United States
Coast Guard

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NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 1-89
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Subj: Underwater Survey Guidance

1. PURPOSE. The purpose of this Circular is to provide vessel owners and operators, underwater survey diving contractors, and other interested persons guidance for conducting underwater surveys. It addresses both the application process, the advance planning necessary, and the procedures to be followed during an underwater survey.

2. BACKGROUND. In December 1980, the Coast Guard published the final report of a research project entitled "1980 Underwater Technology Survey for Extension of Time Between Drydockings" (available through the National Technical Information Service (NTIS), Springfield, VA 22161, Report ADA 101-131). The report indicates that current technology, properly applied with additional administrative and operational controls, can provide a satisfactory means of inspecting the underwater bodies of vessels without their being hauled out. Underwater examinations using video equipment have been accepted on occasion by the Coast Guard as a means of verifying the continuing acceptability of the structure of large mobile offshore drilling units (MODU's) since 1969. Since publication of 46 CFR 107 in 1978, underwater examinations for column-stabilized and self-elevating MODU's have been allowed by regulation. In 1982 an experimental underwater examination program for ships was initiated and in 1983 a separate underwater survey program for the Military Sealift Command's Near Term Propositioning Force was established. These programs provided the basis for including underwater surveys in the 1988 revision of the drydock and tailshaft regulations, 46 CFR 31.10-21(d), 91.40-3(d), and 189.40-3(d). These regulations provide the option of alternating drydock examinations with underwater surveys to owners and operators of tank vessels, cargo and miscellaneous vessels, and oceanographic research vessels that are less than 15 years of age. 46 CFR 31.10-21(e), 91.40-3(e), and 189.40-3(e) also permit continued participation in the underwater survey program for vessels 15 years of age and older. Vessels older than 15 years of age which have not previously participated in the underwater survey program are ineligible.

3. DISCUSSION.

a. Underwater surveys are optional. The regulations permit owners/operators to alternate drydockings with underwater surveys. For instance, a salt water service vessel that would normally be drydocked at years 2.5, 5, 7.5, 10, 12.5, and 15 could conduct alternate underwater surveys instead of drydocking at years 2.5, 7.5, and 12.5.

b. Enclosure (1) is a guide for the underwater survey program.

4 IMPLEMENTATION.

a. U.S. vessel owners and operators are encouraged to use the guidance in enclosure (1) when applying for and planning an underwater survey.

b. Underwater survey diving contractors are encouraged to use the guidance in enclosure (1) when preparing to conduct an underwater survey.

J. D. SIPES
Rear Admiral, U.S. Coast Guard
Chief, Office of Marine Safety,
Security and Environmental Protection

End: (1) Underwater Survey Guidance

Underwater Survey Guidance

1. Entry Into Underwater Survey Program.

   a. Pre-Survey Drydocking. An owner who desires to enter his vessel into the Underwater Survey Program must first drydock the vessel. The purpose of this drydocking is to conduct a preliminary survey of the hull to evaluate its condition and the feasibility of conducting an underwater survey. This survey and the video discussed below will be used as a reference for the first underwater survey once the vessel has been approved for the underwater survey program.

   b. Hull Markings. During the pre-survey drydocking, a means must be provided whereby the location of the diver relative to the hull can be determined with sufficient accuracy to locate specific points on the underwater body. This may entail a weld bead grid system on the hull, a contrasting color coating system, a movable grid an acoustic "pinger" locating system, or any other arrangement that is satisfactory to the OCMI (Officer in Charge, Marine Inspection). Hull markings, or "targets", every 100 feet, at the keel, below the turn of the bilge, and below the water line are recommended. Consideration should be given to the possibility that bottom coatings alone may wear off over time.

   c. Sea Chests. Hinged gratings must be installed on all sea chests to allow divers access into each sea chest to inspect the external sides of through hull connections and sea valves.

   d. Reference Video. Once all hull markings and preparations have been made, a video tape with audio commentary should be made of all external areas of the underwater hull, including rudder, propeller(s), tailshaft(s), hull protective system, and all other attached appurtenances. The video should clearly show the hull reference system, required by 46 CFR 31.l0-21(d)(3), 91.40-3(d)(3), and 189.40-3(d)(3), which will be used to determine the diver location relative to the hull.

2. Applications for Underwater Surveys Instead of Alternate Drydock Examinations.

   a. Applications for underwater surveys, as required by 46 CFR 31.10-21, 91.40-3, and 189.40-3, should be submitted at least 90 days before the requested survey to the OCMI who will conduct the underwater survey. The OCMI who issued the vessel's Certificate of Inspection should also be notified that an underwater survey application has been filed.. The information required to be included in applications for underwater surveys is specified in 46 CFR 31.10-21(d), 91.40-3(d), and 189.40-3(d). To ensure that this information is presented in adequate detail, the following specific items should be addressed:

      (1) The identity of the diving contractor.

      (2) The number of divers to be employed, type of diving equipment to be used, and their underwater nondestructive testing (NDT) and damage repair capabilities.

      (3) A copy of the diving operations manual required by 46 CER 197.420.

      (4) The means of waterborne diver support.

(5) The means of taking rudder bearing clearances.

(6) The means of blanking sea chests for removal of sea valves, if blanks are to be used. Also include their specifications (i.e., thickness, material, PSI test pressure, etc.).

(7) A letter signed by the vessel's master, chief engineer, or the person in charge, stating the general overall condition of the vessel, level of maintenance, any known or suspected damage, cleanliness of the underwater body, and the anticipated draft of the vessel at the time of the survey.

(8) The number of additional or vessel personnel who will be available to assist the dive team and Coast Guard marine inspector in conducting the underwater survey.

(9) The anticipated duration of the underwater survey. Experience indicates that at least 5-10 days should be allowed.

(10) The method by which and the extent to which the hull will be cleaned.

(11) Whether or not an Internal Structural Examination, Cargo Tank Internal Examination, and Integral Fuel Oil Tank exams as required by 46 CFR 31.10-21, 91.40-3, and 189.40-3 will be conducted concurrently with the underwater survey.

(12) Plans or drawings showing the external details of the hull below the sheer strake, including the following items together with a plan showing their location:
- (a) all shell openings;
- (b) all docking plugs;
- (c) bilge keels;
- (d) welded seams and butts;
- (e) appendages;
- (f) anodes, including methods of attachment;
- (g) rudder;
- (h) propeller;
- (i) reference points; and
- (j) watertight and oiltight bulkheads.

b. Decisions of acceptability will be based on the condition of the vessel, the hull protection system and the procedures that will be followed for the performing of the underwater survey. Additionally, the decision of acceptability will, in most cases, require an on-site evaluation of the vessel by the cognizant OCMI. Previously, many items noted during other inspections that required repairs were delayed until drydocking. Now these same items may be required to be repaired earlier due to the longer interval until actual drydocking or further delayed due to the impracticability of accomplishing them at a place outside of a drydock facility. Accordingly, during the on-site survey, particular attention will be paid to above the gunwhale" conditions and outstanding requirements.

c. Whenever more than just the underwater survey is to be conducted, e.g., cargo tank internal or internal structural examinations, an NFPA (National Fire Protection Association) certified marine chemist should be available for initial tank gas-free certification, as required by 46 CFR 35.01-1, 91.50-1, and 189.50-1. A competent person should also be aboard for daily testing once the spaces have been certified "safe for men.

3. Applications for Continued Participation in the Underwater Survey Program by Vessels 15 Years of Age and Older. As required by 46 CFR 31.10-21(e), 91.40-3(e), and 189.40-3(e), the request to continue in the underwater survey program for those vessels which will be 15 years of age or older at the time of the next underwater survey should be submitted to Commandant (C-MVI) via the cognizant OCMI at least 90 days before the drydocking preceding the underwater survey. This advance notice, which would be 3 to 5 years in advance of the requested underwater survey, is intended to ensure that a thorough assessment of the vessel is made during the drydocking preceding the underwater survey, with an eye toward the vessel's suitability to go twice the drydock interval between actual haul outs. Additionally, it will ensure that a complete set of suitable hull gaugings is taken (see 46 CFR 31.l0-21(e)(2), 91.40-3(e)(2), and 189.40-3(e)(2)). A complete set of hull gaugings is considered to be all of the gaugings deemed necessary by the OCMI to determine the condition of that particular vessel's hull. They should include as a minimumgaugings taken around two or more complete transverse sections of the hull. Plate gaugings of one or more strakes in the wind and water area, of additional transverse belts, or of questionable areas such as those with heavy pitting or fractures, may also be required. The results of the drydock examination and the hull gaugings will be submitted by the OCMI to Commandant (C-MVI) for final determination of whether the vessel may remain in the underwater survey program.

4. Preparatory Meeting. A shipowner's representative and a member of the diving team should conduct a preparatory meeting with the Coast Guard inspector prior to the underwater survey to discuss the details of the survey. In the case of overseas surveys, every effort should be made to hold this meeting before the inspector proceeds overseas. At this meeting, the duration of the survey, the site selection, the diver's equipment, personnel and operation, hull cleanliness and preparation, extent of internal examinations, route of the survey along the vessel's bottom, and the overall conduct of the survey should be discussed. In addition, the inspector will be able to advise the shipowner's representative and the diver of all the items the inspector intends to inspect during the underwater survey. Additional items may need to be surveyed depending upon the actual conditions found aboard the ship during the survey.

5. Conducting the Survey. The following guidelines have been developed based upon Coast Guard underwater survey experience, the NTIS report, and the American Bureau of Shipping (ABS) Guide for Underwater Inspections in Lieu of Drydocking Survey, 1975.

a. General. As a minimum, an underwater survey will include a general examination of the hull plating and a detailed examination of all critical welds, propeller, rudder, other hull appurtenances, sea chests, and sea valves. Detailed examination of other areas will be conducted as considered necessary by the inspector. It must be stressed that the underwater survey program is an option that the ship's owners/operators have elected to use. Responsibility for the management of the vessel, its personnel, and maintenance of necessary safety and service systems remains at all times with the master and his representatives.

b. Duration of the Underwater Survey. The underwater survey should take as long as the inspector considers necessary to ensure that the ship is in a safe condition to continue until the next drydock examination (up to 3 years for salt water service and 5 service). Previous experience indicates that at least 5 days should be allowed to conduct the underwater survey. However, if problems develop or repairs become necessary, more time will be required. Initial estimates of the duration of the underwater survey should be proposed by the owner in the application and either refined or confirmed during the preparatory meeting.

c. Site Selection. The location 6f the underwater survey is of the utmost importance for two major reasons. First, the site must be in an area with sufficient water depth under the keel and sufficient clearance adjacent to both sides of the vessel to allow the diver to safely survey the entire underwater hull of the ship, without concern for the presence of hostile sea life or high current velocities. Second, the site must have good underwater visibility. Conducting an underwater survey in poor visibility could adversely affect the intent of the program (equivalency to a drydock examination) and the safety of the ship. Water turbidity (clarity) is a particularly subjective item, and the decision of acceptability will be based primarily on the clarity of the television monitor presentation. If the inspector feels that better visibility is required, the shipowner will be given the option of either moving the ship to a location with better visibility or drydocking the ship.

e. Additional Personnel. Current trends in automation and reduced staffing may result in a situation where a vessel's normal complement will not provide a sufficient number of personnel to assist in the inspection process and maintain the shipboard watch. Additional personnel may be needed to act as line handlers to support the dive boat, to position a movable grid if used, to pull sea valves, etc. Consideration should be given to crew watchstanding responsibilities when evaluating the need for additional personnel.

f. Divers, Diving Equipment, and Operations. The underwater survey should not be conducted unless the inspector is satisfied that the equipment and procedures being used by the divers will provide a safe and meaningful examination of the ship. Safety must be foremost on the minds of all those working together on the actual diving operation. While matters in this regard are best left to the experienced, professional individuals normally found conducting this type of work, everyone involved in the survey should be alert to these needs and ensure that any requirements regarding this inspection can be safely accomplished. As required by 46 CFR 197.202 commercial diving operations taking place from vessels required to have Certificates of Inspection issued by the Coast Guard, regardless of geographical location, must comply with the provisions of 46 CFR Part 197 Subpart B - Commercial Diving Operations.

(1) Acceptability Of Diving Personnel and Equipment. A professional commercial diving firm should be employed by the owner. While specific approval is not required by the Coast Guard, a subjective evaluation by the OGMI or the attending inspector will be conducted. Such an evaluation may consider:

(a) Prior experience or training;

(b) Qualifications of dive team members in photography, nondestructive testing (NDT), underwater damage repair, and other training and experience;

(c) The type, quality, and condition of equipment to be used, i.e., a color monitor and color tape video recording system is required along with two way recorded audio between the diver and the inspector. A still underwater photographic capability should also be available; and

(d) The degree of professional approach/attitude, as evidenced by an organized dive plan, personnel assignments, standbys and backups, compliance with appropriate safety regulations (Coast Guard, Occupational Safety and Health Administration (OSHA), various states), etc.

g. Hull Preparation. The underwater survey should not begin until the inspector is satisfied that all areas of the hull to be inspected, including sea chests and sea valves, have been cleaned to allow for a meaningful examination. The method of cleaning is left to the discretion of the vessel owner. Water blasting of welds is discouraged, unless a particular problem is anticipated, because removal of paint and coatings subjects welds to unnecessary corrosion and pitting. The reference video taken at the pre-survey drydocking should be used to familiarize all involved personnel with the layout of the hull markings and overall condition of the hull at the time the recording was made. The internal examination (opening up) of sea valves may require diver installation of custom prefabricated blanks or watertight boxes on through hull fittings. Each hull opening to be blanked or plugged should be permanently marked or identified on the hull. This will simplify verification that blanks are inserted and removed from the correct hull openings. The ship should be at, or as close as possible to, its light draft.

h. Sea Valves.

(1) The preparation of the sea valves for inspection during an underwater exam is most critical, as it will affect the watertight integrity of the hull and the ability to keep essential machinery in operation. Prior to commencing the examination of sea valves, the vessel's personnel should develop and provide a detailed procedure which at a minimum includes the following:

(a) The number, type, size, and method of operating the sea valves to be opened.

(b) The disabling of automation features which might affect the sea valves being examined.

(c) Method of installing blanks/plugs for sea chests/valves.

(d) The sequence of valves to be blanked/opened should ensure that vital cooling systems, essential electrical service, and bilge and fire pumping capabilities are maintained.(e) Closure of watertight doors.

(f) An emergency procedures plan.

(g) Means of communication between the bridge, dive team and engineroom (direct communications via sound powered phones are preferred).

(2) Removing and examining sea valves while a vessel is afloat and while some portion of the machinery plant remains in operation is. a situation not generally experienced by shipboard personnel. Of necessity, all involved personnel should maintain the highest sensitivity to problems which may start out small but could lead to more serious matters. Intentionally disabling some systems is not a typical operation and should be carefully controlled by the ship's personnel. Sometimes the failure of internal safeguards or other construction features can lead to pressure in piping systems thought to be slack. This condition can lead to lengthy delays while the cause is located and corrected. Points to consider are:

(a) Interconnected sea chest vents that meet below the water line will subject both sea chests to sea pressure unless both sea chests are blanked simultaneously.

(b) Failure of check valves can pressurize secured systems. This would most likely occur in crossovers between main and auxiliary fire pump lines, main and auxiliary cooling systems and crossovers to the sanitary Systems from any other salt water system.

(c) Temporary “jumpers” installed to keep essential systems on line may defeat the designed system isolation.

(d) Pressurizing auxiliary and sanitary systems with full fire main pressure can damage equipment designed for low pressure service.

i. Bearing Clearances. Readings of the propulsion shaft bearing and rudder shaft bearing clearance should be taken. These readings should be acceptable to the inspector as accurate and reliable. Otherwise, drydocking the ship may be necessary. Clearances should be compared with those obtained during the last examination and meet the standards set in 46 CFR 61.20-23.

j. Internal Structural Examination, Cargo Tank Internal Examination, and Fuel Oil Tank Examination. These exams are required by 46 CFR 31.10.21, 91.40-3, and 189.40-3 and include an examination of the vessel's main strength members, including major internal framing, hull plating, voids, and ballast tanks. In most situations, the internal structural examination should be conducted before, or at the same time, as the underwater survey. The results of the internal structural examination should be used to identify those areas where a problem exists or is suspect. These areas should be given special emphasis when conducting the external underwater survey.

k. Repairs and Deficiencies. Any required repairs should be performed to the satisfaction of the inspector. Depending upon the magnitude of the repair or the number of repairs necessary, this may result in an unsatisfactory examination and require drydocking of the ship. Deficiencies that are not repaired, or are not considered severe enough to require repair, will be evaluated in conjunction with the overall results of the underwater survey in determining whether the ship should be allowed to operate a full interval until the next drydocking. If there is doubt as to whether a ship is in a sufficiently safe condition to operate a full interval until the next drydocking (up to 3 years for salt water service and 5 years for fresh water service), a requirement to drydock the ship may be issued.

1. Underwater Inspection Techniques And Equipment.

(1) General. The attending inspector will generally be limited to viewing the television (TV) monitor, reviewing video tapes, talking with the diver, observing NDT procedures, reviewing any still photos, and reading the diver's survey report. This method of survey does not generally lend itself to the flexibility and "hands-on" aspects marine inspectors have come to know at normal haul outs. Nevertheless, there are a number of things that can and should be prepared for. The diving operation will normally be a surface supplied air dive that includes the diver, a tender watching the diver's umbilical, a standby diver (usually the tender), and the diving supervisor. Communications with the diver should be via hardwire. The TV monitor should be located close to the diving supervisor's position to facilitate simultaneous viewing of the TV monitor and communication with the diver.

(2) Diver's Observations. The diver's visual findings and commentary can be very beneficial. A knowledgeable inspection diver can provide greatly enhancing detail and description to the TV monitor. For example, wiping off sea growth to clear a picture of the weld or carrying a short ruler or a marked diving knife to give dimensions can be helpful to topside viewers. On the other hand, the camera used by the diver provides a small field of view. The view can be affected by water clarity, the diver's exhaust bubbles, the diver's motion and speed of advance, glare from the diver's light as well as the amount of available light, etc. The diver's comments on the overall condition of the hull regarding sea growth, damages, and the coating system may prove to be helpful, but the inspector will maintain control of the inspection by requiring the diver to proceed at such a pace so that there is good visual acuity of the section of the hull being photographed. The inspector may also have to direct the diver to adjust the attitude of the camera to reduce glare or to bring an item more into focus. The measure of reliance upon such information is left to the judgment of the inspector at the time of the inspection and, ultimately, to the OCMI.

(3) Monitor System. A color TV system should be used. A color bar or test slate should be available to allow proper adjustment of the picture for maximum efficiency and clarity. This includes consideration for a compatible lighting system (type of light, candlepower, etc.). The monitor presentation should be satisfactory to the inspector/OCMI. It should concentrate on hull appurtenances (propellers, rudders, bilge keels, sea chests, etc.) as well as any areas of damage. Although it may not be necessary to cover every inch of every weld on the underwater body, the attending inspector/OCMI should be satisfied as to their satisfactory condition. [NOTE: The owner should provide a copy of the audiovisual tape and the written report by the diving company to the OCMI.]

(4) Photography. Still photography, particularly 35mm, provides generally improved detail as compared to TV pictures. This is particularly useful in specific or localized applications such as damage or deformation. Its use is highly recommended when questionable areas are found on a hull.

(5) NDT Procedures. These may consist of the diver's visual examination, magnetic particle inspection, or ultrasonic testing. For crack detection or. help in determining the extent of cracks, magnetic particle methods are available. For thickness gauging, ultrasonic testing is recommended. In any case, operators should be appropriately qualified and qualifications should be verified. Equipment calibration is likewise necessary. It is recommended that NDT personnel be ASNT Level II qualified (American Society for Nondestructive Testing).

m. Acceptable Underwater Repairs. Limited underwater repairs are possible, utilizing newly developed techniques or materials. Some applications of welding, both wet and dry, below the water's surface are possible. Presently, any underwater weld should be considered a temporary repair, subject to reevaluation at subsequent inspections and haul outs. Fabrication and quality assurance standards for underwater welding can be found in the American Welding Society's, "Specifications for Underwater Welding."

n. Evaluating Results of the Survey. The not prevent the underwater survey from satisfaction of the inspector. If the with the results of the survey, credit ship's operating schedule should being conducted to the complete OCMI is not completely satisfied will not be given for the survey.