance with [CAP 437](#) requirements.
- Non-Hazardous Portable Tanks are tanks used to store inert and non pressurised fluids.

In addition to any national legislation, the minimum acceptable inspection requirements to assure the integrity of Portable Tanks are given in Table 10.1.

Table 10.1 - Portable tanks

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Portable Tanks may be purchased either by the Project Group or by the Subsidiary. Where purchased by the subsidiary it shall be the responsibility of the Head of INSPECTION & CORROSION to provide inspection and Quality Control Support Services to the Procurement Department for the replacement purchase of any Portable Tanks. Individual Quality Plans shall be prepared for each Purchase Order and the level of Quality Control shall be determined in accordance with the General Specification for Portable Tanks & their Lifting Structures.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration in Plant Inventory	Before First Use	R	
Load test by Manufacturer and review of test certificate by the Inspection-Corrosion Department		R	
Wall Thickness Measurements to verify nominal values and consistency with as-built drawings		R	
Preparation of Vessel Inspection Drawings with inspection points.		R	
External and Internal General Visual Inspection	With Comm. Team	R	
Operational Phase			
In-Service Inspection - Jet Fuel Portable Tanks			
General External and Internal Visual Inspection	Not > 6 Monthly	R	In accordance with CAP 437
Function Test of PSV	Not > yearly	R	
Detailed External and Internal Visual Inspection	Not > 30 Monthly	R	
Overhaul of PSV and subsequent test		R	
Pressure Test of Tank and its associated piping at MAOP		R	In accordance with IMO requirements
Hydrostatic Test of Tank and its associated piping at 1.5 x MAOP	Not > 5 yearly	R	
Inspection of Lifting Equipment	In accordance with Section 9.1.2 and BS EN 12079		

Table 10.1 - Portable tanks

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
In-Service Inspection - Portable Hazardous Tanks			
General External and Internal Visual Inspection	Not > 6 Monthly	R	
Detailed External and Internal Visual Inspection	Not > 30 Monthly	R	
Overhaul of PSV and subsequent test		R	
Pressure Test of Tank and its associated piping at MAOP		R	In accordance with IMO requirements
Hydrostatic Test of Tank and its associated piping at 1.5 x MAOP	Not > 5 yearly	R	
Inspection of Lifting Equipment	In accordance with Section 9.1.2 and BS EN 12079		
In-Service Inspection - Portable Non Hazardous Tanks			
General External and Internal Visual Inspection	Not > 6 Monthly	R	
Detailed External and Internal Visual Inspection	Not > 30 Monthly	R	
Inspection of Lifting Equipment	In accordance with Section 9.1.2 and BS EN 12079		
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the operating parameters or the environment			
Following abnormal incidents such as damage, extreme environmental events, etc.			
Where unexpected inspection results are reported which could affect other plant			

11. Marine terminal facilities

11.1 Jetties

11.1.1 General

Jetties are part of Marine Terminal Facilities and their primary function is to ensure safe mooring and berthing of tankers during their loading and unloading. For the purpose of this General Specification Jetties shall include all above water and sub-sea structures, tertiary structures, Cathodic Protection (CP) Systems and energy absorbing fenders.

11.1.2 Inspection Strategy

A prescriptive inspection scheme shall be followed in accordance with Table 11.1 and any national Marine Authority requirements.

In all cases tertiary Structure shall be inspected to ensure personnel safety.

Consideration shall be given to the installation of marine grown removal/prevention equipment.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 56 of 113

Table 11.1 - Jetty structures

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of jetties shall be the responsibility of Project. This section is therefore limited to modification and repairs of inshore jetties. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Structures.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory.	Before Start-up	R	
Pre float-out/Installation General Visual Inspection of complete structure plus all appurtenances	Before Float-out/Installation	R	Performed at fabric. site
Comprehensive pre float-out/Installation photographic survey		R	Performed at fabric. site
Preparation of Inspection Drawings with component identification		R	
Measurement and confirmation of Position and Level	Before Start-up	R	Performed by jacket installation Contractor and witnessed by Integrity Dept.
Scour survey at Jetty legs/pile sleeves	After Piling	R	
Post installation General Visual Inspection of complete structure plus all appurtenances		R	
Operational Phase			
First In-Service Inspection			
General Visual Inspection of Tertiary Structure	Not > yearly	R	Above water: normally performed by abseiling techniques
General Visual Inspection of complete sub-sea and atmospheric section of jetty plus all appurtenances and other sub-sea and atmospheric components	Within One year of Topsides Installation	R	Scour survey: sonar equipment or simple sounding. Seabed survey: sonar equipment or if visibility use air divers.
Cathodic Protection (CP) of complete sub-sea section of jacket plus all appurtenances and other components including risers		R	
Marine growth survey and assessment		R	
Seabed/debris survey and scour survey at Jetty legs/pile sleeves		R	
Jetty differential settlement/level survey		R	
Subsequent In-Service Inspection			
General Visual Inspection of Tertiary Structure	Not > yearly	R	
General Visual Inspection of surface structure of jetty plus all appurtenances		R	Can be increased to two yearly in benign environments
General Visual Inspection of Splash Zones and energy absorbing fenders		R	
General Visual Inspection of sub-sea structure of jetty plus all appurtenances	Not > 2 yearly	R	
Marine growth survey and assessment		R	Effects on sub-sea structure loading.
Seabed/debris survey and scour survey at Jetty legs/pile sleeves		R	

Table 11.1 - Jetty structures

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Cathodic Protection (CP) survey of complete sub-sea section of jacket plus all other sub-sea components including risers: Potential measurement Sacrificial anode consumption assessment, when relevant	Not > yearly	R	
Jetty differential settlement/level survey		R	
For impressed current CP systems: monitor output voltage and current of Transformer/Rectifier	Monthly	R	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events, dropped objects, vessel collisions, observed damage, and changes in platform loading			

11.2 Loading Arms

Loading Arms are flexible piping mechanisms used to connect Jetty Piping to tankers. The design of each arm will depend on the type of fluid being transferred. Loading Arms by design will be located at the end of jetties and exposed to the marine environment also their failure may have serious safety, environmental and financial consequences.

Due to their difficult working environment and their high consequences if failure, Loading Arms shall be subject to a strict prescriptive inspection schedule in accordance with Table 11.2.

Prior to every use each Loading Arm shall be subject to a general visual inspection primarily to check for damage, evidence of leakage and continuity of earthing wire by the operations personnel. Sealing faces shall also be carefully checked for both damage and corrosion. The function of Loading Arms shall also be checked to ensure all joints are free to move together with their emergency disconnect mechanism.

In addition to the above scope written Schemes of Examination shall be performed taking into account Vendor's Maintenance and Inspection recommendations.

Table 11.2 - Loading Arms

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of Loading Arms shall be the responsibility of Project. This section is therefore limited to modification and repairs of Loading Arms. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Loading Arms.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory.	Before Start-up	R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 58 of 113

Table 11.2 - Loading Arms

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Installation General Visual Inspection of complete structure plus all appurtenances	Before Installation	R	Performed at fabrication site
Comprehensive pre Installation photographic survey		R	Performed at fabrication site
Preparation of Inspection Drawings with component identification		R	
Post installation General Visual Inspection of complete structure plus all appurtenances		R	
Operational Phase			
Operational Inspection			
General Visual Inspection of complete structure and associated components	Before Each Use	R	Inspection Performed by Operations Personnel
Earthing wire continuity check			
Visual inspection of inlet of sealing faces			
Function Test of swivel joints and telescopic joints			
In-Service Inspection – Minor			
Detailed Visual Inspection of complete structure and associated components	Not > yearly	R	Can be increased to two yearly in benign environments
Full function test of the loading arm movement together with any quick disconnect system			
Earthing wire continuity check			
In-Service Inspection - Major			
As per Minor Inspection programme	Not > 5 yearly		
Limited internal inspection at end connections and removal of selected swivel joints		R	
NDE of inaccessible internal part by ultrasonic or radiographic examination		R	
Surface NDE where SCC is deemed credible		R	
Removal of selected sections of insulation to identify Under Insulation Corrosion or Stress Corrosion Cracking			
Additional Checks as recommended by Vendor		R	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events, dropped objects, vessel collisions, observed damage, and changes in platform loading			

11.3 Offloading Buoys

11.3.1 General

This section considers the following:

- Buoy body, comprising a fixed part (connected to the Oil Offloading Line or to the submarine hoses) and a rotating part (connected to the floating hoses).
- Mooring lines and their anchor points to moor the buoy on the seabed.
- Hawser lines to moor the tanker ship to the buoy.
- Subsea Pipe Line End Manifold(s) (**PLEM**), anchored to the seabed and providing a link between the oil export sealine(s) and the submarine hoses.

Due to their difficult working environment and their high consequences in case of failure, Offloading Buoys shall be subject to a strict prescriptive inspection schedule in accordance with Table **11.3**.

Also consider paragraph **18** when it comes to Mooring Line inspection strategy, paragraph **13.4** for connected bonded hoses and paragraph **17** for oil offloading lines (OOL) in a deep water environment.

Offloading buoys must be “classified” by a Classification Society (third party).

The strategy in Table **11.3** is primarily based on 2 components:

- Classification scheme covering the hull, tanks and mooring equipment.
- Company additional requirements.

11.3.2 Surveys by Classification Society

Offloading buoys are subject to initial and periodical surveys by a Classification Society. The Classification Society’s requirements shall be included in the maintenance plan.

In Table **11.3**, Class inspection activities are given only for information as the actual Class requirements will be specific to the Buoy with reference to the Class Society’s Rules.

11.3.3 Additional Company Inspection Programme

The Classification Society’s requirements shall be complemented with specific prescriptive requirements on known critical items based on Company experience and affiliates feedback. The main concerns are:

- Surge tank, void compartments for premature corrosion due to paint damage.
- Mechanical failure of bearing due to poor maintenance and greasing.
- Inefficiency of anodes fitted on skirt and non protection of first links of mooring (paragraph **18**).
- Leak at Flexjoint (paragraph **17**).

The objective of this prescriptive additional program is to detect anomalies (very likely acceptable Class wise) at early stage before they reach a point where repair is difficult or costly. In addition, first in-service inspection aims at calling on guarantee recourses as applicable.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 60 of 113

Mooring ropes or Hawser shall be replaced annually as a base case. It is recommended that used Hawsers be returned to their Vendor for destructive testing. When it can be proven that the condition of the Hawser was satisfactory for service, the replacement frequency may be increased to a maximum of 2 yearly. This shall only be applicable when the same Vendor is used to supply the Hawsers. In the event that the inspection frequency is extended to 2 yearly, then the Hawsers shall be subject to an annual detailed visual inspection. In addition, mooring ropes or hawsers service life shall be limited to 100 cyclic loads (i.e. tanker loading operations).

Table 11.3 - Offloading buoys

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Although the manufacture and hence QA of Mooring Buoys shall be the responsibility of Project, the subsidiary shall be responsible for the regular procurement of buoys spare parts. It shall therefore be the responsibility of the Head of INSPECTION & CORROSION to provide inspection and Quality Control Support Services to the Procurement Department for the replacement purchase of any Offloading Buoy Components. Individual Quality Plans shall be prepared for each item to be purchased and the level of Quality Control shall be determined in accordance with the General Specification for each item of equipment and OCIMF requirements.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory.	Before Start-up	R	
Pre Installation General Visual Inspection of complete structure plus all appurtenances	Before Installation	R	Performed at fabrication site
Comprehensive pre Installation photographic survey		R	
Preparation of Inspection Drawings with component identification		R	
Torque and trim commissioning measurements	Post Installation	R	
Post installation General Visual Inspection of complete structure plus all appurtenances		R	
Operational Phase			
Example of Classification Society's survey (according to BV Rules)			
Annual survey: General examination of buoy structure, deck and deck equipment (including shell plating above the waterline, deck and openings, internal parts, turntable and bearing, personnel protection, piping systems, foundation of lifting and tanker mooring equipment, visible part of anchoring system, hawser, etc.)	Not > 1 year	R	BV NR 494, Sec 2.2.2 & Sec 2.2.3 and Sec 2.2.7
Internal inspection of compartments (internal spaces used as ballast tanks or surge tank).	Not > 2.5 years	R	BV NR 494, Sec 2.3.2
Underwater survey of bottom part and mooring line supports and CP survey	Not > 2.5 years	R	BV NR 494, Sec 2.3.1
Renewal survey: Thorough examination of buoy structure, deck and deck equipment (including internal spaces of fixed and rotating parts), piping systems and pressure containing equipment (e.g. swivel), cargo transfer arrangement. External inspection and rotation test of main bearing and swivel assembly Thickness measurements (buoy structure, plating, support of mooring line and hawser)	Not > 5 years	R	BV NR 494, Sec 2.4.2 BV Pt A, Ch 2, Sec 4.2.5

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 61 of 113

Table 11.3 - Offloading buoys

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Additional Company Inspection			
General Visual Inspection of complete structure and associated components	Before Each Use	R	Inspection Performed by Operations Personnel
Assessment of Buoy freeboard and trim		R	
GVI of the mooring buoy structure and its appurtenances. GVI of rotating part and structure GVI of ancillary equipment including winches, sheaves and tensioning equipment attached to the buoy. GVI of hook and hook assembly	Not > yearly	R	May be extended based upon results
GVI of pipe work including central pipe at well. CVI of swivel		R	
Main bearing: GVI of main bearing, including greasing system, seals and water barrage condition. Torque test, rotation test and grease analysis to assess bearing condition		R	In accordance with Vendor's procedure
Underwater inspection of Buoy and PLEM, including chain connectors and their attachment to the buoy structure. Marine growth assessment CP measurements and anode depletion assessment		R	
Function Test of Buoy Emergency Shutdown Valves		R	
Inspection of Buoy position with reference to PLEM, submarine hoses and anchors		R	
Inspection of mooring lines according to paragraph 18		R	
Tanker mooring: CVI of tanker mooring equipment and their connection to the buoy Replacement of mooring ropes and hawsers		R	Replacement of hawsers may be extended to 2 years according to 11.3.3 Hawsers service life to be limited to 100 cyclic loads.
Major Overhaul in dry dock including change out of slew ring bearing and re-painting of body	Not > 10 years	G	May be extended based upon satisfactory annual inspections
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events, dropped objects, vessel collisions, observed damage			

Other buoys:

Although not considered as Floating Units, buoys used for the collection of metocean data (wave buoys, etc.) shall be subject to periodical inspection to ensure their structural integrity.

The inspection shall cover as a minimum the visual examination of buoy structure (including subsea buoy) and top part of mooring line on an annual basis. In addition, a general visual inspection of the entire mooring line and anchor shall be performed every 30 months.

General Specification		GS EP EXP 311
Plant integrity - Minimum inspection requirements		
Rev.: 03	Effective date: 10/2012	Page: 62 of 113

11.4 Offloading Hoses

11.4.1 General

The offloading hoses fall into 3 categories:

- Submarine hoses which role is to provide a flexible connexion from subsea PLEM (Pipeline End Manifold) to mooring buoy.
- Floating hoses which role is to transfer stabilized crude oil from buoy or terminal up to oil tankers.
- Rail and tail hoses are to be fitted to the tanker offloading flange. As they are handled during each offloading operation, they are reinforced to resist twist and buckle.

Most of the time, hoses are designed according to the bonded concept.

11.4.2 Inspection Strategy

Due to the high flow and their high consequences if failure, offloading hoses shall be subject to a strict prescriptive inspection schedule in accordance with Table 11.4.

In addition to this section, specific requirements for oil offloading lines between FPU and buoy in a deep water environment are given in paragraph 17.

Table 11.4 allows 2 replacement strategies to be implemented: strategy #2 may be preferred when offloading frequency is less than 50 per year or so.

11.4.3 Conditions for submarine hose life extension

Submarine hoses with new design are now available from the market (e.g. Trelline from Trelleborg, Deepflo from Dunlop). Vendors all claim their new design should allow operational life extension.

Consequently, change-out frequencies in Table 11.4 may be extended for these new design hoses on condition that:

- A qualification programme formally validated by TEC/PLR experts has been successfully completed.
- A dedicated inspection plan has been designed and is duly implemented.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 63 of 113

Table 11.4 - Offloading Hoses

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Although the manufacture and hence QA of bonded hoses shall be the responsibility of Project, the subsidiary shall be responsible for the regular procurement of replacement hoses. It shall therefore be the responsibility of the Head of INSPECTION & CORROSION to provide inspection and Quality Control Support Services to the Procurement Department for the replacement purchase of any bonded hoses and floating line or submarine connexions Components. Individual Quality Plans shall be prepared for each item to be purchased and the level of Quality Control shall be determined in accordance with the General Specification for each item of equipment and OCIMF requirements.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory.	Before Start-up	R	
Pre Installation General Visual Inspection of complete assembled lines plus all appurtenances	Before Installation	R	Performed on yard
Comprehensive pre Installation photographic survey		R	
Preparation of Inspection Drawings with component identification		R	
Hydraulic pressure test of the full assembly line with fluorescent marker		R	Pressure to be compatible either with flange MOP rating and MBC (Marine Breakaway Coupling) design.
Tightening torque commissioning measurements	Post Installation	R	Performed on site when connected at the buoy
Post installation General Visual Inspection of complete assembled lines and all appurtenances		R	
Hydraulic pressure test with fluorescent marker		R	
Operational Phase			
Visual inspection of floating hoses, rail and tail hoses, including their terminations	Before Each Use	R	Inspection Performed by Operations Personnel Check for wear, kinks and general damage
Detailed inspection of floating hoses, rail and tail hoses, over their complete lengths including the end terminations and marinebreakaway couplings, in accordance with Manufacturer recommendations. Flanges tightness assessment	Not > yearly	R	Either by towing the complete hose onshore, or in-situ by divers.
Detailed inspection of Submarine hoses and tightness assessment			
Function Test of PLEM Emergency Shutdown Valves			
Strategy # 1 for floating and submarine hoses: Change-out and test in accordance with OCIMF and Vendors requirements. Re-use if satisfactory for a 2 nd 3-year period then scrap. Maximum interim storage period is 3 years.	Not > 3 yearly	R	Change-out frequency for submarine hoses may be extended on condition as per paragraph 11.4.3
Strategy # 2 for floating and submarine hoses: One-run service. Change-out and scrap	Not > 6 years	R	
Rail and Tail hoses: One-run service. Change-out and scrap Marine Break-away Couplings: Overhaul by the Manufacturer	Not > 3 years	R	

Table 11.4 - Offloading Hoses

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events, dropped objects, vessel collisions, observed damage, and changes in loading			

12. Pipelines

This section provides with minimum inspection requirements applicable to rigid pipelines.

Unbounded flexible pipelines are not in the scope of this section and are covered by paragraph 13.4.

12.1 General

Specific written schemes of examination shall be prepared for each individual pipeline from pig launcher to receiver although pig traps themselves shall be assessed as Pressure Vessels - Reference Section 4.1. Since both the consequence and probability of failure will change over the length of each pipeline, the first task in preparing inspection programmes is to sub-divide each line into distinct portions. At least at the highest frequency, a comprehensive inspection report should be issued to conclude on the consolidated full length of pipeline.

The minimum inspection requirements specified here after, together with national legislation, shall enable the formulation of a written scheme of examination for each Pipeline.

These minimum requirements have been prepared for different types of pipelines:

- Onshore pipelines (refer to **Table 12.1**).
- Offshore pipelines (refer to **Table 12.2**).
- Deep offshore pipelines including specific design such as Pipe in Pipe and Bundle (refer to **Table 12.3**).

12.2 Design Review

Pipelines (export, trunk and remote flowlines) shall be designed to allow their integrity to be verified throughout their operational life. Generally this will mean they shall be designed to allow both operational and intelligent pigging. Where the design does NOT allow intelligent pigging the method of integrity verification shall be explained within the project SOR.

Pipeline bend radii shall be sufficient to allow passage of intelligent pigs, only barred tees shall be installed on pipelines and pig traps. Sufficiently long horizontal pig traps shall be installed with adequate lifting facilities and access space to allow the handling and insertion of intelligent pigs. Lay-down areas or deck hatches shall also be installed to facilitate pig handling. Sufficient pig detection equipment shall be installed including at intermittent platforms or stations.

Pipeline markers capable of detection by intelligent pig should be installed at regular intervals along the pipeline. These may simply be short pup pieces.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 65 of 113

Future Emergency Pipeline Repair Schemes (EPRS) shall be reviewed as part of the pipeline technical review. Adequate surplus materials shall be procured at the project stage to ensure that an emergency repair can be performed.

Cathodic Protection (CP) systems shall be designed with test points along onshore lines. Systems shall allow on/off potential surveys to be performed.

Corrosion monitoring devices shall be installed at pipeline ends at a position representative of the anticipated corrosion, as per to **GS EP COR 002**.

On pipelines susceptible to internal metal loss consideration shall be given to installing devices such as Ultrasonic Mats on pipeline doglegs. The interrogation and monitoring devices shall be located on the adjacent platform. The primary function of such devices shall be to detect wall thinning and assess the effectiveness of preventative methods.

12.3 Inspection Strategy

Pipeline integrity management systems are partly based on the followings:

- Preventative measures in response to the potential threats.
- Corrosion control and monitoring programme as per **GS EP COR 002**.
- Inspection program and written scheme of examination. Intelligent pigging is a key component of the inspection activities applicable to Pipelines.

Baseline inspection: in addition to gauging and calliper pigs, intelligent pigging may be run to prove the ability of the pipeline to be pigged in the future. The guidance to issue intelligent pig records prior to start-up is to provide a baseline reference for future inspections. This may be particularly useful when a magnetic pig is planned to be used to inspect the line in the future: the objective of the baseline inspection will be to record the initial “signature” of the pipe before it has been exposed to the operation fluid. However, the use of a magnetic pig not strictly identical to the one used during the baseline inspection may jeopardise further signature comparison. This baseline inspection will normally be the responsibility of the Project and included in the pipeline commissioning scope of work.

On Pipelines where the design does not allow conventional intelligent pigging such as flowlines, consideration shall be given to modifying the line to enable such inspections or using riser umbilical pigs. Where this is considered impossible or impractical, their integrity **shall** be proven by other means such as pressure testing. Such pressure tests should normally be performed at 1.1 times the current maximum operating pressure.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 66 of 113

Table 12.1 - Onshore Pipelines

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of pipelines shall be the responsibility of Project. This section is therefore limited to modification and repairs of pipelines. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Pipelines.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory	Before Start-up	R	
Preparation of Inspection Drawings with component identification		R	
Verification of installation and as-built survey. For river crossings - review of magnetic/acoustic location and burial surveys. Physical survey of the Right of Way.	During Survey	R	
External General Visual Inspection of topsides and above ground sections and Wall Thickness Measurements (where internal corrosion is identified as a possible mode of failure)	Before Start-up	R	
Baseline Inspection by Intelligent Pig		G	
Review the baseline gauging and calliper survey of the pipeline, Assess pigging facilities for future pigging operations and confirm tightness of trap isolation valves		R	
Witness Cathodic Protection baseline survey together with commissioning of impressed current transformer rectifiers		R	
Operational Phase			
First In-Service Inspection			
Pipeline Right of Way (ROW) Survey, private and public sections	Within 6 Months from start-up	R	
Wall Thickness Measurements of topsides and above ground sections	Not > 2 year from start-up	R	Where internal corrosion is identified as a possible mode of failure
Initial in-service intelligent pigging survey	According to corrosion or damage assessment	R	
River Crossings: - burial survey (Magnetic or acoustic) - visual inspection at low tide/dry season	Not > 2 year from start-up	R	
Cathodic Protection (CP) survey of complete pipeline		R	
ESD Valve performance testing	Not > 1 yearly	R	To be included in Production Procedures

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 67 of 113

Table 12.1 - Onshore Pipelines

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Subsequent In-Service Inspections			
Pipeline Right of Way (ROW) Survey, private and public sections	Not > 1 year	R	
Wall Thickness Measurements of above ground sections	Not > 2 yearly	R	Where internal corrosion is identified as a possible mode of failure
Intelligent pigging survey	Not > 5 yearly	R	May be: -extended to 10 yearly where corrosion risk is minimal, -waived where there is NO potential for internal corrosion and positive CP monitoring results. In all cases, a formal corrosion assessment needs to be carried out.
Non piggable lines: the above may be replaced by a pressure test at 1.1 MAOP.	Not > 5 yearly	G	
River Crossings: - burial survey (Magnetic or acoustic) - visual inspection at low tide/dry season	Not > 3 yearly	R	
Cathodic Protection: - complete Cathodic Protection (CP) survey using "on – off" method - monitor output voltage and current of Transformer/Rectifier	Not > 2 yearly	R	
	Not > 1 Monthly	R	
ESD Valve performance testing	Not > 1 yearly	R	To be included in Production Procedures
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events, dropped objects, third party activity, observed damage			

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 68 of 113

Table 12.2 - Offshore Pipelines

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of pipelines shall be the responsibility of Project. This section is therefore limited to modification and repairs of pipelines. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Pipelines.			
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory	Before Start-up	R	
Preparation of Inspection Drawings with component identification		R	
Verification of installation and as-built survey. Witness or review of ROV as-laid survey. For shore approaches: review of magnetic/acoustic location and burial surveys.	During Survey	R	
External General Visual Inspection of offshore risers shall be performed during as-installed jacket survey	During Jacket Survey	R	
External General Visual Inspection of topsides and above ground sections and Wall Thickness Measurements (where internal corrosion is identified as a possible mode of failure)	Before Start-up	R	
Baseline Inspection by Intelligent Pig		G	
Review the baseline gauging and calliper survey of the pipeline, Assess pigging facilities for future pigging operations and confirm tightness of trap isolation valves		R	
Witness Cathodic Protection baseline survey together with commissioning of impressed current transformer rectifiers		R	
Operational Phase			
First In-Service Inspection			
External General Visual Inspection of Riser (Atmospheric Section, Splash Zone, subsea section, dog leg, supports, guides, I tube bellmouth area, etc ...)	Not > 2 yearly	R	Combined with jacket survey for the subsea section
Wall Thickness Measurements of topsides, atmospheric riser and above ground sections	Not > 2 year from start-up	R	Where internal corrosion is identified as a possible mode of failure
Initial in-service intelligent pigging survey	According to corrosion or damage assessment	R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 69 of 113

Table 12.2 - Offshore Pipelines

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Offshore remote section: - General Side Scan Sonar - ROV survey of specific pipelines details and areas of concern	Not > 2 year from start-up	R	
Offshore 500 m zone: pipeline crossings and other pipeline features (with ROV)		R	Combined with jacket survey
Shore Approach: - burial survey (Magnetic or acoustic) - visual inspection at low tide/dry season		R	
Cathodic Protection (CP) survey of complete pipeline		R	
ESD Valve performance testing	Not > 1 yearly	R	To be included in Production Procedures
Subsequent In-Service Inspections			
External General Visual Inspection of Riser (Atmospheric Section, Splash Zone, subsea section, dog leg, supports, guides, 1 tube bellmouth, etc ...)	Not > 2 yearly	R	Combined with jacket survey for the subsea section
Wall Thickness Measurements of atmospheric riser and above ground sections	Not > 2 yearly	R	Where internal corrosion is identified as a possible mode of failure
Intelligent pigging survey	Not > 5 yearly	R	May be: -extended to 10 yearly where corrosion risk is minimal -waived where there is NO potential for internal corrosion and positive CP monitoring results. In all cases, a formal corrosion assessment needs to be carried out.
Non piggable lines: the above may be replaced by a pressure test at 1.1 MAOP.	Not > 5 yearly	G	
Offshore remote section: - General Side Scan Sonar - ROV survey of specific pipelines details and areas of concern	Not > 3 years	R	May be extended to 5 yearly as a result of an engineering assessment
Offshore 500 metre zone: - pipeline crossings and other pipeline features (with ROV) - Cathodic Protection (CP) survey		R	Combined with jacket survey
Shore Approach: - burial survey (Magnetic or acoustic) - visual inspection at low tide/dry season		R	
ROV Survey of complete pipeline	Not > 5 yearly	R	May be extended to 10 yearly as a result of an engineering assessment
- Cathodic Protection (CP) survey - Sacrificial anodes consumption assessment	Not > 5 yearly	R	May be extended to 10 yearly as a result of an engineering assessment

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 70 of 113

Table 12.2 - Offshore Pipelines

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
ESD Valve performance testing	Not > 1 yearly	R	To be included in Production Procedures
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events, dropped objects, vessel collisions, observed damage			

Table 12.3 - Deep Offshore Pipelines

(Flowlines sections and associated structures, Pipe in Pipe, Bundle, ...)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Design Review			
Production Flowlines: - Pipework isometric design - Insulation material and elements to be challenged where flow assurance is not a constraint. - On particular critical areas (bends, fittings downstream choke-valve,...) consider a UT housing system to allow ROV positioning for further measurements.		R	
Bundle concept: - Search evidence that the mechanical integrity of the carrier pipe versus the dynamic installation loads has been verified. - Remotely accessible device to monitor inner pipe CP			
Rigid Pipe-in-pipe concept: CP monitoring means			
Associated structures: - CP monitoring system and measuring point localisation - Pitch & roll monitoring system - Verify that installation method statement addresses residual bending and torsion stresses to the pipe - CP continuity between all elements			
Inspectability Reviews			
Carry out a global criticality analysis. Address out coming inspectability requirements in the project EPCC contracts (Markings, CP system, insulation materials, valve actuators /pig traps on terminations)	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identify critical items on which inspection & monitoring engineering shall be developed.
Collect Contractors Failure Mode and Effect Criticality Analysis results, Design monitoring systems Establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the monitoring devices to the riser design

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 71 of 113

Table 12.3 - Deep Offshore Pipelines

(Flowlines sections and associated structures, Pipe in Pipe, Bundle, ...)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of flow line equipment shall be the responsibility of Project. This section is therefore limited to modification and repairs occurring during the flow line construction phase (offshore towing, offshore fabrication & laying). Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General & Project Specifications applicable to the equipment.			
Commissioning/Baseline Inspection			
For single pipe or pipe-in-pipe flow lines assembled offshore, verify length markings, insulation coating and anodes.	During laying operations	R	A detailed photographic survey is required.
Bundle concept: - Check for anti-collapse venting system condition. - Verify CP monitoring device for inner pipes is working, where present.			
For onshore fabricated and towed offshore flowlines: - carry out a detailed chronological survey of the fabrication including insulation element integration when applicable - Check CP system (sacrificial anodes), vent system when accessible.	Before towing /installation	R	
Carry out a comprehensive photographic survey of flow line structures (initiation, in-line and termination, including temporary and permanent pig traps and valve actuators) and the secondary devices or structures (mud mats, crossing frames...) when applicable.	Before offshore shipment	R	
Collect complete manufacturing data books (certificates, Non-conformity reports, NDT reports...) including Hydraulic and electrical flying leads.		R	
- Collect flowline as-laid survey reports & videos. - Collect hydro tests reports, all Non-Conformity and laying damage reports.	Before start-up	R	Key milestone in the overall integrity management plan
- Review the baseline gauging and calliper survey of the pipelines. - Assess pigging facilities for future pigging operations and confirm tightness of trap isolation valves. - When UT Housing systems are fitted, carry out base line UT wall thickness measurements.		R	
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered
Carry out internal inspection by the mean of intelligent pigging	Before start-up	Optional	As per paragraph 12.3

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 72 of 113

Table 12.3 - Deep Offshore Pipelines

(Flowlines sections and associated structures, Pipe in Pipe, Bundle, ...)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
First In-Service Inspection			
Perform a general geophysical survey (side scan sonar, pipe tracker, sub-bottom profiler) and visual inspection (ROV or AUV) of the flowline route to estimate flowline penetration, lateral displacement, free spanning, debris, damage.	Not > 2 years after start-up	R	Record and index video and pictures for next inspection
Perform a general visual inspection of the flowline termination and in-line structures (crossing, support frame) to monitor notable changes in their general condition, settlement and attitude (pitch and roll angles).			CP survey is applicable to rigid flowlines. Flexible Flowlines end fittings CP survey to be carried out
Perform a general CP survey of the complete sealine (when applicable), including CP local measurement points on associated initiation, in-line, termination, crossing & supporting structures			
Carry out wall thickness measurements into UT Housing systems.			
Carry out an internal inspection by the mean of instrumented pig (MFL or US, Calliper) where internal corrosion is a threat	Not > 3 years after start-up	R	May be waived where internal corrosion threat is minimum
Carry out function tests of Subsea valve actuators required for branch insulation (in-line tees) and pigging activities (permanent pig trap valves).	TBD by operating philosophy	G	With ROV Typical interval should be 3 year
Subsequent In-Service Inspection			
As per First In-Service Inspection	Not > 3 years	R	May be extended to 5 years for water injection lines
Carry out wall thickness measurements into UT Housing systems.	Not > 2 years (*)	R	(*) = 6 months when sand has been found
Carry out internal inspection by instrumented pig	Not > 5 years	R	May be: -extended to 10 yearly where corrosion risk is minimal -waived where there is NO potential for internal corrosion and positive CP monitoring results. In all cases, a formal corrosion assessment needs to be carried out.
Carry-out collection and analysis of operational data: - operating P&T (inlet/outlet) - fluid composition (H₂S, CO₂ content) - produced water (BSW, pH) - quantity /frequency of injected corrosion inhibitors - detection of sand and abrasive produced elements.	To be further assessed in the asset integrity management plan	R	

Table 12.3 - Deep Offshore Pipelines

(Flowlines sections and associated structures, Pipe in Pipe, Bundle, ...)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landslides or other geo-hazards), dropped objects, vessel collisions, observed damage, notable changes in the flowline route (side scan sonar results), alarming corrosion status (results from CP survey & internal inspection by instrumented pig).			

13. Dynamic Riser Systems (deep offshore)

This section addresses the following riser systems:

- Top Tension Risers,
- Riser Towers,
- Steel Catenary Risers,
- Flexible Risers.

Inspection and monitoring requirements given in this section are based on the recommended practice [DNV-RP-F206 "Riser Integrity Management"](#).

Inspection and Monitoring Plans of Dynamic Risers Systems shall be developed at early stage during engineering and design review.

13.1 Top Tension Risers

13.1.1 Design Review

Integrity of Top Tension Riser concept is highly dependent upon the tensioning device located at top of riser and the connection mechanism to the riser base foundation (or well head) located at bottom of riser.

As a minimum, a permanent tension monitoring system with a remote reading system installed in the control room shall be considered in order to monitor the tension of the link component between buoyancy tank and top of riser. The data processing method shall be carefully addressed to facilitate the interpretation. In particular, alarm levels and mean values on set-up periods will be made available for setting.

In addition, the following monitoring systems will be considered for critical risers:

- Angle at bottom of riser,
- Motion of buoyancy tank at top of riser.

13.1.2 Inspection Strategy

Detailed inspection and monitoring requirements are presented in Table **13.1**.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 74 of 113

Table 13.1 - Riser Systems - Top Tension Concept

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Design Review of monitoring system			
As per paragraph 14.1.1			
Inspectability Review			
Carry out a global criticality analysis. Address outcoming monitoring requirements in the project EPCC contracts. Minimum relevant data to be monitored are: - Tension in link between buoyancy tank and top of riser, - Angle at bottom of riser - Motion of buoyancy tank	During basic engineering phase and before EPCC Contract award	R	Purpose: identify critical items on which inspection & monitoring engineering shall be developed.
Collect contractors Failure Mode and Effect Criticality Analysis results, design monitoring systems and establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the monitoring devices to the riser design (top tension, riser CP, bottom connector integrity)
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of riser systems shall be the responsibility of Project. This section is therefore limited to modification and repairs occurring during the riser construction phase. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General & Project Specifications applicable to the equipment. When applicable, the monitoring devices /equipment integration and installation operation reports shall be collected.			
Qualification Programme Witnessing			
Inspection department representative shall witness the relevant and important milestones of the site integration and qualification tests programmes. In particular, ROV access to inspection areas, monitoring equipment integration, insulation materials qualification (cool down), functional and fatigue tests results shall be collected.			
Commissioning/Baseline Inspection			
Verify identification and length markings as well as cathodic protection measurement point locations on submerged metallic part.	Before end of construction phase	R	Detailed photographic survey to be carried out
Comprehensive photographic survey of the riser tensioning system.	Before shipment offshore, float out or installation	R	Both atmospheric element on the floating unit and Subsea elements shall be considered.
Witness qualification and factory acceptance test of the top tensioning and bottom connection devices.		G	
Collect offshore deployment and installation Non-conformity and damage reports form CONTRACTORS and Company Project representatives.	Before start-up	R	
Carry out post-installation visual survey and collect recorded video		R	
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered
Carry out internal riser pipe inspection by the mean of tethered or wire-lined instrumented tool (calliper, vertilog, or equivalent)	Before start-up	G	Results shall be used as a reference for future inspection.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 75 of 113

Table 13.1 - Riser Systems - Top Tension Concept

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
First In-Service Inspection			
Carry out a general visual survey of the entire riser. Perform close visual verification on sensitive parts (top tensioning and bottom connection systems, buoyancy element when applicable...).	Within first year after start-up	R	Recorded pictures and video to be used as reference for sub-sequent inspections
Perform a CP survey on submerged parts			
Subsequent In-Service Inspection			
General visual survey of the entire riser.	Yearly	R	Perform marine growth cleaning of exposed elements (keel joint, strakes...) if required.
Close visual verification of sensitive parts: - top tensioning and bottom connection systems, - buoyancy elements or air-cans, - thermal insulation condition when applicable.		R	
Perform a CP survey on submerged parts		R	
Assess for sacrificial anode consumption when applicable		R	
Carry out internal riser pipe inspection by the mean of tethered or wire-lined instrumented tool (calliper, vertilog, or equivalent).	Not > 5 years	R	May be extended to 10 years where corrosion risk is minimal and waived where there is NO risk of corrosion
Monitoring activities			
Gather and analyse data from the monitoring systems when available (such as hydraulic tensioning device pressure logger, stress/ motion sensors...)	As per detailed engineering phase but not > yearly	R	To be checked against pre-defined acceptance criteria
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landscape or other geo-hazards), dropped objects, vessel collisions, observed damage, notable problems in the tensioning devices, or the P, T operating parameters (out of maximum services ranges)			

13.2 Riser Towers

13.2.1 Design Review

Riser tower integrity is closely related to the constant buoyancy force created at top of riser and to the connecting mechanism between the major components of the riser tower, i.e., the buoyancy tank, the riser bundle (or riser pipe for single riser) and the bottom link device to the foundations (suction anchor, gravity base or driven piles).

As a minimum, a permanent tension monitoring system with a remote reading system installed in the control room shall be considered in order to monitor the tension of the link component between buoyancy tank and top of riser. The data processing method shall be carefully addressed to facilitate the interpretation. In particular, alarm levels and mean values on set-up periods will be made available for setting.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 76 of 113

In addition, the following monitoring systems will be considered for critical risers:

- Angle at bottom of riser.
- Motion of buoyancy tank at top of riser.

CP measurement points shall be created on the critical elements (such as buoyancy tank, taper joint and bottom of tower structure) at fabrication stage. In addition, the possibility to verify the corrosion condition of the core pipe and the riser pipes shall be carefully addressed at design. At least continuity cable with remote reference electrodes shall be proposed. The location of these points shall be ROV accessible and close to a grabbing facility (bars, profiles, protecting frames...) to allow the manipulation of the portable CP probe by ROV.

13.2.2 Inspection Strategy

Detailed inspection and monitoring requirements are presented in Table 13.2.

Inspection and monitoring requirements for flexible jumpers (between Floating Production Unit and top of Riser Tower) are given in paragraph 13.4.

Table 13.2 - Riser Systems - Riser Tower Concept

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Design Review			
As per paragraph 13.2.1			
Inspectability Review			
Carry out a global criticality analysis. Address out coming monitoring requirements in the project EPCC contracts. Minimum relevant data to be monitored are: • Tension in link between buoyancy tank and top of riser, • Angle at bottom of riser • Motion of buoyancy tank • Core Pipe cathodic protection	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identify critical items on which inspection & monitoring engineering shall be developed.
Collect contractors Failure Mode and Effect Criticality Analysis results, design monitoring systems and establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the monitoring devices to the riser design (buoyancy tank excursion, core pipe CP, local stress and motion monitoring)
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of riser systems shall be the responsibility of Project. This section is therefore limited to modification and repairs occurring during the riser construction phase. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General & Project Specifications applicable to the equipment. When applicable, the monitoring devices /equipment integration and installation operation reports for shall be collected.			
Qualification Programme Witnessing			
Inspection department representative shall witness the relevant and important milestones of the site integration and qualification tests programmes. In particular, ROV access /interface tests to inspection areas, monitoring equipment integration, insulation materials qualification (cool down), and fatigue tests results shall be collected.			

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 77 of 113

Table 13.2 - Riser Systems - Riser Tower Concept

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Commissioning/Baseline Inspection			
Verify identification and length markings and cathodic protection measurement point locations and grabbing facilities when relevant	Before end of construction phase	R	A detailed photographic survey is required.
Assist to integration and mounting of the transponder unit onto the buoyancy tank. CONTRACTOR shall provide as part of their dynamic analysis the relevant theoretical maximum alarm levels (i.e., max buoyancy tank excursion in the horizontal plan) as a function of the water ingress volume.	Before float-out /towing	G	This task is not applicable if the device is installed after riser tower installation and docking operation
Collect chronological construction phase pictures from Company QA/QC and site representative. Particular attention to be paid on the foam modules and insulation element sealing system for bundled pipes.	All along construction phase	R	
Place buoyancy foam coupon elements at marked location in the water column section (taper joint and bottom of tower frame structure locations) to allow easy ROV grabbing for sample recovery	Before float-out /towing	G	Number of coupons and recovery frequency to be assessed.
Collect complete manufacturing data books (material & welding certificates, painting /coating, NDT reports)		R	
Carry out a post-installation (docking) visual survey of the entire tower, including secondary elements such as goose necks, umbilical arches or bottom of risers elements (spool pieces, gravity weights...) when applicable.	After installation /Before start-up	R	
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered
Perform in-situ calibration of the buoyancy tank excursion motion monitoring system (transponder)	After installation (of all flexible jumpers)	G	Re-set theoretical alarms levels if needed by re-running the dynamic model using the data recorded on site.
Carry out internal pipe(s) inspection contained in the tower by the mean of intelligent pigging	Before start-up	G	Results shall be used as a reference for future inspection.
Operational Phase			
First In-Service Inspection			
Carry out a complete visual survey of the tower, and its main components (flexible jumpers, goose neck /spools, buoyancy tank, taper joint, umbilical arches, bottom of tower elements) when applicable.	Within the first year after start-up	R	Collected pictures and videos to be used as a reference for sub-sequent inspections
Carry out a CP survey on metallic submerged parts (buoyancy tank, taper joint, bottom of tower structure) and on the core pipe when accessible	Within first year after start-up	R	
Recover 1 buoyancy coupon element and send to third party laboratory for analysis.		G	
Collect and analyse data from the monitoring device systems designed and implemented during the project such as top of riser motion, tension monitoring, angle monitoring at bottom of riser.		R	

Table 13.2 - Riser Systems - Riser Tower Concept

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Subsequent In-Service Inspection			
Carry out a complete visual survey of the tower, and its main components (flexible jumpers, goose neck /spools, buoyancy tank, taper joint, umbilical arches, bottom of tower elements, base foundation connection, insulation material) when applicable. Report for seabed scour or seabed profile change or vertical displacement at riser base foundation location.	Yearly and as defined during the detailed engineering phase	R	
Carry out a CP survey on metallic submerged parts (buoyancy tank, taper joint, bottom of tower structure) and on the core pipe when accessible. Assess for anode consumption		R	
Marine growth assessment against design criteria		R	Perform marine growth cleaning if required.
Carry out internal pipe(s) inspection contained in the tower by the mean of intelligent pigging	Not > 5 years	R	May be extended to 10 years where corrosion risk is minimal and waived where there is NO risk of corrosion
Monitoring activities			
Collect and analyse data from the monitoring device systems designed and implemented during the project such as top of riser motion and tension monitoring, angle monitoring at bottom of riser.	Not > 6 months during the first 2 years of operation	R	Interval can be relaxed if results compare favourably to design acceptance criteria.
Recover 1 buoyancy coupon element and send to third party laboratory for analysis.	Not > 1 year	G	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landscape or other geo-hazards), dropped objects, vessel collisions, observed damage, buoyancy tank excursions...			

13.3 Steel Catenary Risers

13.3.1 Design Review

The integrity of the Steel Catenary Risers is mainly dependent upon the steadiness of their dynamic behaviour. A particular attention shall be paid to the elements in relation with this behaviour, mainly:

- Hang-off device.
- Vortex Induced Vibration (VIV) preventing devices (strakes).
- Hold back or guiding systems (hold back sling, sliding shoe) at touchdown point location.

As a minimum, the following monitoring systems shall be considered:

- Angle and Tension at Flex-Joint.
- Tension and Bending at Stress Joint.
- Tension and Bending at Touch Down Point.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 79 of 113

In addition, it is recommended that a Motion Record Unit and current meters are installed on the Floating Production Unit to monitor the actual site environmental constraints and riser excitations (mainly motions at riser hang-off, current profiles).

The gathered data will later be used (motion spectral analysis) to estimate the current fatigue damage of the riser by running the dynamic models used at design phase. It shall be noted that theoretical reference values shall be re-calculated later on upon fabrication completion to consider as-built parameters impacting the dynamic behaviour such as actual pipe thickness along the section (delta with nominal thickness, hi-lo tolerances, welding specifications...)

13.3.2 Inspection Strategy

Detailed inspection and monitoring requirements are presented in Table 13.3.

A particular attention shall be paid to the components sensitive to fatigue failure (e.g. riser pipe, flex-joint). The long-term performance of VIV strakes, hold back systems and other local devices should be addressed as well.

Dynamic, global and local fatigue analysis reports shall be carefully reviewed.

Table 13.3 - Riser Systems - Steel Catenary Concept

Inspection Type /Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Inspectability Reviews			
Carry out a global criticality analysis. Address outcoming monitoring requirements in the project EPCC contracts. Minimum relevant data to be monitored are : - Angle and Tension at Flex-Joint - Tension and Bending at Stress Joint - Tension and Bending at Touch-Down Point.	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identify critical items on which inspection & monitoring engineering shall be developed.
Collect contractors Failure Mode and Effect Criticality Analysis results, design monitoring systems and establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the monitoring devices to the riser design (MRU on floating unit, CP system, tension and angle monitoring)
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of riser systems shall be the responsibility of Project. This section is therefore limited to modification and repairs occurring during the riser construction phase. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General & Project Specifications applicable to the equipment. When applicable, the monitoring devices /equipment integration and installation operation reports for shall be collected.			
Qualification Programme Witnessing			
Inspection department representative shall witness the relevant and important milestones of the site integration and qualification tests programmes. In particular, ROV access to inspection areas, monitoring equipment integration, insulation materials qualification (cool down), and fatigue tests results shall be collected.			

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 80 of 113

Table 13.3 - Riser Systems - Steel Catenary Concept

Inspection Type /Integrity Tasks	When	Rule or Guidance	Comments
Commissioning/Baseline Inspection			
Verify identification, length markings, cathodic protection measurement point locations and grabbing facilities when relevant	Before end of construction phase	R	A detailed photographic survey is required.
Assist to integration and function tests of monitoring device when applicable (motion, angle, tension or temperature sensors)	During pre-fabrication process	R	
Collect NCR and minor repair reports as well as field joint weld NDT reports and fabrication /laying pictures from Company offshore representative or QA/QC.	During offshore fabrication, deployment /installation	R	
Carry out a complete visual survey of the riser and its components (VIV preventing devices, hold back systems, TDP area...)	After hook-up to floating unit	R	Recorded pictures & videos to be used as a reference for sub-sequent inspections
Check riser as-built thicknesses and revise input values to the riser dynamic model when necessary		R	
Perform a CP survey on protected metallic part when applicable		R	Recorded values to be used as a references for sub-sequent CP surveys
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered
Carry-out a commissioning and testing of the monitoring system when available		R	
Carry out internal riser pipe inspection by the mean of intelligent pigging	Before start-up	G	Results shall be used as a reference for future inspection.
Operational Phase			
First In-Service Inspection			
Carry out a complete visual survey of the riser and its components (VIV preventing devices, hold back systems...)	Within the first year after start-up	R	
Perform a CP survey on protected metallic part when applicable		R	
Subsequent In-Service Inspection			
Carry out a complete visual survey of the riser and its components (VIV preventing devices, hold back systems...). Particular attention to touch down point. Check for wear, chafing, seabed profile displacement. Compare with previous survey results.	Yearly and as defined during the detailed engineering phase	R	
Perform a CP survey on metallic part under protection		R	
Assess for anode consumption		R	
Marine growth assessment on exposed elements: flex joint if located in the splash zone, strakes		R	Perform marine growth cleaning if required.
Carry out a pipe internal inspection by the mean of intelligent pigging.	Not > 5 years	R	May be extended to 10 years where corrosion risk is minimal and waived where there is NO risk of corrosion

Table 13.3 - Riser Systems - Steel Catenary Concept

Inspection Type /Integrity Tasks	When	Rule or Guidance	Comments
Monitoring activities			
Collect and analyse data from monitoring devices designed and implemented during the project, such as motion, tension, angle, temperature sensors.	Yearly	R	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landslides or other geo-hazards),, dropped objects, vessel collisions, observed damage, dynamic behaviour (local motion /stress and angle monitoring devices availability depending), or the P, T operating parameters (out of maximum services ranges)			

13.4 Unbounded Flexible Risers and Pipelines

13.4.1 Design Review

Unbounded flexible pipelines shall be designed in accordance to **GS EP PLR 109**. Attention shall also be paid to the overall riser dynamic behaviour and the elements that drive this behaviour:

- Buoyancy modules (lazy wave arrangement).
- Supporting system (mid water arches and surface unit).
- Hold back or guiding systems.

Subsea networks combining flexible risers and rigid pipelines shall be designed to be pig-able. In particular, dedicated cleaning procedures shall be developed to be compatible with the flexible internal sheath design.

The complex fatigue behaviour of flexible riser systems is particularly difficult to evaluate in operation. A close review of dynamic analysis as well as global and local fatigue analysis shall be performed.

A particular attention shall be paid to the fabrication and mounting of flexible end fittings.

Particular attention shall be paid to the installation method statement to avoid external sheath damage which would result in corrosion of the tensile armoured layers. Furthermore, installation shall be carefully followed-up to detect any external sheath damage. Associated repair procedures and reports shall be considered for inspection plan consolidation.

Un-bounded flexible riser design shall consider dedicated monitoring systems:

- Annulus monitoring device shall be fitted at the riser termination ends in order to verify the external sheath integrity and to detect any water ingress in the annulus. Such device shall also be used to control and monitor the presence of condensed water in the annulus.
- Oil and gas flexible risers shall be equipped with dedicated annulus percolated gas venting and composition analysing devices.

General Specification		GS EP EXP 311
Plant integrity - Minimum inspection requirements		
Rev.: 03	Effective date: 10/2012	Page: 82 of 113

- A coupon removal device shall be made available to monitor the ageing of the internal polymer sheath in contact with the contained fluid.
- An acoustic device is recommended on top of riser for detection of armoured wire failure.
- Temperature and Pressure in the flexible riser shall be monitored to anticipate damage to the internal sheath.

In addition, it is recommended that Motion and Current record units are installed on the Floating Unit to monitor the actual site environmental conditions and riser excitations (mainly motions at riser hang-off, current profiles). The data will then be compared to the input data used for the dynamic analysis.

13.4.2 Inspection Strategy

Detailed inspection and monitoring requirements for flexible risers **and unbounded flexible pipelines** are presented in Table **13.4**.

The visual inspections aim at checking the overall condition of the flexible with particular attention to:

- The external sheath condition.
- The behaviour of the driving elements of the dynamic flexible riser, typically: Hang-off device, buoyancy modules (lazy wave arrangement), supporting system (mid-water arches) and hold back or guiding systems (hold back sling, sliding shoe at touch-down point).
- The condition of attachment and link parts of these items.

Complementary solution shall be assessed if external sheath is not visually accessible in splash zone (I or J-tube vent test, for example)

All monitored parameters (annulus monitoring, percolated gas samples, polymer coupons, operating conditions, motion...) shall be checked versus the acceptance criteria or alarm thresholds defined during the detailed engineering.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 83 of 113

**Table 13.4 - Riser Systems – Unbounded Flexible Concept
Unbounded Flexible Pipelines**

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Inspectability Reviews			
Carry out a global criticality analysis. Address outcoming monitoring requirements in the project EPCC contracts. Minimum relevant data to be monitored are: - annulus condition monitoring, - annulus gas composition, - inner sheath polymer coupon - motion data	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identify critical items on which inspection strategy & monitoring devices shall be engineered.
Collect contractors Failure Mode and Effect Criticality Analysis results, Design monitoring systems and establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the monitoring devices according to the riser design
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of riser systems shall be the responsibility of Project. This section is therefore limited to modification and repairs occurring during the riser construction phase. - Individual Quality Plans shall be prepared for each modification or repair. - The level of Quality Control shall be determined in accordance with the General & Project Specifications applicable to the equipment. - When applicable, internal sheath samples shall be collected for representative coupons to be used for site monitoring of internal sheath ageing - When applicable, the monitoring devices / equipment integration and installation operation reports shall be collected. - Carry out site fabrication visits and collect chronological batches of pictures. - Witness flexible spooling sequence.			
Qualification Programme Witnessing			
Inspection department representative shall witness the relevant and important milestones of the site integration and qualification test programmes In particular: - ROV access to inspection areas, - monitoring equipment integration, - insulation materials qualification (cool down), - fatigue tests results - annulus test (with flow rate control) reports shall be collected.			
Commissioning/Baseline Inspection			
Verify identification and length markings and cathodic protection measurement point locations on end fittings.	Before end of construction phase	R	A detailed photographic survey is required.
Carry out a comprehensive photographic survey of the end fittings	Before shipment /installation	R	Check CP system (sacrificial anodes), vent system and other when accessible.
Collect flexible pre-abandonment survey reports & Videos. Collect pre-abandonment pressure tests reports as well as all Non-Conformity and minor laying damage reports.	Before Hook-up	R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 84 of 113

**Table 13.4 - Riser Systems – Unbounded Flexible Concept
Unbounded Flexible Pipelines**

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Collect post hook-up pressure test reports and pre-commissioning test summary sheets as well as all Non-conformity, installation /hook-up damage reports from the installation CONTRACTORS and Company representatives.	Before start-up	R	Key milestone in the global integrity management plan
Carry out a post-hook up (dynamic riser in place) visual survey and collect recorded video.		R	Will be used and compared with the first in-service inspection
Collect complete manufacturing data books (certificates, Non-conformity reports, NDT reports...)		R	
Perform a CP survey on protected metallic part when applicable		R	To be used as reference for subsequent CP surveys
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered
Carry out commissioning and start-up of the monitoring devices available on the flexible riser system. Collect start-up records, user manual and relevant information about the monitoring devices.		R	Vent gas composition, annulus monitoring, motion record unit when applicable.
Operational Phase			
First In-Service Inspection			
Visual inspection of the complete riser: above water line, splash zone (with divers) and end fitting termination.	Within the first year after start-up	R	See comments in paragraph 13.4.2
CP system survey when accessible (flexible end fitting)		R	Potential measurements, anode consumption
HC lines: Collect annulus gas sample from the gas venting system and send to laboratory for analysis		R	Gas composition shall be as per armour wire design specification
HC lines: Carry-out annulus vacuum or nitrogen pressure tests as per relevant procedures.		R	To check for outer sheath integrity
Subsequent In-Service Inspection			
As per first in-service inspection.	Yearly	R	
Assess for marine growth on exposed elements (bell mouth, I-tube, J-tube entry, hang-off collar...)			Perform marine growth cleaning if required.
Offshore 500 metre zone: External General Visual Inspection (with ROV) from riser splash zone including: - Cathodic Protection (CP) survey, pipeline crossings and other pipeline features - annulus Gas Relief Valves (located at sub sea flexible ends) function check for bubbling	Not > 2,5 years	R	Combined with hull survey GRV's to be cleaned as required.
Offshore Remote section: General Side Scan Sonar plus ROV survey of specific pipelines details plus areas of concern		R	
Offshore Remote section: ROV Survey including Cathodic Protection (CP) survey of complete pipelines	Not > 5 yearly	R	Check annulus sub-sea GRV when applicable
Remove Passive Fire Protection shell, where relevant	Not > 5 yearly		

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 85 of 113

**Table 13.4 - Riser Systems – Unbounded Flexible Concept
Unbounded Flexible Pipelines**

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Engineering Reviews			
When applicable, spectral analysis of data gathered from the motion record unit	Not > yearly	R	
Estimation of riser fatigue (based on the above)	Not > 5 yearly	R	
Monitoring activities			
HC lines: - Collect annulus gas sample from the gas venting system and send to laboratory for analysis - Carry-out annulus vacuum tests as per relevant procedure	Every 6 months	R	To be extended or decreased depending on confidence.
Collect and analyse operational data: - operating P&T inlet/outlet, - line depressurisation (pressure, rate, duration), - fluid composition (H₂S, CO₂ contents), - produced water (composition, pH), - composition, quantity, frequency of injected products (methanol, corrosion inhibitors), - detection of sand and abrasive produced elements.	As defined during the detailed engineering phase	R	
Collect data from other monitoring systems: - environmental conditions, - motion, - annulus monitoring - armoured wire rupture acoustic detection device, - polymer coupons.	As defined during the detailed engineering phase	R	Depend on the data acquisition system
Ad-hoc inspection			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in: - the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landslides or other geo-hazards), - the flexible annulus gas composition (out of acceptable ppm ranges) - P, T operating parameters (out of maximum services ranges) Following: - dropped objects, - vessel collisions, - observed damage			

14. Subsea Umbilical Systems (deep offshore)

14.1 Dynamic Umbilical Sections

14.1.1 Design review

The integrity of the dynamic umbilical is closely linked to the elements involved in the dynamic behaviour such as end fitting, bend stiffeners, buoyancy modules for lazy wave configuration, gutters for mid water arch support concept and hold back system (tether and gravity base) at touchdown point location.

14.1.2 Inspection Strategy

Detailed Inspection Strategy is presented in Table 14.1.

Table 14.1 - Dynamic Umbilical Sections

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Inspectability Reviews			
Carry out a global criticality analysis. Address outcoming design & inspectability requirements in the project EPCC contracts. Pay special attention to markings, bend stiffeners, buoyancy modules and hold back systems when applicable. Splicing repair kits shall be considered.	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identify critical items on which inspection & design engineering shall be developed.
- Collect contractors Failure Mode and Effect Criticality Analysis results, - Design monitoring systems - Check for: - end fittings concept, - material selection for the umbilical piping v/s corrosion - storage /transportation procedures - arrangement of contact pieces between the outer sheath and the secondary elements (wear shoes on the gutter for example) - Establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the design and inspectability of the dynamic umbilical equipment.
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of umbilical systems shall be the responsibility of Project. This section is therefore limited to modification and repairs occurring during the umbilical construction phase. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General & Project Specifications applicable to the equipment. The spooling, yard keeping and storage conditions shall be closely followed-up in particular the quality of the piping filling fluid (HW540, dye & inhibitors).			

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 87 of 113

Table 14.1 - Dynamic Umbilical Sections

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Qualification Programme Witnessing			
Inspection department representative shall witness the relevant and important milestones of the site integration and qualification test programmes. In particular qualification reports for: • bend stiffener /restrictors fatigue test, • lifting device interface with termination end, • buoyancy module and attachment device • hold back system when applicable shall be collected.			
Commissioning/Baseline Inspection			
• Verify identification and length markings, bend stiffener /restrictors and buoyancy modules (when applicable) integrity. • Check hydraulic fluid quality (HW540, dye /inhibitor)	Before end of construction phase	R	A detailed photographic survey is required.
• Carry out a comprehensive photographic survey of the end fittings • Check CP system (sacrificial anodes), vent system when accessible.	Before shipment /installation	R	
• Collect umbilical pre-abandonment survey reports & Videos. • Collect pre-abandonment pressure tests reports as well as all Non-Conformity and minor laying damage reports.	Before Hook-up	R	
Collect reports: • post hook-up pressure test • pre-commissioning test summary sheets • Non-conformities • installation /hook-up damage from the installation Contractors and Company representatives.	Before start-up	R	Key milestone in the global integrity management plan
Carry out a post-hook up (dynamic umbilical in place) visual survey and collect recorded video.		R	Will be used and compared with the first in-service inspection
Collect complete manufacturing data books (certificates, Non-conformity reports, NDT reports...)		R	
Perform a CP survey on protected metallic part when applicable Perform echochart signature for electrical wires		R	Recorded values to be used a references for subsequent CP surveys For further electrical faults locations
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered

Table 14.1 - Dynamic Umbilical Sections

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
First In-Service Inspection			
General Visual Inspection of the umbilical dynamic section submerged elements including: - hang-off area (bend stiffener), - mid-water elements (buoyancy module, arch gutters - touch down area and hold back system (clamp + tether + base anchors) when applicable	Not > 1 year after start-up	R	
Perform relevant CP system verifications when applicable and accessible (umbilical end fitting)		R	
When relevant: CVI (Close Visual Inspection) of damages on the outer sheath recorded during installation phase.		R	
Subsequent In-Service Inspection			
As per First In-service Inspection	Yearly	R	
Electrical function tests on spare quads	Not > 6 Monthly	G	From Subsea Panel Control Unit in topside control room.
Carry out a continuity test of the umbilical spare electrical quads	TBD (Not > 1 year)	G	Frequency to be set-up by the operation philosophy
Hydraulic and service lines: - Flow rate verification - Flush and clean		G	
Renew inert fluids in the unused lines by flushing to sea or back flushing to surface tank via local Subsea bridging device (Subsea hydraulic connector)		G	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landslides or other geo-hazards), dropped objects, vessel collisions, observed damage on outer sheath, buoyancy module slippage /release or other alarming event.			

14.2 Static Umbilical Sections & Distribution Units

14.2.1 Design Review

Particular attention shall be paid to the static electrical and hydraulic distribution and junction elements design (Distribution Unit or Boxes) available along the umbilical section.

In particular, the design of the bend restrictors at the inlet and outlet of the junction boxes shall be carefully looked at against the installation method statement to avoid local overstress and vertebra cracks.

Subsea meet-able electrical connectors design reliability shall be closely addressed up as continuity and ground fault failures on distribution unit inboard connectors can be considered as major critical failures for the Subsea network.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 89 of 113

14.2.2 Inspection Strategy

Detailed Inspection Strategy is presented in Table 14.2.

Table 14.2 - Static Umbilical Sections

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Inspectability Reviews			
Carry out a global criticality analysis. Address outcoming design & inspectability requirements in the project EPCC contracts (markings, bend restrictors, distribution unit). Splicing offshore repair kits shall be considered.	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identify critical items on which inspection & design engineering shall be developed.
- Collect contractors Failure Mode and Effect Criticality Analysis results, - Design monitoring systems - Establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the design and inspectability of the static umbilical equipment.
Pre Start-up Phase			
Qualification Programme Witnessing			
Inspection department representative shall witness the relevant and important milestones of the site integration and qualification tests programmes. In particular: - bend restrictor fatigue tests, - hydraulic /electrical terminations (resin material, splicing quality) in distribution units /boxes - lifting device interface with termination end.			
Commissioning/Baseline Inspection			
- Verify identification and length markings, bend restrictors and distribution boxes /units hydraulic & electrical terminations. - Check filling hydraulic fluid quality (HW540, dye /inhibitor)	Before end of construction phase	R	A detailed photographic survey is required.
- Carry out a comprehensive photographic survey of the distribution units and the end fittings (before and after spooling) - Check CP system (sacrificial anodes), vent system when accessible.	Before shipment /installation	R	
- Collect umbilical post-abandonment survey reports & videos. - Collect hydro tests reports as well as all Non-Conformity and minor laying damage reports.	Upon laying completion	R	Key milestone in the overall integrity management plan
Collect umbilical post-installation survey of the hydraulic and electrical flying leads (power distribution Subsea cables to adjacent Subsea structures)	Upon flying leads installation	R	
Collect complete manufacturing data books (certificates, Non-conformity reports, NDT reports...) including Hydraulic and electrical flying leads.	Before start-up	R	
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 90 of 113

Table 14.2 - Static Umbilical Sections

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
First In-Service Inspection			
GVI of the umbilical section and distribution units including: - seabed profile around the mud mat surface (and evolution) - bend restrictor condition	Not > 1 year after start-up	R	Record video pictures. Results to be compared to as-laid results
Close visual inspection of each electrical and hydraulic inboard connector available on the distribution units.		R	
CP survey on protected metallic part (distribution box structure, end fittings) when applicable		R	Recorded values to be used a references for subsequent CP surveys
Subsequent In-Service Inspection			
As per First In-Service Inspection	Every 2 years	R	
Check embedment of long umbilical sections between 2 consecutive distribution units	Every 5 years	R	
Continuity test of the umbilical spare electrical quads	TBD (Not > 1 year)	G	Frequency to be tuned by the operation philosophy
Renew inert fluids in the unused lines by flushing to sea or back flushing to surface tank via local Subsea bridging device (Subsea hydraulic connector)		G	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landslides or other geo-hazards), dropped objects, vessel collisions, observed damage on bend restrictors, distribution box attitude modification, or other alarming event.			

15. Manifolds & foundations (deep offshore)

15.1 Design review

The Subsea production manifold design shall respond to the requirement for sensitive parts to be recovered by module. This shall be the result of a detailed criticality assessment carried out by the SPS equipment supplier.

Items with high failure probability such as control pods or vital or most utilized actuators shall be modular-recoverable with the help of Remotely Operated Vehicle (ROV) and /or light intervention Remotely Operated Tools (ROT). The failure rates used by SPS equipment suppliers for this evaluation shall be as realistic as possible.

Design of insulation material (syntactic foam, moulded insulation neoprene, high technical insulation layers or other) shall be reviewed against thermal insulation capability and ageing behaviour at ambient conditions. A complete qualification programme to verify the thermal insulation capability shall be proposed, including a cool down test according to a representative protocol. Particular attention shall be paid to the sealing of the insulation covers on top of the

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 91 of 113

Subsea connectors and “cold spots” or “thermal bridges” in the system shall be avoided as much as possible.

Material selection and associated cathodic protection system and electrical continuity shall be carefully addressed. The risk of Hydrogen Induced Stress Cracking (HISC) of duplex stainless steels under cathodic protection shall also be considered. In particular, an accurate quality process shall be implemented for piping supports, bolt and fastener installation during manifold fabrication process.

Foundation of the manifold structures (both support structures and foundation anchors) shall be designed to undertake most of the loads & stresses induced by the Subsea connections to the module.

15.2 Inspection Strategy

Detailed Inspection Strategy is presented in Table 15.1.

Table 15.1 - Manifolds & Foundations (deep offshore)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Design Phase			
Inspectability Reviews			
Carry out a global criticality analysis. Address outcoming requirements in the project EPCC contracts. In particular: - Ability of critical items on manifold module (valve, pods, pig detectors, other sensors...) to be modular-removed; - insulation parts (covers...) sealing quality - foundation resistance to well jumper and spool induced loads.	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identified critical items on which design and inspection engineering shall be developed.
- Collect contractors Failure Mode and Effect Criticality Analysis results, - Design monitoring systems - Establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the design & inspectability of the equipment
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA on the manifold modules c/w sub-modules (control pods, choke valves, adjustable throttle devices..) and support structure /foundation equipment shall be the responsibility of Project. This section is therefore limited to modification and repairs occurred on the equipment. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Subsea Production Systems.			

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 92 of 113

Table 15.1 - Manifolds & Foundations (deep offshore)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Commissioning/Baseline Inspection			
Verification of Technical Records and Registration of Technical Details in Plant Inventory. Particular attention shall be paid to: • Super Duplex Welding NDT, • coating material certificates, • metrology land surveys, • rigging sketches + bill of material, • FAT reports of major component (control pods, valve, recoverable sensors...).	Before Hand-Over from Project to Field Operations	R	Performed during fabrication phase and reception of the equipment.
General Visual Inspection of the structural parts with attention to: • identification and marking of electrical cable routing, • temporary and permanent pressure caps.	Before offshore shipment	R	Performed at fabrication site. A check list shall be specifically established to report for this survey.
Comprehensive photographic survey of the structures (FORE, AFT, LEFT, RIGHT and TOP faces) as well as the visible sacrificial anodes, boundary continuity cables and main fasteners (bolts, nuts and washers or other).		R	Performed at fabrication site
Comprehensive pre-deployment survey if the equipment is stored for more than 15 days onboard the cargo barge prior to deployment.	Before offshore deployment	G	Performed offshore on deployment vessel or cargo barge
Prepared inspection worksheet /drawings with relevant information on high interest areas of inspection.	Before installation	R	3D views are strongly recommended to ease ROV pilot appraisal
Confirm as-built weight, Centre Of Gravity		R	To be part of the As-built dossier
Scour survey of the structure foundations with video recording and photographs.	After installation	R	
Carry out an as laid survey of the structures. Record as-laid attitude data: Pitch, Roll and heading angles,	After installation	R	Record both with the ROV embarked inertial sensors and devices pre-installed on the structures.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 93 of 113

Table 15.1 - Manifolds & Foundations (deep offshore)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
First In-Service Inspection			
GVI of the equipment. Check condition of: - FORE, AFT, RIGHT, LEFT and TOP faces of structures - visible anodes - boundary continuity cables - main fasteners	Within 1 year after start-up	R	Video and still pictures to be compared to baseline data
Carry out a seabed survey around base foundation to estimate seabed scour and foundation settlement. Assess structure attitude (heading, pitch /roll angle) evolution.			Attitude shall be recorded both with the ROV embarked inertial sensors and the attitude measurement devices pre-installed on the structures (bulls eye for instance)
Cathodic Protection (CP) survey of the structures (manifold + supporting structures). Both reference anodes and structural potential shall be measured using a calibrated ROV CP portable probe.			Beware of over-protection
CVI and thermal leak detection of the sealing of all insulated parts with emphasis on insulation covers at connections.			
Subsequent In-Service Inspection			
Seabed survey as per First In-service Inspection	Yearly	R	
As per First In-service Inspection	2 yearly	R	
insulated system only: Collect & analyse data from temperature sensors available on the production manifold insulated piping to verify its thermal insulation capacity.	During cool down test of the Subsea production system	R	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction landslides or other geo-hazards), dropped objects, vessel collisions, observed damage, notable changes in the thermal insulation performances of the system (production only), important seabed profile evolution along well jumper route.			

16. Xmas Tree & Well Jumper (deep offshore)

16.1 Design review

Sensitive elements in the Xmas Trees such as:

- Control pod.
- Specific valves (choke, chemical injection).
- Metering devices.
- And most vital or frequently used actuators.

shall be recoverable by module by the mean of Remotely Operated Vehicles (ROV) and/or light intervention Remotely Operated Tools (ROT).

Refer to paragraph **15.1** when it comes to cathodic protection and insulation system design.

Insulation parts installed separately on the cold spots (bottom guiding skirt, insert choke module...) shall present an efficient sealing system and shall be tested carefully during the qualification programme.

On particular critical areas (such as bend, fittings downstream choke-valve,...), an UT (Ultrasonic Test) housing system shall be considered to allow ROV positioning for further measurements.

Permanent guide base (or other Xmas Tree module supporting structure in mechanical interface with the well conductor pipe) shall be designed to undertake most of the loads & stresses induced by the well jumper connection.

Capability to monitor the well jumper stresses or loads transmitted to adjacent Subsea structure piping (either manifold piping for cluster arrangement, or flow lines in-line tee/termination end structure piping for lazy chain arrangement) shall be considered.

Misalignment (axial / angle) tolerances shall be stipulated and the complete chain of errors (Subsea metrology tools + fabrication jigs set-up + fabrication + as-built measurement tools) shall be considered and followed-up until end of fabrication phase.

If a non-supported concept has been selected for flow constraints, the monitoring methodology to assess for buoyancy module ageing (effect of ambient conditions) shall be addressed in the design.

16.2 Inspection Strategy

Detailed Inspection Strategy is presented in Table **16.1**.

Wellheads and Xmas Trees (Seabed Barriers), after transfer from Drilling to Field Operations shall be subject to regular tests defined in accordance with Company Rules. Clear responsibility limits between the departments shall be defined.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 95 of 113

Table 16.1 - Xmas Tree & Well Jumpers (deep offshore)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Design Phase			
Inspectability Reviews			
Carry out a global criticality analysis. Address outcoming requirements in the project EPCC contracts. In particular: - metrology tolerances - allowable connector stresses for the well jumpers - modularity of critical items on Xmas Trees (valve, pods...) and the insulation parts (covers...)	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identified critical items on which design and inspection engineering shall be developed.
Collect contractors Failure Mode and Effect Criticality Analysis results, design monitoring systems and establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the design & inspectability of the equipment
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of Xmas Tree modules c/w sub-modules (control pods, choke valves, adjustable throttle devices..) and well jumper equipment (pipe, cables and connectors) shall be the responsibility of Project. This section is therefore limited to modification and repairs of sub-sea structures and equipment. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General Specification for Subsea Production Systems. A particular QA/QC effort shall be made to verify the well jumper transmitted stress contributors (tolerances and errors) all along the process (metrology, fabrication, as-built measurement and installation). Refer to Commissioning /Baseline inspection - Well jumpers section of this table.			
Commissioning/Baseline Inspection of Xmas Trees			
Verification of Technical Records Upload Technical Details in Plant Register. Attention shall be paid to: - Super Duplex Welding NDT, - coating material certificates, - metrology land surveys, - rigging sketches + bill of material, - FAT reports of major component (control pods, choke valve...).	Before Hand-Over from Project to Field Operations	R	Performed during fabrication phase and reception of the equipment.
GVI of structural parts and sensitive parts such as identification markings of electrical cable routing.	Before offshore shipment	R	Check list to be specifically established.
When UT Housing systems are fitted, carry out base line UT wall thickness measurements.		R	
Comprehensive photographic survey of the structures (FORE, AFT, LEFT, RIGHT and TOP faces) as well as the visible sacrificial anodes, boundary continuity cables and main fasteners (bolts, nuts and washers or other).		R	Performed at fabrication site
Comprehensive pre-deployment survey if the equipment is stored for more than 15 days onboard the cargo barge prior to deployment.	Before offshore deployment	G	Performed offshore on deployment vessel or cargo barge

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 96 of 113

Table 16.1 - Xmas Tree & Well Jumpers (deep offshore)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Prepared inspection worksheets and drawings with relevant information on areas of interest for inspection.	Before installation	R	3D access views are strongly recommended to ease ROV pilots
Confirm as-built weight, Centre Of Gravity and final dimension leg lengths		R	
Collect As-built 3D Isometric Views of the well jumpers		R	To be provided by the manufacturer
Scour survey of the structure foundations and free span survey along the well jumper route	After installation	R	For comparison with subsequent inspections
Carry out an as laid survey of the structure and the well jumper. Record as-laid attitude data (Pitch, Roll and heading angles), both with the ROV sensors and with pre-installed on the structure devices	After installation	R	
Commissioning/Baseline Inspection of Well Jumpers			
Verification of well jumper Subsea metrology results, and carry-out calculation verifications against allowable stress transmitted to inboard subsea structure piping.	After Subsea structure installation (manifold, Xmas Tree, FLET...)	R	Sensitive point to prevent risk of overloading the connectors (third party contract is advised)
Verification fabrication jigs set-up protocol	Before jumper fabrication starting		
Verification as-built measurements against max allowable design tolerances. Calculation checks are advised.	Upon jumper fabrication completion		
GVI of structural parts and sensitive parts such as: - identification markings electrical cables routing, - piggy back racks, - buoyancy attachment device, - electrical connectors - Multi-Phase Flowmeter or other sensors when applicable.	Before offshore shipment	R	Check list to be specifically established
Comprehensive pre-shipment photographic survey of the rigging arrangement and yard lift trials (rigging adjustments).		R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 97 of 113

Table 16.1 - Xmas Tree & Well Jumpers (deep offshore)

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
First In-Service Inspection			
GVI of the equipment. CVI to check condition of: - FORE, AFT, RIGHT, LEFT and TOP faces of structures - visible anodes - boundary continuity cables - sealing devices of all insulated parts - main fasteners	Within 1 year after start-up	R	Video and grabbed pictures to be compared to baseline data
Cathodic Protection (CP) survey of the structure and the well jumper. Potential measurements. Assess for anode consumption when anodes are visible.			
Perform a scour survey of the structure base foundations.			Pictures to be compared to baseline recorded data
Carry out a free span survey along the well jumper route and check for sand /silt accumulation.			Perform water ROV local jetting of sand /silt accumulation if required.
Carry out wall thickness measurements into UT housing systems.			
Collect & analyse data from Temperature sensors available on the production Xmas Tree insulated piping , and verify the thermal insulation efficiency of the Subsea production system.	During loop start-up	R	To be compared with the other sensors located on the production loop
Subsequent In-Service Inspection			
As per 1 st in-service inspection	Not > 2 years	R	
Production and Gas Injection: GVI as per 1 st in-service inspection.	Yearly	R	
Wall thickness measurements when sand has been found.	Not > 6 Monthly		
Collect & analyse data from Temperature sensors available on the production Xmas Tree insulated piping , and verify the thermal insulation efficiency of the Subsea production system.	During cool down test of the SPS (frequency to be defined)	R	To be compared with the other sensors located on the production loop
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landslides or other geo-hazards), dropped objects, vessel collisions, observed damage, notable changes in the thermal insulation performances of the system (production only), important seabed profile evolution along well jumper route.			

17. Oil Offloading Lines (deep offshore)

This section only addresses the inspection requirements applicable to Oil Offloading Lines in deep water environment.

Inspection details for offloading buoy are described in paragraph **11.3**.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 98 of 113

17.1 Design review

Oil offloading lines design shall be reviewed to ensure that the critical parts, typically:

- Termination flex joints.
- End fitting attachment devices (chains...) when applicable.
- Buoyancy modules (lazy wave arrangement).

are able to resist hydrodynamic loads and cyclic pressure and temperature regime.

Fatigue shall be considered in the design of the export lines. For rigid concept, Vortex Induced Vibration preventing devices (strakes) shall be considered.

The attachment mechanism of the buoyancy modules and their CP system shall be addressed in detail in the lazy wave offloading line concept.

Pig-ability of the oil offloading lines shall carefully be addressed.

17.2 Inspection Strategy

Detailed Inspection Strategy is presented in Table 17.1.

In addition, requirements in paragraph 13.4 are applicable to flexible concept lines.

Table 17.1 - Oil Offloading Lines

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Inspectability Reviews			
Carry out a global criticality analysis. Address outcoming monitoring requirements in the project EPCC contracts: • internal pressure & temperature, • tension /stress at hang-off, • pressure layer condition for flexible concepts, • vortex induced vibration for rigid concepts. Address inspectability of flex joint, and pig-ability of the lines.	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identify critical items on which inspection & monitoring engineering shall be developed.
Collect Contractors Failure Mode and Effect Criticality Analysis results, design monitoring systems and establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the monitoring devices to the riser design
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of oil offloading lines shall be the responsibility of Project. This section is therefore limited to modification and repairs occurring during the riser construction phase. Individual Quality Plans shall be prepared for each modification or repair. The level of Quality Control shall be determined in accordance with the General & Project Specifications applicable to the equipment. When applicable, the monitoring devices /equipment integration and installation operation reports for shall be collected. Chronological batches of pictures shall be collected and archived.			
Commissioning/Baseline Inspection			
Verify identification and length markings and cathodic protection measurement point locations	Before end of construction or laying phase	R	A detailed photographic survey is required.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 99 of 113

Table 17.1 - Oil Offloading Lines

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Carry out a comprehensive photographic survey of: • end fittings, • flex joints • buoyancy modules and attachment devices, tether / hold back systems	Before shipment /installation	R	
Carry out a post-installation (oil offloading line in place) visual survey and collect recorded video.	Before start-up	R	Key milestone in the global integrity management plan
Collect complete manufacturing data books (certificates, Non-conformity reports, NDT reports...)		R	
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered
Carry out commissioning and start-up of the monitoring devices when applicable. Collect start-up records, user manual and relevant information about the monitoring devices.		R	Flex joint inspection, VIV, Stress monitoring or other when applicable.
Operational Phase			
First In-Service Inspection			
GVI of the oil offloading line submerged elements from one end to the other. CVI on critical elements such as buoyancy modules or hold back tether / chain systems.	Within the first year after start-up	R	
CP system verification: • along oil offloading line (rigid concept) • at flexible end fitting.		R	when applicable and accessible
Collect data from monitoring devices	Depends on monitoring system	G	To be further assessed against design /allowable or limitation criteria
Subsequent In-Service Inspection			
CVI of in-air parts of end fittings and flex joint device	Not > 6 Monthly	R	
As per 1 st in-service inspection	Not > yearly	R	
Rigid concept: intelligent pigging	Not > 5 yearly	R	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landslides or other geo-hazards), dropped objects, vessel collisions, observed damage or notable changes in the flexible dynamic behaviour.			

18. Mooring Systems

Equipment in this section includes the following:

- Mooring lines main components (chains or/and wire rope).

- Mooring supporting equipment (fairleads, stoppers, loading bearing segment and connecting devices).
- Accessories between the floating unit and the seabed.
- Anchor (suction pile or foundation).

with the exception of:

- The mooring equipment used for tandem offloading operations and for tanker shuttle attachment to offloading buoy.

18.1 Classification of Floating Units' mooring systems

The Floating Unit's permanent mooring system is covered by the Rules of the Classification Society. The Classification Society's requirement for surveys of mooring line components must be taken into consideration in the inspection plan (for FUs classed with Bureau Veritas, the requirements are included in the BV Guidance Note NI 493).

Note: Classification does not usually cover windlass, winches, sheaves, used for deployment of the system or for occasional handling of lines during vessel operation (retensioning equipment), nor associated monitoring and control systems.

18.2 Design review

As a mooring system can be considered as a spring-type link between a floating unit and the fixed mooring anchor base located on the seabed, link parts at top end and along the line section shall be designed to resist wear and fatigue induced by dynamic loads.

A system shall be installed to permanently monitor tension in the lines (and derive line stiffness) as it is considered a key parameter in the whole mooring system. Line tension monitoring threshold and alarm values will either be expressed in terms of stress values or floating unit excursions as a function of the sea state.

It is also advised that the particular points where potential accelerated fatigue and wear out phenomena are expected are designed compliant with a facilitated inspection device (such as permanent wired video device for instance). In particular, the upper chain section interface or contact areas with chain stoppers, fairleads or other articulated devices is particularly exposed to fatigue, and dedicated local monitoring techniques (such as load cells, wear out indicators, video surveillance...) at these locations shall be considered in the mooring system design.

To avoid excessive localised wearing on fairleads of mooring lines, tension changes may be requested by Manufacturer. At detail engineering phase, change frequency has to be recorded and then included in inspection plan.

18.3 Inspection Strategy

The inspection strategy presented in Table 18.1 is two-fold:

- Main inspection requirements of the Classification Society.
- Additional Company inspection requirements.

The inspection plan shall consider system for permanent monitoring of tension in the lines, if fitted, together with particular points where potential accelerated fatigue and wear out phenomena are expected from the design review. In particular, the upper chain section interface

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 101 of 113

or contact areas with chain stoppers, fairleads or other articulated devices are particularly exposed to fatigue and wear out. Dedicated local monitoring techniques (such as load cells, wear out indicators, video surveillance...) at these locations shall be considered).

Table 18.1 - Mooring system

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Inspectability Reviews			
Carry out a global criticality analysis. Address out coming monitoring requirements in the project EPCC contracts. Mainly: - line tension, - upper chain section, fairlead, chain stoppers, articulated pieces and link parts condition.	During basic engineering phase and before EPCC CONTRACT award	R	Purpose: identify critical items on which inspection & monitoring engineering shall be developed.
Collect Contractors Failure Mode and Effect Criticality Analysis results, design monitoring systems and establish inspection strategy.	At the earliest in the detailed design phase of EPCC Contract	R	Purpose: Implement and optimise the monitoring devices to the equipment design
Define Tension variation and frequency	At detailed design phase	R	Purpose: avoid excessive wear on fairleads
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of mooring lines shall be the responsibility of Project. This section is therefore limited to modification and repairs occurring during the mooring lines construction spooling and transportation phases. Individual Quality Plans shall be prepared for each phase. The level of Quality Control shall be determined in accordance with the General & Project Specifications applicable to the equipment. When applicable, the monitoring devices integration and installation operation reports shall be collected. Chronological batches of pictures shall be collected and archived until the mooring lines hook-up has been completed.			
Commissioning/Baseline Inspection			
Verify identification, length markings and cathodic protection measurement point locations on anchor bases and on mooring lines linking parts when applicable. Verify inspectability and ROV access on singular future inspection points.	Before end of construction phase	R	A detailed photographic survey is required.
Carry out a comprehensive photographic survey of the chains: - marking on chain links - sockets, shackle & anodes - suction anchors marking, - vent or hatch sealing.	Before shipment /installation	R	
Carry out baseline chain links measurements on the upper chain section.		R	Values to be compared to API RP 2I & DNV standards.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 102 of 113

Table 18.1 - Mooring system

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Carry out a post-installation (mooring line in place) visual survey and collect recorded video.	Before start-up	R	Key milestone in the global integrity management plan
Collect complete manufacturing data books (certificates, Non-conformity reports, suction anchor hatch seal testing, chain, link and tensioning devices load tests...)		R	
Prepare inspection worksheets and consolidate inspection plan		R	Defects from installation phase to be considered
Carry out commissioning and start-up of the monitoring devices available on the mooring lines. Collect start-up records, user manual and relevant information about the monitoring devices.		R	
Collect Classification notation certificates.		R	
Establish: - excursion and draught threshold allowable values - criteria for re-tensioning the mooring lines corresponding to different load cases applied to floating units	Within 6 months after start-up	R	
Operational Phase			
Example of Classification Society Inspection (according to BV rules)			
Annual survey: Visual examination of visible part of chain or wire adjacent to winches, windlasses, stoppers and fairleads	Yearly	R	BV Pt A, Ch2, Sec 9.3.1 BV Pt A, Ch2, Sec 8.1.2 BV NR 494, Sec 2.2.7
Underwater survey of housing and supporting equipments (fairleads, and stoppers etc.) with special attention to their connection to the unit's structure	2,5 yearly	R	BV Pt A, Ch2, Sec 8.1.2 BV NR 494, Sec 2.3.1

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 103 of 113

Table 18.1 - Mooring system

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Renewal survey: - GVI of the entire line from top chain to bottom anchor device including anchor base device (suction piles or foundation) and dimensional check (gauging) of the chain cables - CVI of critical parts such as chain, stoppers, fairleads, articulated devices, shackles, sockets and other connectors along the mooring line sections - Thickness measurement of mooring lines supporting equipment - Verification of pre-tension setting of each line and condition of CP systems	5 yearly	R	BV Pt A, Ch2, Sec 9.3.3 BV NR 494, Sec 2.4.2
Additional Company Inspection			
First In-Service Inspection			
CP survey of the entire mooring line: - potential measurements - liaison cable condition	Within the first year after start-up	R	
Subsequent In-Service Inspection			
Mooring tensioning equipment CVI of visible parts of winches, windlasses, sheaves, stoppers, guiding systems and fairleads with special attention to: - Interface points such as fairlead/stopper and chain hawse. - Foundation into hull NDT in area of observed wear	Not > yearly	R	
Buoy 1) Mooring supporting equipment - CVI of the strong-points, stoppers, windlasses together with their attachments to the hull structure. 2) Mooring line - CVI and dimension check (length measurement, link diameter), of pre-selected upper chain section links. Analyse trend. - Wear assessment on the chain link shoulders in way of the chain stopper and windlass pockets. - CP survey of the top part of mooring line with particular attention to connecting link assembly (potential measurements, anode depletion assessment, liaison cable condition) - Chain angle measurement 4) Monitoring system - Inspection and test of chain monitoring system (inclinometer, tension gauges, telemetry), if any.	Not > yearly	R	Other methods to measure link deformation may be recommended by suppliers

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 104 of 113

Table 18.1 - Mooring system

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
F(P)SU 1) Mooring supporting equipment - CVI of the strong-points, stoppers, windlasses, fairleads and pedestal roller together with their attachments to the hull structure. - Check the ability of the chain stopper assemblies and the fairlead to move around its z-axis, as applicable. 2) Mooring line - CVI and dimension check (length measurement, link diameter), of pre-selected upper chain section links. Analyse trend. - Wear assessment on the chain link shoulders in way of the chain stopper and windlass pockets. . - CP survey of the top part of mooring line with particular attention to connecting link assembly (potential measurements, anode depletion assessment) - Chain angle measurement 4) Monitoring system - Inspection and test of chain monitoring and control system (inclinometer, tension gauges, telemetry)	Not > 2,5 yearly	R	Other methods to measure link deformation may be recommended by suppliers
Buoy & F(P)SU GVI of the entire mooring line with particular attention to: - linking elements (wire or fiber rope connections...) - wire rope external sheet - marine growth assessment - wire rope twisting assessment CVI of bottom part of mooring line and visible part of the anchor CP survey of chain and connectors on entire mooring line: - potential measurements on final bottom links and anchor - anode depletion assessment on anchor and connectors	2,5 yearly	R	Allowable wear ratio in accordance with API RP 2I & DNV standards.
Monitoring activities			
Measure UTM coordinates of the floating unit Measure draught at singular key locations on the hull	Monthly	R	When mooring line tension data logger is not available
Retrieve mooring line tension measurements from data loggers	Monthly	G	When available
Take a snapshot or video from the chain video surveillance system.	Monthly	G	When available
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	

Table 18.1 - Mooring system

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Inspection Reviews			
Analyse UTM coordinate and draught measurement monthly data	Yearly	R	To be carried out by Specialist
Stress profile analysis, re-tensioning assessment and fatigue assessment of mooring lines, based on tension measurements (when available).	Yearly	G	To be carried out by Specialist
Assess for chain abrasion or wear out from monthly snapshots or videos (when available)			In accordance with API RP 21 & DNV standards.
Following a significant change in the environment conditions, extreme environmental events (earthquakes, soil liquefaction, landslides or other geo-hazards), dropped objects, vessel collisions, observed damage or notable changes in the dynamic behaviour of the system (floating unit + mooring lines + anchor base).			

19. Floating Production and/or Storage Units

Floating Production and/or Storage Systems may be “new builds” or converted Oil Tankers to which mooring systems and production facilities have been installed. By design, tankers are intended to return to dry dock for major inspection, overhaul and repair on a regular basis while Floating Production and/or Storage Systems are required to stay on station on a permanent basis. The inspection strategy for classical marine components, mooring equipment and production facilities shall be developed and take this constraint into account.

Floating Units (FU) must be “classified” by a Classification Society (third party).

This strategy is primarily based on 2 components:

- Classification scheme covering the hull, tanks and non-permanent mooring equipment,
- Company additional requirements.

Detailed inspection activities are presented in Table 19.1.

19.1 Classification Society requirements

Classification Society has its own inspection requirements that must be complied with. This includes inspection plan design, inspection planning, inspection reporting, and recommendation follow up.

In Table 19.1, Class inspection activities are given only for information as the actual Class requirements will be specific to the Floating Unit with reference to the Classification Society Rules.

Modifications and alterations: any significant modifications or alteration to systems or equipment covered by the Classification Society’s Rules must be reported to the Classification Society for review prior to implementation.

Approval of service suppliers: Contractors engaged in Thickness Measurement and Underwater Inspection performed within the scope of the Class Survey must be approved by the Classification Society.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 106 of 113

19.2 Additional Company requirements

Class requirements shall be complemented with specific prescriptive requirements on known critical items based on Company experience and Affiliates feedback.

The main concerns are:

- Coating damage, cathodic protection malfunctions and corrosion in Water Ballast Tanks.
- Mechanical failure of internal caisson attachments in Water Ballast Tanks.
- High consumption of anodes in Slop Tanks.
- GRP seawater piping network breakdown (ballast piping, fire-fighting piping).
- Corrosion at the interface areas of the hull and mooring system.

Process tanks, Wash tanks, Settling tanks (eg hull integrated tanks for process separation purpose) are exposed to corrosion resulting from the fluid chemistry. Specific attention shall be paid to bottom plating condition particularly if sand or others deposits are expected (favourable conditions for corrosion under deposit or microbiological induced corrosion).

The objective of this prescriptive additional programme is to detect anomalies at early stage before they reach a point where repair is difficult or costly.

In addition, first in-service inspection aims at calling on guarantee recourses as applicable.

Table 19.1 - Floating Production and/or Storage Units

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Inspectability Reviews			
Define Classification Society, rules and terms of reference, then items subject to Class inspection. Refer to STR General specifications	During basic engineering phase	R	Purpose: identify items to be followed by Classification Society for construction phase
Issue finite element calculation of hull	At the earliest in the detailed design phase	R	Purpose: define hotspot area to be checked
Issue first Class inspection plan	At detailed design phase	R	Purpose: define first 5-year inspection cycle
Define flag authority for towing AND at subsidiary location	At detailed design phase	R	Purpose: give rules for life saving equipment and radio licences.
Pre Start-up Phase			
Construction Inspection			
Although the manufacture and hence QA of FSU, FPU shall be the responsibility of Project, the subsidiary shall be responsible for the regular procurement. It shall therefore be the responsibility of the Project Inspection Engineer to provide inspection and Quality Control Support Services to the Procurement Department for the replacement purchase of any components. Individual Quality Plans shall be prepared for each item to be purchased and the level of Quality Control shall be determined in accordance with the General Specification for each item of equipment and OCIMF requirements.			

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 107 of 113

Table 19.1 - Floating Production and/or Storage Units

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Commissioning/Baseline Inspection			
GVI (General Visual Inspection) and photographic survey of complete hull. Particular attention to: - carbon steel piping coating - ballast GRP pipe network - sea-chests boxes.	Before Installation	R	Performed at fabrication site
Preparation of Inspection Drawings with component identification		R	
Thickness measurement of wind and water strakes in cargo area (one point on each plates to confirm original thickness)		G	
Register crude oil tanks which were sea-water ballasted for bad weather situation.	During towing	G	May explain abnormal anode consumption.
Hull impressed current CP measurements	Post Installation	R	
GVI of complete structure plus all appurtenances		R	
Verification of Technical Records and Registration of Technical Details in Plant Inventory.	Before Start-up	R	
Operational Phase			
Example of Classification Society's Inspection			
Annual survey: General examination of hull, deck and their appurtenances (including foundations of deck/hull equipment, openings, bulkheading, machinery spaces, etc.) General examination of hull and deck equipment (including, gas vent pipes, ventilation, tandem mooring equipment, etc.)	Yearly	R	BV Pt A, Ch 2 Sec 2.2 & Sec 2.3 & Sec 6.2 & Sec 6.3 BV Pt A, Ch 2 Sec 2.2 & Sec 6.2 & Sec 9.1.2 & Sec 9.3.1
Underwater survey of hull (including plating, sea chest & sea valves) and CP potential reading on the immersed part of the hull	2.5 yearly	R	BV Pt A, Ch 2, Sec 4.2.1 & Sec 8
Renewal survey: Thorough examination of hull and deck structure Thorough examination of hull and deck equipment Internal examination of tanks and compartments (storage tanks, slop tanks, water ballast tanks, pump rooms, pipe tunnels, cofferdams and void spaces bounding crude oil storage tanks...) Tank testing (bulkheads leak test) Close up inspection and Thickness measurement	5 yearly Under Continuous Survey, 20 % of tanks are to be inspected annually	R	BV Pt A, Ch 2, Sec 4.2.2, 4.2.3, 4.2.4 & Sec 6.6.3 & Sec 6.6.2 & Sec 6.6.6 BV Pt A, Ch 2, Sec 4.2.4 & Sec 6.6.5 BV Pt A, Ch 2, Sec 4.2.5 & Sec 6.6.3 & Sec 6.6.4
Additional Company Inspection			
Hull impressed current CP record	Monthly	R	
Mooring tensioning hydraulic unit tests	4 Monthly	G	Performed by Operations Personnel
Visual inspection of offloading hose and mooring line including their terminations when tandem configuration	Before Each Use	R	
Underwater complementary Close Visual Inspection of hull, at sea-water reject lines location (local CP measurement to be carried out)	At shut down time	R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 108 of 113

Table 19.1 - Floating Production and/or Storage Units

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Full survey of weather deck and hull plating above the water line with particular attention to: - Condition of coating - Buckling - Corrosion - Connection of crane pedestal, winches, davits, pull-in systems, masts and riggings with deck. UT wall thickness measurement on suspected area. Cathodic Protection potential measurement reading on the immersed part of the hull	Yearly	R	
GVI of Tandem tanker mooring equipment (including quick release hook, chafe chain, mooring hawsers and pick-up equipment) and its foundation to the hull.	Yearly	R	
GVI of sea water carbon steel piping network (ballast piping...) and UT scan wall thickness measurement, as necessary.	Yearly	R	
Cathodic Protection potential measurement reading in water ballast tanks	Yearly	R	
GVI of water ballast tanks, slop tanks, process tanks with particular attention to: - Bottom shell including under bellmouths - Side shell including risers interfaces - Bulkheads - Stringer platforms - Deckhead - Girder systems - Web frames and crossies - Sea chests boxes and overboard trunk boxes (which shall be Ultrasonic scanned). Check coating condition when applicable. Assess for anode consumption.	2,5 yearly	R	
Underwater inspection with particular attention to: - risers interfaces - sea chests boxes and overboard trunk boxes - caissons attached to the hull - marine growth assessment Check coating condition. CP measurement and anode depletion assessment.	2,5 yearly	R	
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	
Inspection Reviews			
Class renewal survey: - Review of 5-year cycle inspection programme and findings - GVI of selected items as described above	5-Yearly	R	Carried out by CS Representative
Following a significant change in the environment conditions, extreme environmental events, dropped objects, vessel collisions, observed damage, and changes in platform loading			

20. Life Saving Appliances

This section provides minimum inspection requirements applicable to Life Saving Appliances (LSA) installed onboard Offshore Platforms and Floating Units (Floating Production and/or Storage Units).

For the purpose of this section, LSA covers davit launched lifeboats, free-fall lifeboats, liferafts and rescue boats, including the associated equipment and launching appliances.

20.1 National legislation and international regulation

LSA inspection is governed by international maritime conventions and/or national legislation and may involve the intervention of a Third Party Inspection Authority.

In case of discrepancy between national legislation, international regulation and this general specification, the more stringent requirement must apply.

20.2 Inspection Strategy

LSA inspection strategy is based on a prescriptive regime with the following periodic tasks:

- Weekly / Monthly maintenance and inspection operations as defined by the Manufacturer.
- Yearly maintenance, testing and inspection operations in accordance with SOLAS regulation and IMO requirements.
- 5 yearly maintenance, testing and inspection operations in accordance with SOLAS regulation and IMO requirements.

Minimum requirements for periodic servicing, testing and inspection of lifeboats, associated equipment and launching appliances are summarized in Table 20.

20.3 Personnel and Qualification

Weekly / Monthly maintenance and inspection of lifeboats, launching appliances and associated equipment shall be performed by dedicated qualified personnel, fully trained and familiar with these duties (the personnel shall preferably be trained and qualified by the Manufacturer).

Yearly / 5 yearly maintenance, testing and inspection of lifeboats, launching appliances and associated equipment shall be conducted by a Manufacturer's representative or by an ILSTO representative (Independent Lifeboat Servicing and Testing Organization – i.e. maintenance contractor agreed by the Manufacturer).

Yearly / 5 yearly load tests shall be witnessed by a Third Party Inspection Authority.

For lifeboats onboard Floating Units, the Third Party Inspection Authority is the Classification Society.

20.4 Reports and Records

On completion of maintenance, testing and inspection operations, a report shall be issued by the personnel in charge in order to confirm that the lifeboat and associated launching appliances remain fit for service. The report shall include a statement confirming that the lifeboat arrangements (in particular the on-load release mechanism) are fit for purpose.

Records of inspections, servicing and repairs shall be updated and filed by the Affiliate.

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 110 of 113

Table 20 – Life Saving Appliances

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Feed & Design Phase			
Inspectability Reviews			
Define flag authority for towing AND at subsidiary location	At detailed design phase	R	Purpose: give rules for life saving equipment and radio licences.
Define applicable regulation for life saving appliances (International Maritime Convention, Classification Society rules) then items subject to third party inspection.	At detailed design phase	R	Purpose: give rules for life saving equipment and radio licences.
Issue first inspection plan by Third Party (Classification Society, Flag Administration)	At detailed design phase	R	Purpose: define first 5-year inspection cycle
Pre Start-up Phase			
Construction Inspection			
Manufacture and hence QA of LSA shall be the responsibility of Project. Maintenance, inspection and repairs of LSA shall be the responsibility of Affiliates. Individual Quality Plan shall be prepared for each item to be purchased and each repair to be carried out.			
Commissioning/Baseline Inspection			
Verification that the lifeboats, their equipment and launching appliances are type approved according to the relevant international standards.	Before Installation	R	
Verification of technical records and manufacturer documentation for the lifeboats, their equipment and launching appliances. Ensure that the Manufacturer Documentation includes: - detailed description of lifeboats and associated equipment with comprehensive drawings - type approval certificates - maintenance and inspection manual including specific procedures for servicing / testing without launching the boat at sea (engine, on-load release system...)	Post Installation	R	
Check the provision and disposition of lifeboats and rescue boats.	Post Installation	R	
GVI (General Visual Inspection) and photographic survey of lifeboats and rescue boats.	Post Installation	R	
GVI of launching appliances system	Post Installation	R	
GVI of the embarkation and recovery arrangements for each lifeboat. Test of each launching appliance, including overload tests and tests to establish the lowering speed when lowering the lifeboat at sea	Post Installation	R	

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 111 of 113

Table 20 – Life Saving Appliances

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Operational Phase			
Lifeboats Thorough examination and operational test: - condition of lifeboat structure including fixed and loose equipment; - engine and propulsion system; - sprinkler system; - air supply system; - manoeuvring system; - power supply system; and - bailing system.	Yearly	R	SOLAS III/20.11 MSC Circ 1206 Subject to 3 rd party certification
Launching appliances Thorough examination and operational test: - davit structure, with particular regard to corrosion, misalignments, deformations; - wires and sheaves, possible damage such as kinks and corrosion; - winch brake Dynamic winch brake test (with load corresponding to empty boat). Note: Dynamic winch brake test is also requested for secondary means of launching of freefall lifeboats	Yearly	R	SOLAS III/20.11 MSC Circ 1206 Subject to 3 rd party certification
Lifeboats release mechanism Thorough examination and operational test Load test of on-load release mechanism (with load corresponding to empty boat) Note: for free-fall lifeboats, load test of release system should be performed with simulated launching, using dedicated tool and procedure provided by the Manufacturer.	Yearly	R	SOLAS III/20.11 MSC Circ 1206 Subject to 3 rd party certification
Liferafts Servicing by approved servicing station (including hydrostatic release unit)	Yearly	R	SOLAS III/20.8
Lifeboats Overhaul, thorough examination and operational test: - condition of lifeboat structure including fixed and loose equipment; - engine and propulsion system; - sprinkler system; - air supply system; - manoeuvring system; - power supply system; and - bailing system - hull integrity	5 Yearly	R	SOLAS III/20.11 MSC Circ 1206 Subject to 3 rd party certification
Launching appliances Dynamic winch brake test (110% overload) Following the test, thorough examination of davits, brake pads, winch foundation, hook and hull. Note: Dynamic winch brake test is also requested for secondary means of launching of freefall lifeboats	5 Yearly	R	SOLAS III/20.11 MSC Circ 1206 Subject to 3 rd party certification
Lifeboats falls wires: Replacement of lifeboat falls	5 Yearly	R	SOLAS III/20.4

Plant integrity - Minimum inspection requirements

Rev.: 03

Effective date: 10/2012

Page: 112 of 113

Table 20 – Life Saving Appliances

Inspection Type/Integrity Tasks	When	Rule or Guidance	Comments
Lifeboat release mechanism Thorough examination and operational test Overload test of on-load release mechanism (110% overload) Note: for free-fall lifeboats, load test of release system should be performed with simulated launching, using dedicated tool and procedure provided by the Manufacturer.	5 Yearly	R	SOLAS III/20.11 MSC Circ 1206 Subject to 3 rd party certification
Ad-Hoc			
Scope to be determined by specific event	As required	N/A	

Bibliography

Classification Society Rules

American Bureau of Shipping	Guide for Building and Classing Floating Production Installations
American Bureau of Shipping	Rules for Building and Classing Single Point Moorings
Bureau Veritas NR 455	Rules for the Classification of Offshore Units
Bureau Veritas NR 467	Rules for Classification of Steel Ships
Bureau Veritas NI 493	Classification of Mooring Systems for Permanent Offshore Units
Bureau Veritas NI 432	Certification of Fiber Ropes for Deepwater Offshore Services
Bureau Veritas NR 494	Rules for the Classification of Offshore Loading and Offloading Buoys
Det Norske Veritas OSS 102	Rules for the Classification of a Floating Offshore Installation at a fixed location
Det Norske Veritas CN n°2.5	Certification of Offshore Mooring Steel Wire Ropes
Det Norske Veritas CN n°2.6	Certification of Offshore Mooring Chains
Det Norske Veritas TNA 503	Flexible Pipes and Hoses for Submarine Systems
Lloyds Register of Shipping	Rules and Regulations for the Classification of a Floating Offshore Installation at a fixed location
IACS	Ship Building and Repair Quality Standard (N°47)
IACS UR W22	Offshore Mooring Chain
IACS UR Z17	Procedural Requirements for Service Suppliers
SOLAS	International Convention for the Safety of Life at Sea
MARPOL	International Convention for the Prevention of Pollution from Ships
ICLL	International Convention on Load Lines