Ship machinery and equipment maintenance

Ship machinery maintenance is of predominant importance for accurate operation of each ship. For this purpose, the ship's machinery plant should be kept well maintained and clean at all times for assuring safe and smooth operation and functionality of the ship. Furthermore, it is most significant that ample new spare parts and equipments are carried on board in order to correctly accomplish maintenance in due time under the supervision of fully competent staff according to the manufacturer's instructions. Moreover, Crankshaft deflections need to be taken frequently at regular intervals. Fuel oil and Lube oil must be analyzed in order to ensure that they do not contain any debris or contamination. Main as well as auxiliary engines result in a breakdown that cause severe damage like fire that may require the ship from terminating its services until lengthy and costly repairs and maintenance measures are accomplished.

Experts acknowledge the fact that maintenance requirements are not standardized. However, these requirements will differ substantially from one ship to another. Some ship owners employ a fundamental preventative maintenance policy, while others operate more sophisticated systems based on condition monitoring. This is why machinery surveys are adopted in flexible basis so as to plan according to owners' existing business processes and schedules. An approach that is based on operating at schedules intervals offers a manageable and controlled maintenance program. Although, it may not be most efficient, a maintenance program is tailored to operational performance trends, and manifested by individual elements of machinery. Furthermore, by evaluating the condition monitoring data, the extent to which machinery is opened for surveys is considerably reduced. This approach may be applied to a vast variety of reciprocating and rotating shipboard machinery. For instance, Tail-shafts can be controlled and monitored on frequent basis, thereby allowing lengthy periods between withdrawals for accurate inspection. The time interval between raising main stream turbine casings may be extended in a similar fashion. As a result of this, unproductive repair as well as dry dock downtime may be kept to a minimum level. Interestingly, based on Reliability-centered maintenance (RCM), further optimization of the maintenance program can be obtained. This technique employs a structured assessment of functions for deriving the most efficient maintenance strategy. Also, operational performance can be improved by maintaining ship availability and keeping downtime minimal.

For proper machinery maintenance and loss prevention, following measures must be undertaken:

Lubricating Oil:

Lubricating or lube oil sampling should be maintained at frequent levels and regularly recorded as a recommended practice. Also, lube oil purifiers must be operated continuously and adequately. The gravity disc should be chosen so as to achieve the desired oil-water interface at a maximal level of temperature nearing 90 deg C according to the specifications. Furthermore, the lube oil feed system applied to the purifiers must be evaluated for ensuring the optimum flow rate between the feed pump and the purifier's capacity. Old lube oil feed system designs utilize a direct drive pump that bears a large capacity as against the recommended flow through the purifiers.

If the system contains heavy contamination of water, the lube oil in the sump tank should be transported to a settling tank, the sump tank must be cleaned, and new fresh oil must be filed to the minimum level as recommended by the engine manufacturer. Moreover, the contaminated lube oil is drained and circulated by the purifiers and after analysis, the future use if the oil is assessed. If solid particles are determined in the system, the piping system should be cleaned and the entire engine must be flushed.

Crankshaft Safety:

The engine should be stopped as soon as the oil mist detector alarm rings or overheating of engine is detected. To avoid further damage, the main cause of overheating of engine must be identified and correction measures must be taken before the engine is restarted. The lube oil must be kept clean as far as possible by continuously using the lube oil purifiers at the recommended temperature over 90 deg C. Also, lube oil filters must be maintained and placed in clean and suitable environment by frequent routines. Crankshaft deflections should be regularly taken in order to ensure that the operation of the engine is within the limit as permitted by the manufacturer.

Bunkers:

Bunkering processes that includes fuel-testing procedures must be carefully reviewed for ensuring accuracy in procedures while dealing with off-specification bunkers. Each precaution must taken to make sure that adequate amount of bunker supplies are made available in order to allow proper testing before any new bunkers are used. Furthermore, water, high ash and total sediment potential content also must be considered as well as high sodium and water content that indicates the presence of seawater within the bunkers.

At sea, loss of structural integrity due to grounding and collision are the most significant contributors to accidental pollution. Hulls must be designed by considering two most important factors; (1) improvement in the hull strength as well as energy absorption, and (2) sufficient residual strength subsequent to damage for allowing salvage operations. So far, the major focus is on preventing pollution from tankers. Nevertheless, there is now greater concern related to the potential consequences of damage and accidents to bunker tanks and other types of ships, some which may be carrying thousand tones of fuel oil. Present R & D, as far as improving hull strength and energy absorption is concerned, is focusing on the development and advancement of modified calculation methods that are to be used for measuring the ability of varying structural assemblies to withstand ground forces and collision. When the entire numerical simulations done by the finite element method is taken into account, examining the experimental results have proven the significance of including the vertical motion of the ship especially for grounding simulations along with the motion of the struck object or striking ship to evaluate collision simulations. Moreover, significant amount of research has been dedicated to the evaluation of existing as well as proposed design solutions for improvement of collision and grounding strength.

2-D methods have been employed for evaluation of relatively simple post-accident strength for the anticipation of the collapse strength of a hull girder.

By using these methods, the capability of the damaged ship to survive can be assessed by a skillful comparison between the measured strength and the environmental loads; the latter being calculated without considering the result of the accidental damage on the loads and motions acting on the ship. Therefore, research is on-going with the main objective on improvement of ship response calculation methods corresponding to the effects of damage for both mobile offshore units and the ships.

The following are said to be the major R & D requirements in these areas:

Conceptions about ship subdivision in order to minimize the effect of impacts on the hull, as well as concepts for hull structure design for increasing the residual strength and the resistance to impact after damage.

Particularly, further development and enhancement of energy absorbing side and double bottom shell designs and their evaluation through full-scale tests and models along with comprehensive numerical models.

Integrating numerical models for external dynamics, i. e. ship motions, and internal mechanics.

Developing ways of securing bunker tanks from grounding and collisions for new ship designs.

Developing simplified calculation techniques and methods for prediction of energy absorption abilities of particular structural solutions.

Developing design criteria for prevention of pollution as a result of collision and grounding

Analysis of collected casualty information on grounding and collision with the main goal to develop environmental impact indexes and reference design scenarios able to talk for the energy absorption and varying structural configurations.

Apart from grounding and collision, other major causes of loss of hull integrity are fatigue/fracture problems, excessive loading, and consequences of corrosion. Corrosion is reduced by supplying additional thickness to the plate at the design stage and employing corrosion protection systems, many of which are based on coatings requiring maintenance throughout the life of the ship. Also, corrosion problems can be dealt with by good detail design of the hull structure. A factor that provides potential is design for maintenance; for instance, by ensuring suitable access for inspecting local structures as well as for applying coatings. Thus, the main R & D needs covering this area are concerned with the design and structuring of ship hulls for corrosion reduction/prevention and for easier inspection and maintenance.

Planned maintenance system (PMS) deals with scheduling, planning and performance of each and every important machinery on board a ship. Furthermore, PMS software is deployed to every ship for carrying out the operations of the ship in an efficient manner. All the PMS functionalities are carried out according to their schedules. This not only ensures efficient working of the machinery but also help in avoiding any sort of mishap caused due to poor maintenance. To carry out all the maintenance works in a timely manner, PMS software is used.

A PMS software is fabricated for a ship based on the type and number of machinery the ship possesses. A job card is assigned to every machine that consists of every detail about the machinery. Each job card has three main components. A PMS software gives an accurate estimation of the maintenance schedule overdue or nearing, and enables the user to plan and submit the completion report, by which the next maintenance date is automatically rescheduled (Hayman et al).