THE EFFECT OF VISUAL INSPECTION OF AIR RECEIVERS ON THE INTEGRITY MANAGEMENT OF TUG BOATS

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ABSTRACT

The Effects of visual inspection of Air Receivers on the Integrity Management of Tugboats is reported. Key parameters for monitoring fit-for-service of air receivers were identified. Also the essential usage of compressed air in tugboats was noted. Consequence on this, the visual inspection of the air receivers was conducted along the guidelines of statutory requirements. The outcome of the visual inspection was satisfactory and hence the Air Receivers retained the fit-for-service status .

1. INTRODUCTION

1.1 DEFINITION OF INSPECTION

Inspection is defined as: an official process of checking that things are in the correct condition or that people are doing what they should; an action of looking at something carefully, especially in order to check that it is satisfactory [1]. For the Inspections to be done, an Inspection and Test Plan must be done. Inspection and Test Plan is a document made by Manufacturer/Subcontractor or Contractor to describe the minimum requirements of the Quality Control activities, Inspection and Test Items during fabrication and /or construction phase, reference documents, required acceptance criteria certifying or verifying documents, and Inspection parties involved; it also assure that the product will be built in accordance with project specification, codes and standard requirements, and meet local government regulations[2]. In engineering activities, inspection involves the measurements, tests, and gauges applied to certain characteristics in regard to an object or activity.

The results are usually compared to specified requirements for determining whether the item or activity is in line with these targets. Inspections are usually non-destructive. In the same vein, Inspection is seen as the act of looking at something closely in order to learn more about it, to find problems, et cetera; the act of inspecting something [3]. Also, Inspection means the act of inspecting or viewing, especially carefully or critically; formal or official viewing or examination [4]. Alternatively, Inspection [5] is viewed basically as an organized examination or a formal evaluation exercise. An inspection involves the measurements, tests, and gauges applied to certain characteristics in regard to an object or an activity. Inspection [6] can also be seen as careful examination or scrutiny while some school of thought view Inspection[7] as the critical appraisal involving examination, measurement, testing, gauging and comparison of materials or items. An inspection determines if the material or item is in proper quantity and condition, and if it conforms to the applicable or specified requirements. On the other hand, Inspection [8] can be seen as the examination of a part to determine if it conforms to specifications. Inspection traditionally follows the completion of a part. In other words, Inspection [9] is close examination of something, especially for faults or errors; an official check or examination of something for safety or quality. In the same vein, Inspection [10] is described as a visual examination of a facility and/or equipment to identify, report and eliminate or control hazards that could cause accidents before they result in loss. Inspections should target all exposures to property and members of the public.

Different approaches currently used to assess surface anomalies identified on a product is considered. The common point between these methods is that they are based on a document presented in the form of a table, which is to help the inspector to assess the anomaly detected in a repeatable and reproducible way. We will present three types of table: criteria/level table, tree-like presentation table and an indexed table. Each of these tables presents certain limits when applied to the inspection of a product surface.[11] In 2002, the peer review auditor program was replaced with independent inspections of audit firms by the Public Company Accounting Oversight Board

(PCAOB). The PCAOB inspections differ from the peer reviews in several key areas including the independence level of the reviewers, the nature and timing of the reviews, and the content and timing of the findings' disclosures. This study focuses on the informational value of the quality control criticisms disclosure included in Part II of the PCAOB inspection reports. After each inspection, the PCAOB issues inspection reports that include a public portion (Part I) of identified audit deficiencies, and must include a non-public portion (Part II) of identified quality control weaknesses. Part II of the report only becomes public if the firm fails to satisfactorily remediate the quality control deficiencies in a 12-month period. This study examines the change in audit firms' market share following the public disclosure of Part II of the inspection report. The results find that audit firms lose a significant amount of market share following the public disclosure of quality control criticisms, and suggest that such a disclosure provides a credible signal of auditor quality to audit clients. [12]

In another development, Software inspection is considered a cost-effective quality assurance technique in software process improvement. Although inspections detect the majority of defects in the early stages of the development process, this technique is not a common practice in the software industry, especially in small and medium enterprises. A proposed model for the inspection process intended to be applicable and acceptable to both small and medium enterprises and large software organisations is considered. The model was implemented in two organisations: one in a medium-scale company and the other one in a department of a big company where its feasibility and benefits were confirmed. A comparison with recent alternative inspection models has also been performed showing the practicality of the proposal and ease of adoption and cost-effectiveness. [13]

Also, in-service monitoring of nuclear plants is indispensable for both the Operator and the Regulator. The notion of in-service monitoring ranges from the continuous monitoring of the reactor in operation to the thorough in-service reactor inspection during programmed shutdowns. However, the highly specific environment found in French liquid metal fast reactor plants - Phénix and

Superphénix - makes monitoring and inspection complicated because of the use of a sodium coolant that is hot, opaque, and difficult to drain. The Commissariat à l'Energie Atomique, in collaboration with its traditional French partners, Electricité de France utilities and FRAMATOME/Novatome Engineering, decided to conduct a 6-yr research and development program (1994-2000) to explore this problem vis-à-vis Superphénix, as well as the possibilities of intervening within the reactor block or on components in a sodium environment. Furthermore, the safety re-evaluation of Phénix, conducted between 1994 and 2003, represented an excellent "test bench" during which the limits of inspection processes - applied to an integrated reactor concept - were surpassed using techniques such as fuel subassembly head scanning, ultrasonic examination of the core support, and visual inspection of the cover-gas plenum following a partial sodium draining. Repair techniques were investigated for cleaning of sodium wet structure surfaces, cutting of damaged parts, and welding in sodium aerosol atmosphere. Both conventional and laser processes were tested. [14]

Suppose that a lot has been produced by a process with a constant failure rate. So either the entire lot is good, or all units up to some point are good and from that point on are all defective. We wish to determine the order in which units in such lot should be inspected so as to minimize the expected number of inspections needed to identify all defectives. Unlike previous work in this area, we do not a priori assume that the last unit in the lot is defective, and that key difference turns out to dramatically influence the nature of the optimal inspection policy and the expected number of units inspected. After analyzing the optimal policy, we suggest a very simple and intuitive heuristic, which turns out to perform extremely well. [15]

1.2 WHY AIR RECEIVERS ARE REQUIRED

Air receivers are tanks used for compressed air storage and are recommended to be in all compressed air systems. Using air receivers of unsound or questionable construction can be very dangerous. Therefore, the American Society of Mechanical Engineers (ASME) has developed a code regarding the construction of unfired pressure vessels, which has been incorporated into many federal, state, and local laws. This particular code is ASME Code Section VIII Division 1. Air receivers should always meet or exceed this code in addition to any other state, municipal, or insurance codes that may apply. The ASME also approves the receiver accessories. They are equipped with a safety valve, which is set at a pressure lower than the working pressure for which the air receiver was stamped and at a higher pressure than the operating pressure, to safeguard against excessive pressure. In addition, receivers have a drain valve to eliminate accumulated moisture. They also have pressure gauges, hand holes or manholes, and a base for vertical air receivers. Standard receivers are designed for horizontal or vertical mounting.

Air receivers serve several important purposes:

i) Decrease wear and tear on the compression module, capacity control system and motor by reducing excessive compressor cycling; ii) Eliminate pulsations from the discharge line; iii) Separate some of the moisture, oil and solid particles that might be present from the air as it comes from the compressor or that may be carried over from the after-cooler; iv) Help reduce dew point and temperature spikes that follow regeneration; v) Offer additional storage capacity made to compensate for surges in compressed air usage and vi) Contribute to reduced energy costs by minimizing electric demand charges associated with excessive starting of the compressor motor.

The benefit of extra storage capacity alone outweighs the additional cost of this component.

Wet vs. Dry Receiver: There are wet air receivers (supply) and dry air receivers (demand).

Wet Receivers: Wet receivers provide additional storage capacity and reduce moisture. The large surface area of the air receiver acts as a free cooler, which is what removes the moisture. Because the moisture is being reduced at this point in the system, the load on filters and dryers will be reduced. The term "wet receiver" refers to the storage vessel or tank placed immediately after the compressor. This device helps with contaminant removal, pressure stabilization and pulsation reduction. **Dry Receivers:** When sudden large air demands occur, dry air receivers should have adequate capacity to minimize a drop in system air pressure. If these pressure drops were not minimized here, the performance of Air dryers and filters would be reduced because they would no longer be operating within their original design parameters .The term "dry receiver" refers to the receiver placed after the air dryer and other air preparation equipment. [16]

Seagoing vessels have to undergo regular inspections, which are currently performed manually by ship surveyors. The main cost factor in a ship inspection is to provide access to the different areas of the ship, since the surveyor has to be close to the inspected parts, usually within arm's reach, either to perform a visual analysis or to take thickness measurements. The access to the structural elements in cargo holds, e.g., bulkheads, is normally provided by staging or by “cherry-picking” cranes. To make ship inspections safer and more cost-efficient, we have introduced new inspection methods, tools, and systems, which have been evaluated in field trials, particularly focusing on cargo holds. More precisely, two *magnetic climbing robots* and a *micro-aerial vehicle*, which are able to assist the surveyor during the inspection, are introduced. Since localization of inspection data is mandatory for the surveyor, we also introduce an external *localization system* that has been verified in field trials, using a climbing inspection robot. Furthermore, the inspection data collected by the robotic systems are organized and handled by a *spatial content management system* that enables us to compare the inspection data of one survey with those from another, as well as to document the ship inspection when the robot team is used. *Image-based defect detection* is addressed by proposing an integrated solution for detecting corrosion and cracks. The systems' performance is reported, as well as conclusions on their usability, all in accordance with the output of field trials performed onboard two different vessels under real inspection conditions. [17

All new air receivers installed after the effective date of these regulations shall be constructed in accordance with the 1968 edition of the A.S.M.E. Boiler and Pressure Vessel Code Section VIII, which is incorporated by reference as specified in Sec. 1910.6. All safety valves used shall be constructed, installed, and maintained in accordance with the A.S.M.E. Boiler and Pressure Vessel Code, Section VIII Edition 1968. Air receivers shall be so installed that all drains, handholes, and manholes therein are easily accessible. Under no circumstances shall an air receiver be buried underground or located in an inaccessible place. Drains and traps. A drain pipe and valve shall be installed at the lowest point of every air receiver to provide for the removal of accumulated oil and water. Adequate automatic traps may be installed in addition to drain valves. The drain valve on the air receiver shall be opened and the receiver completely drained frequently and at such intervals as to prevent the accumulation of excessive amounts of liquid in the receiver. Every air receiver shall be equipped with an indicating pressure gauge (so located as to be readily visible) and with one or more spring-loaded safety valves. The total relieving capacity of such safety valves shall be such as to prevent pressure in the receiver from exceeding the maximum allowable working pressure of the receiver by more than 10 percent.

No valve of any type shall be placed between the air receiver and its safety valve or valves.

Safety appliances, such as safety valves, indicating devices and controlling devices, shall be constructed, located, and installed so that they cannot be readily rendered inoperative by any means, including the elements. All safety valves shall be tested frequently and at regular intervals to determine whether they are in good operating condition.[18]

Pressure vessels are potentially very dangerous and can fail catastrophically causing multiple fatalities, serious injuries and property damage. The Longford gas explosion in Victoria in 1998 was the result of pressure vessel failure. Two people were killed in an air receiver explosion at a roadhouse in Karachi, Pakistan. The body of one of the people killed was found at a distance of 1 kilometre from the place where the explosion occurred.. It was fortunate that no-one was in the vicinity when the explosions took place in Victoria.. An air receiver that has a hazard level of A, B or C must be 'plant registered'. Refer to Australian Standard AS 4343-2005, Pressure equipment – Hazard levels. [19] A pressure vessel is a container that holds either gasses or liquids and is subject to internal or external pressure. It includes interconnecting parts and components, valves, gauges and other fittings up to the first point of connection to the connecting piping.. Pressure vessels, including air receivers, have hazard levels assigned to them. Those with a hazard level of A, B or C have specific requirements, including the requirement to be plant registered. An air receiver is a type of pressure vessel. It is a tank that stores compressed air for large demands in excess of compressor capacity. A vertical air receiver tends to be larger and almost always has a hazard level of A, B or C. A horizontal air receiver tends to be smaller. As a general rule, if it is over a metre in length then it will have a hazard level of C as a minimum. An air receiver must be registered in Victoria according to the hazard level, as follows: i) Air receiver plant registration is required where an air receiver has a hazard level of A, B or C; ii) Air receiver design registration is required where an air receiver has a hazard level of A, B, C or D. [19] Hazard levels Pressure vessels can be rated from A through to E, with A being the most hazardous and E being the least hazardous. There are a number of factors that contribute to a pressure vessels hazard level, which include: i) size; ii) pressure; iii) temperature; iv) source of power; v) location; vi) usage; vii) hazardous contents; viii) contents type. Air receivers are classed as having non-hazardous gas content. With many of the risk factors consistent for air receivers, what determines their hazard level is the size of the vessel and the maximum design pressure [19] Selecting an air receiver Before purchasing an air receiver, the employer should consult with key staff, including health and safety representatives (HSRs). This consultation should be documented and include operational requirements and any hazards that need to be considered, for example: i) the intended use; ii) operational parameters; iii) frequency of use (eg 24 hours a day continuously or sporadically;) iv) physical constraints of the workplace; v) required distances from other plant; vi) required distances from flammable liquids; vii) required distances from people; viii) impact caused by the weather. Consultation should also consider safety within the workplace after the air receiver is purchased, for example: i) what new risks will be introduced to the workplace?; ii) what engineering controls will need to be introduced (eg piping that is pressure rated)?; iii) what new safe systems of work will need to be developed?; iv) what specific information, instruction, training and supervision will be required for the new plant? A formalised safe work method statement and a risk assessment should also be completed. All of these should form the basis of discussions with the supplier of the air receiver. The manufacturer’s recommendations are also critical in selecting the appropriate air receiver, for example: i) some compressor and air receiver sets are not designed to supply respiratory air [19] Inspections should be carried out by competent person(s) at intervals to keep the air receiver in a safe condition. i) Commissioning or re-commissioning inspection − this must be done before the air receiver is used for the first time and following repairs, changes to use, relocation and when returning to service after period of non-use. ii) Pre-operational and operational surveillance and monitoring − regular surveillance is an essential part of the operation of all air receivers. This must include checking and monitoring all safety devices, visual observation, as well as monitoring for abnormalities, including odours and temperature extremes. iii) Periodic in-service inspection − assures the safe operation of an air receiver until the next scheduled inspection. The major elements of periodic inspections are: – external inspections include fittings, safety devices, protective coatings, anchoring, supports and identification markings. These inspections are used to detect anomalies or defects, such as corrosion, leaks, bulging, signs of excessive temperatures or signs of cracking – internal inspections are used to detect anomalies or defects to internal surfaces. There is a variety of non-destructive testing techniques for these tests. Care must be taken to ensure that the testing is truly representative of the air receiver's condition – pressure relief valve is tested at the same time as the internal inspection to ensure that it is in a safe working condition.(See Table A in Appendix). The task of repair is a technical area that requires liaising with various people. This may include the manufacturer, the supplier, an in-service inspector or other competent people. The following are points to consider: i) due to cost of repair versus cost of replacement, a damaged air receiver is often scrapped; ii) the causes of all defects must be addressed before any repairs, alterations or modifications; iii) the stored energy needs to be safely discharged and the system locked. [19]

1.3 SOLUTIONS, ELEMENTS AND BENEFITS OF ASSET INTEGRITY MANAGEMENT

on the other hand, the goal of asset management is to effectively manage corporate assets in order to gain maximum value, profitability and returns while safeguarding personnel, the community, and the environment. A true Asset Integrity Management program incorporates design, maintenance, inspection, process, operations, and management concepts, since all these disciplines impact the integrity of infrastructure and equipment. Asset Integrity Management (AIM) Solutions include: i)Risk-Based Inspection (RBI); ii)Forensic Engineering and Failure Analysis Services; iii)Offshore Hazard and Risk Assessment Services; iv)3D Laser Scanning; v)Technical Inspections; vi)Dimensional Control; vii)Smart Asset Optimization; viii)LFM Software; ix)Surveying and Mapping Energy Services; x)Non-Destructive Testing (NDT) Services. **On the other hand, Elements of Asset Integrity Management are: i)**Inspection (advanced technologies); ii)Risk assessment and Risk Based Inspection (RBI); iii)Maintenance (reliability, predictive and preventive strategies); iv)Operational and process support (critical operating and process windows); v)Process safety and mechanical integrity services; vi)IT support/software tools; vii)Management strategies; viii)HSE strategies; ix)Business and financial modeling; x)Training in industry codes, standards and regulations **In the same vein, benefits of comprehensive Asset Integrity Management program include: i)**Maximizing Reliability, Availability, Maintainability (RAM) of equipment; ii)Enhancing plant performance and profit; iii) Improving safety and reduce risk; iv)Reduction in maintenance and inspection cost; v) Improving personnel safety and performance; vi) Optimizing sparing and vii)Compliance with company, local rules and regulations using unparalleled engineering service.[20]

Also, Owners and users of pressure vessels have the option to manage the integrity of their plant and plan inspection from assessments of the risks of failure. They need to be able to demonstrate that the risk assessment and inspection planning processes are being implemented in an effective and appropriate manner. The aim of this report is to assist Duty Holders and regulators identify best practice for plants integrity management by risk based inspection (RBI). [21]

In a similar vein, In-service inspection of pressure systems, storage tanks and containers of hazardous materials has traditionally been driven by prescriptive industry practices. Statutory inspection under Health and Safety legislation has long been a requirement for boilers, pressure systems and other safety critical equipment. Prescriptive practices fixed the locations, frequency and methods of inspection mainly on the basis of general industrial experience for the type of equipment. These practices, although inflexible, have, on the whole, provided adequate safety and reliability. Prescriptive inspection has a number of short-comings. In particular, it does not encourage the analysis of the specific threats to integrity, the consequences of failure and the risks created by each item of equipment. It lacks the freedom to benefit from good operating experience and focussing finite inspection resources to the areas of greatest concern. Goal setting safety legislation for pressure systems was first introduced in 1989 and retained in the Pressure Systems Safety Regulations (PSSR) 2000 (1.2). This has enabled a move towards inspection strategies based on the risk of failure. The legislation leaves the user or owner, in conjunction with the Competent Person, with the flexibility to decide a 'suitable' written scheme for examination to prevent danger on the basis of the available information about the system and best engineering practice. This trend towards a risk based approach is being supported by extensive plant operating experience, improved understanding of material degradation mechanisms, and the availability of fitness-for-service assessment procedures. At the same time, developments in non-destructive testing (NDT) technology have increased the scope and efficiency of examinations that can be undertaken. Inspection trials have produced a greater appreciation of the limits of NDT performance and reliability. Industry is recognising that benefit may be gained from more informed inspection . Certain sectors of industry, particularly the refining and petrochemicals sectors, are now setting inspection priorities on the basis of the specific risk of failure. Improved targeting and timing of inspections offer industry the potential benefits of: i)Improved management of Health and Safety and other risks of plant failure; ii)Timely identification and repair or replacement of deteriorating equipment; iii)Cost savings by eliminating ineffective inspection, extending inspection intervals and greater plant availability. [22]

1.4 TUGBOATS

A **tugboat** (**tug**) is a boat that manoeuvres vessels by pushing or towing them. Tugs move vessels that either should not move themselves, such as ships in a crowded harbor or a narrow canal, or those that cannot move by themselves, such as barges, disabled ships, log rafts, or oil platforms. Tugboats are powerful for their size and strongly built, and some are ocean-going. Tugboats could also be classified as Seagoing, Harbour and River tugboats. Some tugboats serve as icebreakers or salvage boats. Early tugboats had steam engines, but today most have diesel engines. Many tugboats have firefighting monitors, allowing them to assist in fire-fighting, especially in harbours.[23] The Reversing Reduction Gear became popular in marine transportation applications in the 1930s, and today is the predominant propulsion system used in diesel tug applications. The gearbox accomplishes several functions. It provides the means to engage and disengage the diesel engine from the driveline through the use of air or hydraulic clutches, which is necessary because the diesel engine cannot idle below a certain minimum speed. [24] Luna is a historic tugboat normally berthed in Boston Harbor, Massachusetts. Luna was designed in 1930 by John G. Alden and built by M.M. Davis and Bethlehem Steel. She is listed on the National Register of Historic Places and is a U.S. National Historic Landmark. Luna has two compressors and four compressed air storage tanks which are used to crank-start the diesel engines prior to the introduction of diesel fuel. Luna's horn is also air-powered.[25]

1.5 MECHANICAL INTEGRITY

Mechanical Integrity (MI) can be defined as the management of critical process equipment to ensure it is designed and installed correctly, and that it operates properly (i.e. no leaks and all elements are fit for service). A mechanical integrity program should take into account the **inspection** and testing of the equipment using procedures that are recognized and generally accepted good engineering practices (RAGAGEP), and should also consider the suitability of newly-fabricated equipment for usage. Written procedures should be established and implemented, and employees tasked with maintaining the ongoing integrity of **process equipment** should be adequately trained. [26] Also, several benefits accrue from sound reliability and mechanical integrity practices and how they serve as the corner stone of effective asset management. Effective asset integrity management is not only important, but essential to overcoming the challenges presented by operating in the current oil and gas market. [27]On the other hand, do you ever wonder why the United States Department of Homeland Security is always telling us to be ever-vigilant, and "If You See Something, Say Something"? The government believes that millions of people being vigilant, looking for suspicious activity and reporting on it, will help prevent violent crimes and terrorist activity. Mechanical Integrity (MI) managers in plants around the world should adopt the same philosophy in relation to small incidents or near incidents. Think about it; if everyone in an industrial setting actively looked for things that were not right or seemed different, or looked at small mistakes as opportunities to prevent larger ones, what would the future look like? "…there are still too many small incidents that lead to major failures." The MI community now has some help in a recommended practice published by the American Petroleum Institute. API RP 585, Pressure Equipment Integrity Incident Investigation, is a document originally published in April of 2014. This recommended practice highlights the value of investigating low and medium consequence pressure equipment integrity incidents. The goal is for everyone working in the MI field to be able to conduct investigations on lower consequence incidents and near failures regarding pressure equipment loss of containment, so that organizations can learn from the smaller failures and correct systemic causes before they are allowed to contribute to a major incident. [28]

1.6 SUMMARY OF LITERATURE REVIEW

From the foregoing, Inspection is described as a visual examination of a facility and/or equipment to identify, report and eliminate or control hazards that could cause accidents before they result in loss. Inspections should target all exposures to property and members of the public. Air receivers are tanks used for compressed air storage and are recommended to be in all compressed air systems. **Air receivers serve several important purposes:** i) Decrease wear and tear on the compression module, capacity control system and motor by reducing excessive compressor cycling; ii) Eliminate pulsations from the discharge line; iii) Separate some of the moisture, oil and solid particles that might be present from the air as it comes from the compressor or that may be carried over from the after-cooler; iv) Help reduce dew point and temperature spikes that follow regeneration; v) Offer additional storage capacity made to compensate for surges in compressed air usage; vi) Contribute to reduced energy costs by minimizing electric demand charges associated with excessive starting of the compressor motor. There are wet air receivers (supply) and dry air receivers (demand). A **tugboat** (**tug**) is a boat that manoeuvres vessels by pushing or towing them. Tugs move vessels that either should not move themselves, such as ships in a crowded harbour or a narrow canal, or those that cannot move by themselves, such as barges, disabled ships, log rafts, or oil platforms Compressed air from the air receivers is needed to i) crank start the diesel engines prior to the introduction of diesel fuel; ii) for the pneumatic horns and iii) for the air clutches which aid the engagement/disengagement of the gearbox, among others. Periodic in-service inspection − assures the safe operation of an air receiver until the next scheduled inspection. The major elements of periodic inspections are: – external inspections including fittings, safety devices, protective coatings, anchoring, supports and identification markings. These inspections are used to detect anomalies or defects, such as corrosion, leaks, bulging, signs of excessive temperatures or signs of cracking. The goal is for everyone working in the MI field to be able to conduct investigations on lower consequence incidents and near failures regarding pressure equipment loss of containment, so that organizations can learn from the smaller failures and correct systemic causes before they are allowed to contribute to a major incident. Hence in conducting the visual inspection of the Air Receivers of the Tugboats, attention will be focused on i) description of Air Receiver and location; ii) Maker's number; iii) Plant number; iv) Nature of Test/Inspection conducted; v) Summary of findings and v) Current status of equipment.

2. MATERIALS AND METHOD

2.1 MATERIALS

Materials requirement for the inspection include, the Air Receivers, Surveyor's Hammer, Certificate of Competency as a Certified Inspector of Air Receivers and Pressure Vessels; a Data log, Life jacket, Personal Protective Equipment (such as Hard Hat, Safety shoes, safety belt with harness, hand gloves, safety goggles and ear defenders among others) and emery cloth.

2.2 METHODS

This inspection is done as per schedule. The facilities in the Marine Vessel will be in the operation mode. The captain and the crew of the Tugboat will be on and the Coast Guard will be on duty. Safety and operation procedures will be followed in admitting the inspection team into the Tugboat. The surveyor will be interested in the general healthy external appearance of the Air Receiver; the quality of the metal of the vessel by metallic sounding of the vessel with the surveyor's hammer; quality of the Relief Valve by cracking and closing; quality of the Condensate Purge Valve by cracking and closing and the Pressure Gauge of the Air Receiver.. In case of doubt, the inspection can be repeated by another Surveyor and the inspection results compared and contrasted. The inspection team should be a minimum of two personnel. Inspection results so obtained are documented in the Data Log and reviewed for accuracy. On the basis of this inspection report, certificates of Fitness-For -Service are issued for the Air Receivers by the Competent Inspector (Surveyor). This is a Statutory requirement for the Safety- in-Usage of Air Receivers and other Pressure Vessels.

3. RESULTS

Table 1 - Inspection Data For Air Receivers of Six Tugboats.

S/NO.	DESCRIPTION OF	MAKER'S NUMBER	PLANT NUMBER	NATURE OF TEST/INSPECTION	SUMMARY OF	CURRENT STATUS OF

	ITEM/GOODS			CONDUC TED	FINDINGS	EQUIPMENT
1	Horizontal Welded Air Receiver on Board MV Mr. Colt PH 08. S.W.P.200PSI	-	Colt AR-1	Thorough Visual Inspection	Relief Valve = OK. Condensate Purge Valve = OK. Metallic Sounding of Vessel = OK. Pressure Gauge = OK.	In good working condition.
2	Horizontal Welded Air Receiver on Board MV Mr. Farrel PH 02. S.W.P.200PSI	-	Farrel AR-1	Thorough Visual Inspection	Relief Valve = OK. Condensate Purge Valve = OK. Metallic Sounding of Vessel = OK. Pressure Gauge = OK.	In good working condition
3	Portable Horizontal Welded Air Receiver on	-	AR - 1	Thorough Visual Inspection	Relief Valve = OK. Condensate Purge Valve	In good working condition

	Board MV Mr. Sonia (Make: Sears Craftman)				= OK. Metallic Sounding of Vessel = OK. Pressure Gauge = OK.	
4/5	Horizontal Welded Air Receiver on Board MV Mr. Webb Crosby Makers: Brummer Eng. Mfg. Company. Bedford, Indiana. Year of Manufacture: 1979. S.W.P.200PSI @450^{0}F	-	Webb Crosby AR- 1 (Star Board) Webb Crosby AR - 2 (Port)	Thorough Visual Inspection Thorough Visual Inspection	Relief Valve = OK. Condensate Purge Valve = OK. Metallic Sounding of Vessel = OK. Pressure Gauge = OK.	In good working condition In good working condition
6/7	Horizontal Welded Air Receiver on Board MV Mr. Vinton Crosby	-	Vinton Crosby AR- -1 (Star Board)	Thorough Visual Inspection	Relief Valve = OK. Condensate Purge Valve = OK.	In good working condition

	S.W.P.200PSI		Vinton Crosby AR - 2 (Port)	Thorough Visual Inspection	Metallic Sounding of Vessel = OK. Pressure Gauge = OK.	
8	Horizontal Welded Air Receiver on Board MV Miss Crosby. Make: TX S.W.P.200PSI	-	Miss Crosby AR - 1	Thorough Visual Inspection	Relief Valve = OK. Condensate Purge Valve = OK. Metallic Sounding of Vessel = OK. Pressure Gauge = OK.	In good working condition

SOURCE: Visual Inspections Conducted on Marine Vessels (Tugboats) of West African Oil Field Services (WAOS) @the Jetty in Kidney Island, Port Harcourt, Nigeria.

4. DISCUSSIONS

The visual inspection of Horizontal Welded Air Receiver on Board MV Mr. Colt was done by competent Surveyor in line with safety and technical specifications. The Relief Valve, Condensate Purge Valve, Metallic sounding of vessel and Pressure Gauge were found to be satisfactory and hence in good working condition. In the same vein, the visual inspection of the Horizontal Welded Air Receivers on Board MV Mr. Farrel, Mr. Sonia, Mr. Webb Crosby and Mr. Vinton Crosby were found to be satisfactory and hence in good working condition. Also, the Relief Valve, Condensate Purge Valve, Metallic sounding of vessel and Pressure Gauge of MV Miss Crosby were found to be satisfactory and hence in good working condition. The outcome of this inspection therefore confers statutory operational worthiness of two years on these air receivers ,when they will be due for the next statutory inspection. The visual inspection is a first line of inspection and helps to establish a premier facie case for further detailed inspection/investigations. When the outcome of the inspection is extremely favourable as is this result, no further action is prescribed, rather to maintain the status quo. On the other hand, if the outcome of the visual inspection had indicated some suspected defects on the air receivers, the need for further inspection aided by more advanced techniques will be considered.

5. CONCLUSION

Statutory visual inspection of eight (8) air receivers on board six (6) Tugboats has been conducted. The outcome of the inspection is very favourable, that is to say, that the air receivers are all in good working condition and have been duly certified as fit-for -service for the next two (2) years.

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7. APPENDIX

Table A - Inspection Interval For Air Receivers

Pressure Equipment	Commissioning Inspection Required	First Yearly Inspection Required	Typical Inspection Interval(Yearly)	Typical Inspection Interval (Yearly)	Typical Interval for Overhaul and Bench Test(Years)
Air Receiver			External Inspection	Internal Inspection	
PV ≤ 100MPal	No	No			

PV > 100MPal	Yes	No	2 years	4 years	
Pressure Relief Valve	Yes	Yes			4 Years

Source: [19].The Inspection Schedule here is recommended as a minimum subject to the conditions of the plant.