MARTIN OTTAWAY

“Systems Design for Meeting New and Existing International Regulations”

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Systems Design for Meeting New and Existing International Regulations

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The maritime industry is flooded with new regulations on a continual basis. These Regulations, in general, improve the safety and environmental sustainability of the industry. A reasonable argument can be made that the maritime industry leads the world in the adoption of international regulations and quite possibly is the international leader in environmental sustainability. The execution of these regulations falls squarely on the shoulders of the ship designers, the shipbuilders, the ship owners, the ship operators, the auditors (classification societies and consultants), and the enforcement of these regulations is the responsibility of the Flag States and the Port States. The last 30 or so years have shown quite a number of success stories in this execution/enforcement, but there continue to be some areas and even specific regulatory efforts that are problematic. Experience is starting to point towards specific systematic approaches that, once adopted, allow the execution and enforcement of international regulations to achieve faster convergence and, subsequently, faster stable adoption in the industry. This paper analyzes the system dynamic, provides specific examples, and provides a systematic approach and specific recommendations to all stake holders in achieving rapid and stable adoption of emerging international regulations. In particular this paper discusses overall environmental and associated system design and improvement, which is referred to as QESTH, and explores the use of Technical Memos in advancing the general state of the art. The concept of Tech Memos is explained by actual application in OWS issues and the advances in the state of the art in OWS and MARPOL compliance resulting from these tech memos are provided in this paper.

KEY WORDS: systems engineering; rules; regulations; safety; pollution; vessel management; MARPOL; IMO; QESTH; environmental

NOMENCLATURE

Definitions in italics are specific terminology for the purposes of this paper and may be defined differently in other settings.

CAR – Corrective Action Request.
CBOK – *Common Body Of Knowledge*
Crew – *The personnel that work aboard the ship.*
EPA – Environmental Protection Agency
Flag State – The country in which a vessel is home ported and the agency that issues regulations for the vessel.
HQSE - Health, Quality, Safety and Environmental.
IMO – International Maritime Organization.
ISM – International Safety Management. An IMO regulation requiring vessels to have a safety management system.
Law Enforcement Agency – *Any agency that can enforce law that applies to the vessels, in the United States this may be the USCG, Department of Justice or FBI, among others.*
M&R – Maintenance and Repair.
MARPOL – MARitime POLlution. A collection of IMO regulations that aim to minimize vessel generated pollution.
MCRIP – MARPOL Compliance Rapid Improvement Program.
ORB – Oil Record Book. A MARPOL mandated shipboard record book or log.
Owner – *Any and all parts of the shore based management of a vessel such as actual owners, managers or ship operators.*
OWS – Oily Water Separator
Port State Control – The law enforcement agency associated with the port that a vessel is visiting.
QESTH – Quality, Environmental, Safety (Security), Training and Health. The components of the "for the public" portion of a vessel management system.
SMS – Safety Management System. The system originally required under ISM.
Vessel – A ship subject to ISM or local SMS systems.
VGP – Vessel General Permit. An EPA documentation requirement that seeks to establish a particular vessel's impact on the environment.

INTRODUCTION

The maritime industry is flooded with new regulations on a continual basis. These Regulations, in general, vastly improve the safety, and environmental sustainability of the industry. A reasonable argument can be made that the maritime industry leads the world in the adoption of international regulations and quite possible is the international leader in environmental sustainability, considering the continuing inability for countries to achieve international agreement on land based environmental standards. The execution of these regulations falls squarely on the shoulders of the ship designers, the shipbuilders, the ship owners and the ship operators and the enforcement of these regulations falls squarely on the shoulders of the Flag States and the Port States. However, not all stake holders have been equally involved.

The last 30 or so years have shown quite a number of success stories in this execution/enforcement, but there continue to be other areas and even specific regulatory efforts that are

problematic. The author of this paper has spent a considerable time in the trenches of this dynamic and has analyzed this dynamic on a wide range of occasions including through SNAME T&R panels but also in actual enforcement situations ranging from simple implementation design to training, and to criminal prosecutions. This work is starting to point towards specific systematic approaches that, once adopted, allow the execution and enforcement of international regulations to achieve faster convergence and, subsequently, faster stable adoption in the industry.

This paper analyzes the system dynamic, provides specific examples and provides a systematic approach and specific recommendations to execution and enforcement stake holders in achieving rapid and stable adoption of emerging international regulations.

Safety and environmental regulations consist of international and local regulations. While there can be some variation between international and local regulations and while this variety can be frustrating to ship operators and crews, the most effective method for the implementation for such regulations does not appear to vary.

The international safety and environmental regulations are contained under SOLAS and MARPOL and while the methods in this paper apply to both international and local regulations, for discussion purposes, references to regulations will follow the MARPOL and SOLAS format and naming. Further discussions on these emerging regulations are found in the references [3] and [8] and will not be repeated here.

Instead, for the purposes of this paper, it will be assumed that the ship owner is up to date with the implementation aspects of the regulations and has developed an ISM/SMS/HQSE system, which, combined, are those systems that have arrived aboard ships in the last 40 or so years and which to a large extent exist to serve the public in general, or increase system safety and security. Inherent in these systems there is a training component and as such the more accurate term is probably QESTH[1], and this term will be used in this paper for any of the various systems that are used aboard ships all over the world. With regard to the various systems, the selection and design of an optimal approach is problematic by itself and will be further discussed below.

All these systems assume continuous system improvements through the design/verify/test and improve process.

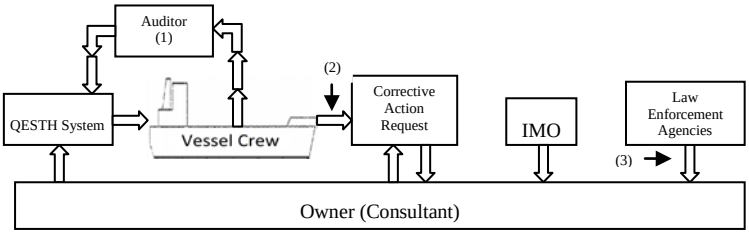


Fig. 1: Today's QESTH Information Flow

Today the auditing and verification of these systems tends to focus on the review of the system design (this is typified by asking: are there any errors or omissions in the system?) and verification of the "verify" portion of the system (are reported non-compliances properly processed?) To a large extent this takes place at location (1) in the above diagram.

This appears to be the state of the art today, but fails to address a huge elephant in the world's wheelhouses and engine rooms. While these systems can identify non-compliances that are reported, they have not developed into systems where there is a real culture of near-miss report and corrective action request (CAR) report generation. On the most practical level, the majority of the systems that are installed under the newest regulations have no benefit to the Crew or Owner since they do not earn money or reduce cost, but instead are a burden imposed by the public. As such, it has been found that most of the systems are operated in a robotic fashion, and there is little energy to improve the systems on a technical, operational or procedural level.

In effect the test/improve option (location (2) in the diagram) is not functioning, the vessel Crews are doing what they cannot avoid having to do, but do not really lean forward to actually improve the system for their individual benefit and for the benefit of the entire system. This is far from the fault of the crews, but instead is caused by a system wide disconnect that has been discussed in references [3] and [8].

More remarkably there is another broken link where, even if there was significant crew feedback, the ship owners also do not communicate in developing optimal solutions to regulatory directives by feedback to the regulations developers (IMO). Instead, the state of the art at the ship owner level is a defensive activity where they will incorporate or promulgate systems that respond to a state of the art that has a post legal prosecution basis, but not a technical basis, which is represented at location (3) in the diagram. Meanwhile this approach leads to situations where Owners[2] are often faced with a situation where they have to ask themselves: "How did we miss this, even though we have a state of the art QESTH system?" Today the "How did we miss

[1] The acronym has been arranged to allow it to be approximately pronounced in the English language as "Quest" system. Hopefully this pronunciation will more clearly describe the goal of these systems. To avoid lisping, it is assumed that the ISPS security component is included in the safety "S". For the sake of further completeness it can also be assumed that ethics is included in the environmental "E". The QESTH system is separate from profit and customer service driven systems.

[2] For the purposes of this paper a maritime company consists of two parties: the Crews and the Owners. Crews are those people within a company that travel the world aboard ships and Owners are those people that work from a fixed location ashore and provide the ship with the support and directions to operate the ship profitably and within the law.

this" situation is often related to OWS mismanagement, but just as easily it can be related to any peculiar ship board practices that have developed over time, but that are not caught by the system.[3]

When these failures occur there is often a large amount of mutual soul searching, but the result is that, in the overwhelming majority of these failures, Crews and Owners become embroiled in litigation and technical truths become obscured.

RESEARCH METHODOLOGY

When QESTH instabilities occur there has been a general trend by ship Owners to call in consultants and the crews to participate in shore based conferences that attempt to reinforce the weakness in the QESTH system that has been identified.

As such, there may be a conference on OWS where consultants show crews the latest methods to avoid OWS QESTH system failures and the crews take lots of notes and go back to sea with more specific instructions and more extensive verification processes.

This process may have reduced subsequent OWS QESTH failures, but there is actually no evidence that this is the case. What actually seems to occur is the system drives ever more extensive verification efforts on something that, in essence, is very difficult to verify. Rather than being faced with ever increasing verification burdens, in the end QESTH systems should be the type of technical/cultural dynamic where verification should decrease over time. This ever increasing paper work burden is related to an inability of the stakeholders to address the hidden technical realities.

In 2011 the author was faced with having to develop yet another conference for a ship owner on this subject, but instead the authors convinced the Owners that this system would not be technically effective unless there would be a major rework of the conference format.

The parties worked up a conference format with program goals towards the continuous improvement of ship environmental practices and focus as follows[4]:

1. Complete transparency.
2. Owner and Crew cultural change.
3. Full buy-in by all participants.
4. Integrated MARPOL training.
5. Attention to detail.
6. Unified approach.
7. Continuous improvement

This system was called the MCRIP (MARPOL Compliance Rapid Improvement Program) approach. While at first glance these focus issues may not be considered to be novel, they did become quite novel when the law enforcement agency agreed to participate.

The focus issues were clearly stated and introduced to all parties, prior and during each conference and the attendees were provided with all of the documents used in the conference before the arrival.

While these were the operative goals and focus of the approach, there was an underlying secondary methodology and reality that could only be disseminated gradually:

1. There is very little operational knowledge on these systems and lots of that knowledge may be incorrect, and this incorrect knowledge is spread across all stake holders.
2. Let's behave like engineers and act on data rather than suspicions.
3. All of us hold little pieces of data, but none of us have a hold on all of the data. Let's combine data.
4. Arrive at technical solutions, rather than defensive solutions.
5. If paperwork can be reduced, we all commit to making every effort to reduce paperwork.
6. Are there technological solutions?
7. Transparency extends to all stake holders including regulatory agencies and law enforcement agencies.
8. We will not penalize anybody for earnest, but incorrect approaches.
9. If we are not sure, we will not discharge anything from the ship and we will get help.

Item 1 above, the lack of operational knowledge, and the possibility that incorrect operational knowledge exists, warrants further discussion. It is an important realization and is actually a logic exercise that flows as follows:

- If everybody operates with correct knowledge there is no conflict.
- If everybody operates with incorrect, but identical incorrect, knowledge, weirdly, there may also be no problems (As in: If we both believe that pigs fly, there is no need to discuss this knowledge unless one of us is struck by a falling pig.)
- Only if one party operates with incorrect knowledge and the other party operates with correct knowledge, or different incorrect knowledge (whatever that knowledge may refer to), conflict will inevitably arise when the two parties meet.

[3] Without providing any type of judgment on the actual practice, it may be high risk navigational diversions for any one type of reasoning or failure to provide assistance on the high seas, or system instabilities caused by introduction of cell phones into wheel houses.

[4] It is noted that the conference was actually a sequence of four conferences that were refined after each conference with input of all stake holders. The focus provided is the final refined approach.

If there are only two parties, these are the only options:

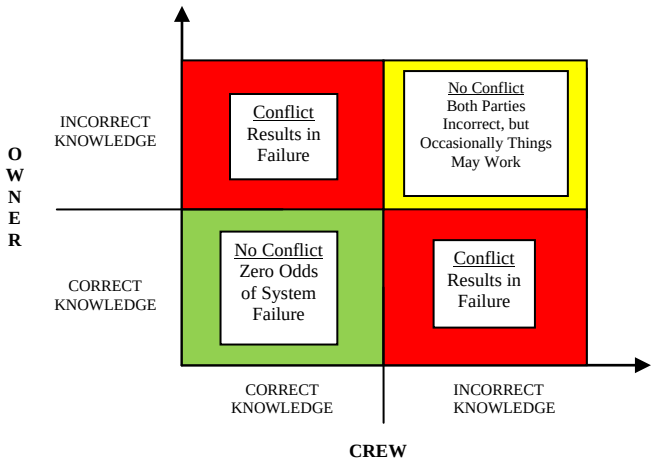


Fig. 2: Possibilities for Conflict or No Conflict with 2 Parties (Owner & Crew) and One Knowledge Subject

If there are four parties (Crews, Owners, Regulators, and Law enforcement) and all the regulations and technical and operational interpretations that exist in QESTH, it becomes apparent that we are dealing with a massive knowledge issue. If one considers that we are not dealing with one Crew and one Owner and one Regulator and one Law Enforcement Agency, it becomes apparent that correct knowledge is an absolutely essential factor in proper implementation.

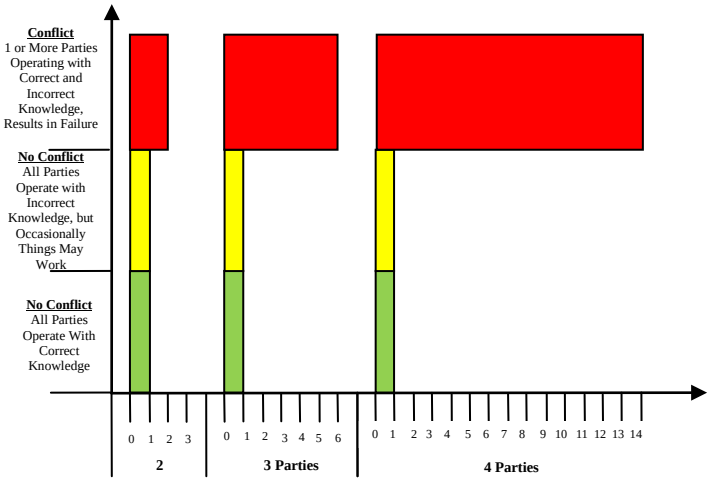


Fig. 3: Number of Possibilities for Conflict vs. Number of Parties Involved for One Knowledge Subject

IMPLEMENTATION

It is noted that with company executives and law enforcement present at a conference as described above, it can be quite difficult to convince Crews that whatever one says will not result in very serious negative consequences and this is a process that cannot be achieved in a few days of campfire song singing and group confidence sessions. Fortunately, in this particular case, there were unionized Crews (with union representatives present and involved), regulators, Owners, auditors (classification society), consultants and law enforcement personnel[5] of a single nationality, that despite, obvious tensions, provides a certain level of startup faith. (Also, in this particular case, the immediate law enforcement agency and the Flag State were the same agency.)

The further development of faith was based on the "Tit for Tat" game theory principle [2]. In the conference format, this was related to the "You show me yours and I'll show you mine" principle, where game theory shows that this can work, if one takes tiny "You show me yours and I'll show you mine" steps.

On a practical level this can relate to the following pronouncements:

Owner: Do you as crews realize that, I, the Owner know much less about this equipment than you do, because while you may be operating it incorrectly, I have never actually operated it so I cannot judge it.
Consultant: We have only occasionally operated this equipment, but always alongside the berth. We have no data about how well this equipment works at sea.
Regulator: We have no idea how this equipment actually operates in real life, we made a goals based regulation on what we thought was technically feasible, but the input we received only came from equipment suppliers, consultants and law enforcement.
Law Enforcement: We thought the equipment would work as intended, but maybe we are wrong. We use internally developed information on judging whether something works or not, but we are not entirely sure either. For example we perform Oil Record Book analyses, but we are not sure we are applying realistic standards.
Crew: Yes, those Oil Record Books really frustrate me. I get all types of directives about having to accurately fill in Oil Record Books, but does anybody have any idea what accurate is? (References [1] and [4])
Law Enforcement: Shouldn't 1 to 2 percent measurement accuracy be achievable?
Crew: Where? Alongside the berth?
Owner: Didn't we install a tank gauging system that is advertised to measure within 2 percent?
Crew: The measuring equipment is within 1 to 2 percent as far as the liquid level is concerned, but not if we cannot accurately measure trim underway. ORB management is not the same as bunker surveys. And even bunker surveys can be problematic if you try to measure fuel consumption within 1 or 2 percent.
Consultant: What do we actually know about tank measurement accuracies?
Law Enforcement: We don't really know, but that is why we assume 1 to 2 percent.

[5] This Owner had actually provided onboard training for the law enforcement personnel, and, as such, already had operated under a certain level of transparency.

Regulator: Now when I think about it, we do not know either.
Owner: We have retrofitted some tanks related to MARPOL equipment upgrades, do these tanks have trim corrections and are they accurate?
Consultant: (Thinking: Here is a job for me) Why don't we figure out what we have. Let us talk to some crews over a beer tonight and we will write a summary of what we know.[6]

TECH MEMOS

This general approach on multiple knowledge subjects has resulted in a number of "Tech Memos" some of which are provided as appendices to this paper. These Tech Memos, while generally rather simple, are actually the state of the art with regard to those subjects and provide the basic technical data that is needed for further regulatory and procedural development. It is suggested that these memos be used as references for further improvement and evaluation of those subjects.

The following Tech Memos are provided:

- Tank naming
- Tank level accuracies
- OWS production rates
- Incinerator use
- ORB stamp
- ORB Spreadsheet

These memos have been prepared in consultation with Crews, Owners, regulatory and law enforcement agencies and have been amended to achieve the highest level of agreement at this time.

These memos are prepared in such a way that they can provide specific technical guidance to ship's crews in realistically complying with QESTH issues. As such, if any stake holder questions vessel operation according to the standards set forth in these tech memos, it is expected that the stakeholder will provide additional solid technical data to alter the approach or instead will submit to the status in the tech memos when it comes to a 20/20 hindsight analysis.

Some of the memos can best be described as exploratory in nature. In this regard the ORB spreadsheet memo deserves special discussion at high regulatory levels (IMO).

The larger meaning and purpose of these memos will be separately discussed below.

[6] Undoubtedly alcohol consumption, in excess, limits cognitive ability. However, there is evidence that social interaction, that may involve alcohol consumption in moderation and at the right moment, facilitates training efficiency. See *Sources of Power*, by Kline [6].

At this stage these memos are specifically available on the SNAME EC-7 website[7]. It is recommended that these memos, and others that might be developed, be disseminated through IMO, in a format where they can be readily accessed by ship's crews.

It is important to note that these are Tech Memos, and are based on state of the art technology. It is conceivable that, for example, in the future, greater tank level accuracies can be achieved. If such greater accuracies can be universally achieved, the Tank Level Memo may warrant modification, but at this time the Tank Level Memo represents the reality as we know it today.

It is recommended that, for any QESTH system issue with data or technical uncertainties, tech memos be prepared prior to policy or regulatory development. The tech memos will provide a well-defined standard for all parties to follow, leaving little to no room for confusion or question about the policy. Undoubtedly technical analysis of any issue in the shipboard setting will provide significant insights that will result in more realistic, generally acceptable and implementable solutions.

TECH MEMO DESCRIPTIONS

This section discusses the development and application of Tech Memos as a tool for summarizing issues related to QESTH system improvements.

As can be noted from the below memos, there may be various reasons for the development of a tech memo, but most significantly they contain one common thread: *a tech memo exists to record existing technical considerations on a subject for which no prior definitive information has been found.*

It is striking that there is a worldwide industry that advances extremely rapidly in QESTH systems, but that has almost no underlying technical basis, and Tech Memos are the first pass at collecting those issues for further dissemination to the industry at large. It is therefore essential that these memos achieve wide distribution for comments and review by all stake holders and address an ever wider range of subjects.

The following tech memos are being offered at this time:

Tank Naming

During shipboard evaluations, and with comparison to regulations and procedures, it has become apparent that not all IOPP certificates identify the correct tanks in the correct section of the IOPP. Further investigation has noted that within company fleets there can be very widely varying and conflicting tank naming approaches, where the same tank may be identified by different names in different documents or certificates. This results in confusion within the company, and, for efficiency

[7] http://www.sname.org/ec7environmentalmanagement/home/

purposes, companies should achieve a higher level of uniformity in tank naming for their procedural approach.

Using the tank naming memo as a guide, one company actually standardized its IOPP tank naming approach across all its vessels, as far as practical[8], thereby reducing the possibility of confusions during vessel operations, procedure development and auditor and port state inspections. The tank naming memo also promotes use of standardized tank name acronyms.

However, more interestingly, industry wide, there is also no consistent overall tank naming convention for commercial vessels. This is actually a rather odd reality that dates back to the beginning of time and up to now there has been relatively little reason to name tanks consistently on all vessels in the world fleet. However, with increased Port State Control scrutiny, the use of widely varying naming conventions can result in confusion.

As such, it would be quite beneficial if a world-wide tank naming convention can be established. The subject memo is the first effort in this regard. It is noted that this memo only covers IOPP tanks[9], but a worldwide naming and acronym convention for all shipboard tanks would be even more beneficial, noting that any tanks on any ship can become the subject of discussion in high risk scenarios where multiple stake holders become involved. At this stage it appears that naming of waste oil treatment tanks is actually the most complex naming task and other tanks are subject to somewhat less functional variation. If there is a world-wide naming convention, in case of grounding or oil spills, it will be possible to develop more rapid situation assessment reports, which in turn will reduce confusion during such critical response periods.

Tank Level Accuracies

The Oil Record Book is a continuous shipboard stumbling block. What appears to be so easy when regarded from shore in fact continues to baffle Crews. There are multifold problems that occur when filling out ORB's and some of the solutions developed by Crews, under close policy and regulatory scrutiny, often are earnest, but at the same time bizarre. There are various issues that are confusing, but one is related to recording tank volumes in the ORB.

MARPOL regulations state that ORB tank volume entries should be "reasonably accurate". However, "reasonably accurate" is an undefined term, and leaves crews between a rock and a hard place. If they simply record what they measure in the tanks, they know that there will be significant inconsistencies that in the long run may add up properly, but, in the short run, appear to be wildly inconsistent.[10] Meanwhile enforcement agencies (and consultants) perform ORB analyses, where they go through often multiple years of ORB entries to see if there are any missing liquids.

Crews become aware of those efforts and, in turn, try to make entries in ORB's that are at least consistent on a volumetric basis. This is where things become bizarre and crews end up adjusting actual and honest data, simply to make it appear to be consistent.

The tank level accuracies memo addresses that issue and provides crews with direct, rational and technically supported guidance regarding the recording of tank levels. At the same time the memo expresses shipboard realities that provide guidance to law enforcement personnel in providing tank volume accuracy opinions that meet with proper engineering standards.

OWS Production Rates

Similar to the tank measurement ORB issues, there have also been OWS production rate issues, and there are actually very official ORB recording instructions that warn crews not to record higher OWS production rates in the ORB than the rated capacity of the OWS. [1]

Again, this results in record keeping weirdness, where crew members may extend the OWS operational period in the ORB simply to bring the amount of liquid processed through the OWS in accordance with the stated OWS production rate.

The OWS Production rates memo is a survey of the available information regarding OWS production rates and regulations and provides this background to Crews, Owners and Enforcement agencies alike to enable them to realistically evaluate ORB statements.

It also provides Crews with specific guidance in situations where OWS production rates are not as they seem. At all times Crews should be rigorously indoctrinated to record anomalies as anomalies and not to avoid the recording of anomalies by "adjusting" measurements or volumes. From a systems point of view, the recording of anomalies is the first step in the implementation of the QESTH feedback system and should be encouraged at any and all levels. Anomalies can be recorded in the ORB, but are actually best first recorded in Corrective Actions Requests (CARs) which are an important but often underused component of QESTH systems.

[8] Renaming tanks on existing vessels is a daunting task, it starts at nameplates, affects gauging documents and equipment, goes through drawings, moves through stability booklets, SOPEP plans and MARPOL certificates, confuses ORB's and messes with class and flag state documents. Conversely, at the new building level, a uniformly applied tank naming convention is far from difficult to implement. There are very specific ship tank groups, all that is required is agreement on the names and acronyms that are applied to these groups.

[9] It is also noted that there was a minor IMO OWS effort in this regard in the form of ([7], p. 152). This effort took place almost simultaneously with MCRIP, and resulted in a slightly different but non-conflictive IOPP tank naming convention.

[10] Crews have been prosecuted for "dumping" a few tons of waste oil. Meanwhile there can be shipboard tanks that hold 100 tons of dirty water, with a few tons of waste oil. If this tank is emptied within 2% accuracy it is possible to conclude that 2 tons will be missing. If one next concludes that 98 tons of water was moved, but the missing 2 tons consists entirely of waste oil it is not difficult to believe that this waste oil may have been pumped overboard.

Incinerator Use

Sludge incineration has become a complex subject due to the fact that there is no single regulation for incinerator use aboard ships. As such, crews are occasionally left to wonder if operation of the incinerator is operationally correct.

This memo discusses a specific case regarding incinerator use. It resulted in a specific policy that removed the decision making process for the crew and thereby simplified the issue.[11]

It does not provide any specific state of the art that can be universally applied, but a memo like this can provide vital support to Owners if the Owner's (or Crew's) actions are questioned with regard to a specific policy. It is interesting to note that, from a legal point of view, a memo like this may be considered to be self incriminating. However, from a proper law (or policy) enforcement point of view, a memo like this simply indicates that proper operation from an environmental point of view is difficult and conflictive. While no easy answers exists from an overall solution point of view, any entity that studies a subject seriously and searches for solutions deserves credit and should be treated with fair and evenhanded consideration by the maritime community at large.

In particular, this issue shows that non universal policies such as special environmental areas can have very problematic carry over effects that are difficult and expensive to resolve at the ship level.

This memo was attached as background info to a CAR that addressed the specific shipboard procedure issue.

ORB Stamp

Almost every ship owner is attempting to get their ships to fill out the ORB's in a consistent fashion in order for them to be digestible by law enforcement agencies. In practice this is almost impossible to achieve since ships have different oily waste treatment processes, different tank arrangements and different routes that dictate different approaches.

As such, at best, an Owner can achieve a *unified* approach rather than a *uniform* approach. However, to provide a unified approach, rather than a uniform approach on a fleet wide basis, results in unintended shipboard variations where one ship's engineer will take one approach and another ship's engineer takes a slightly different approach.[12]

Furthermore, ORB recording results in bizarre repetitive entry requirements, such as the need to list all tank names on a repetitive basis. At one MCRIP conference it was suggested that it might be helpful to have ship customized ORB's, but that would only be of limited usefulness. Next it was suggested to provide each ship with suitable stamps to make the ship's standard entries in the ORB where only the quantities needed to be hand written in the appropriate blanks in the stamped entry. These stamps would be ship specific and actually belong to the ship and correspond to tank naming and function aboard a specific vessel. It is noted that the MARPOL regulation and ORB regulations (which are flag state specific) require handwritten entries and it was not clear if the use of stamps would violate that requirement.

6-Dec-10	D	13 ___m³ bilge water from _____'
		Cap: ___ m³, Ret: ___ m³
		14 Start __:__ - Stop __:__
		15.1 __°__' N x __°__' W - Start
		__°__' N x __°__' W - Stop
		Signed: Rank:

Fig. 4: Stamp design for oily water separator use, code D 13, 14, and 15.1

11-Oct-10	C		Capacity	Ret
		11.1/11.2	ST #6	40 m³ m³
		11.1/11.2	ST #12	25 m³ m³
		11.3	Total retained on board	
			Signed:	Rank:

Fig. 5: Stamp design for the weekly tank volume, code C11

This approach was proposed to the USCG using the ORB Stamp memo, and accepted as suitable. This approach appears to result in significant labor and paper work time savings and, as such, provides Crews at least with a glimmer of hope that paper work tasks will not increase ad infinitum.

Furthermore an ORB that uses a combination of these stamps and handwritten entries can be much more quickly inspected by an auditor or Flag State inspector.

ORB Spreadsheet

When considered in the context of today's technologies the ORB is an anachronism. It requires crews to hand write a document in a convoluted and complex fashion that is actually quite conducive to high levels of automation. At one of the MCRIP conferences a ship's engineer indicated that he actually

[11] The operative answer became: Do not use the incinerator in any restricted zone and deliver to shore any excess burnable materials. This solution is technically frustrating since, from an overall environmental point of view, onboard combustion of low grade fuel in auxiliary boilers at sea actually provides shipboard power in an environmentally non-sensitive area and reduces less efficient shore based disposal impact.

[12] Actual experiments have shown that once a regulator or an Owner is tasked to "correctly" fill in an ORB, even in an exercise setting, they too will immediately agree it is a maddeningly confusing task.

used a spreadsheet to prepare the ORB.[13] This resulted in initial puzzlement since the ORB is supposed to be handwritten. After further clarification it was understood that the engineer had developed an Excel spreadsheet that he used to make daily tank volume entries and that the next sheet on the spreadsheet automatically generated the proper ORB entries. He would then copy those calculated entries into the ORB by hand. This was considered to be a very clever and foolproof approach, but then begged another question. Why would an engineering officer have to waste time hand copying information that could be automatically generated?

The obvious answer is that the ORB predates shipboard personal computers by more than a decade and this engineering officer took advantage of labor saving opportunities that a PC can provide. However, regulatory agencies have not yet looked at the advantages a computerized approach can offer all stake holders.

The first issue the MCRIP conference tried to answer was: Can an engineering officer simply print the second sheet (the sheet with the correct ORB entries) and sign it? The Flag State answer was no, because regulations require the use of a bound official ORB. The implied issue is that a bound record cannot be altered by removing and entering sheets after the fact.

That is a reasonable verification concern, but, technologically, shipboard operations have developed to an extent that time dating a document is not a function of its location within a bound volume. Today it is possible to simply electronically send a document to a designated location and it has been time verified. As a matter of fact, in ship forensics analysis, email, navigational system[14], cell phone and other electronic time stamps are much more useful and effective in recreating event time lines than bound documents.[15]

More remarkably, leading edge Owners are installing planned maintenance and recording systems such as ABS' NS-5 system aboard ships. NS-5 automatically locks in a document once it has been submitted to the system. As such, it is only a modest task to develop an NS-5 based ORB, where the Crew enters tank readings and other ORB required data and NS-5 generates an appropriate ORB. Most remarkably, besides reducing crew workloads, such a system has remarkable carry-on benefits. The ORB exists for Port State, Flag State and Owner review purposes. In practice, the ORB is a double crew nuisance. First it is a nuisance to fill out by hand, and secondly it is a nuisance to maintain aboard for review by parties at interest while the vessel is in port. Of all the time periods in a Crew's busy lives, port time is most precious and questions about an ORB will be most disruptive. If the ORB is forwarded to the NS-5 database as entries are made, any party at interest can enter the NS-5 database and review the ORB without having to bother the Crew. Ideally a Port State inspector or other auditor or inspector can enter the NS-5 system before boarding the vessel in port and instead of having to waste time reviewing documents while aboard, can focus on possible non-conformance discussions and corrections with the Crew (which is the major component of the oft neglected feedback loop portion of QESTH systems). Even more effectively, if appropriate, an auditor can even send an inquiry on the document review to the vessel so the crew is prepared to respond upon his arrival.

In effect, it moves the verification function to a time and location where it does not negatively affect the Crew and allows more focus on the improvement portion of a QESTH system. This is a critical issue today when crew fatigue and hours of rest are coming under ever increasing scrutiny by flag and port state authorities.

The author notes that, as a ship surveyor, there is no greater joy than being supplied with a copy of a ship's document package prior to departing for the port where the vessel will be inspected. By being able to review the ship's documents prior to boarding the vessel, the entire inspection process takes on a new character and, on occasion, has resulted in an experience where both the inspector and the vessel crew depart with a sense of renewed energy and insight with regard to staying up to date with regulatory requirements. Instead of a rush to complete a review while the vessel is in port, there often is some time to develop better solutions, to listen to Crew concerns, and to carefully explain the issues that can cause communication failures that result in ship delays and Crew detentions. Under the best circumstances there may even be an opportunity for the vessel Crew and the auditor to jointly prepare a CAR on an issue that emerged during the audit.

Sludge Production Rates

This paper does not provide a sludge production rate memo, and while on a technical level, there is actually less controversy on actual shipboard sludge production rates than on many other MARPOL subjects, it is important for all stake holders to be fully aware that there is no standard sludge production rate. In the industry a 1 to 2% production rate is considered to be "normal", but it is quite possible that much lower rates are achieved. Again, it is important for Crews to be specifically aware that they do not adjust their ORB entries to provide "accepted realistic" sludge production rates, but instead simply enter what they are actually experiencing.

If, for whatever reason, a crew is generating large amounts of sludge (or very small amounts of sludge), it should be seen as an anomaly and be properly recorded such that it makes it through

[13] Interestingly the actual discussion related to the Owner's requirement that all vessel maintain an IOPP tank sounding log. Such a log is not a regulatory requirement, but has become sort of a common law requirement in an effort to provide further back-up documentation during auditor and port state inspections.

[14] This begs another interesting question: Taking into account AIS and other position broadcast systems why does the Crew have to keep a shipboard position record if the record is widely broadcasted and recorded anyway? The answer is actually quite complex and also worthy of a Tech Memo.

[15] Ironically in response to paperwork workloads aboard vessels, it is not uncommon for ship's crews to prerecord events in bound logs to save time. As such, it has occurred that, after a grounding, a logbook will show the vessel has arrived at a certain location or has performed an equipment operation at some time in the future even though it is solidly aground and never arrived at that place and time in the future.

the system. As such, the entry in the ORB should simply reflect what is measured. If the sludge generation rate is unusual, it should result in a Corrective Action Request or some other form of Quality Management System report, where the situation can then be further assessed with high transparency by all stake holders.

While there was an initial effort at the MCRIP conference to prepare a tech memo on the subject, the memo itself was not considered to be complete and ready for publication due to a lack of raw data. It was determined that the vessels in the MCRIP organizer's fleet were not sufficiently diverse in worldwide operation (instead, they had relatively uniform fuel supply, classes and ages) to provide useful background data. As such, participation by other Owners and Crews will be required to prepare a universally useful and reliable tech memo.

OVERALL QESTH SYSTEM ISSUES

While it appears there are ever more environmental and safety regulations, in actual fact, we are starting to arrive at a new point in the history of QESTH system development. Soon every function aboard a ship will have been regulated from a QESTH point of view. There is specific proof that we are approaching that point of view by taking a Vessel General Permit (VGP), which is, in effect, a listing of all possible ship emissions, and to overlay IMO and local regulations on the VGP. Those portions of the VGP that have not yet been IMO regulated will be regulated soon or are a relatively minor issue as compared to existing regulations.

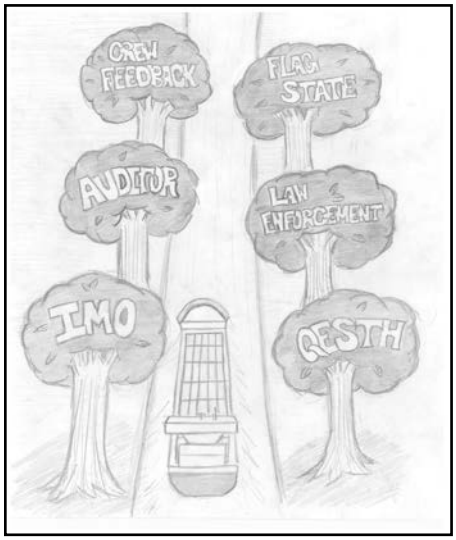
Table 1: Overlaying Discharge Regulations between IMO and VGP

VGP	**IMO**
Oil	MARPOL Annex I
Bilge Oily Water	MARPOL Annex I
Grey Water	----
Black Water	MARPOL Annex IV
Ballast Water	MARPOL Annex II
Garbage	MARPOL Annex V
Recyclables	MARPOL Annex V
Metals	MARPOL Annex V
Food Waste	MARPOL Annex V
Engine Emissions	MARPOL Annex VI
Paint Emissions	----
Leachate	Partially Covered in MARPOL Annex II

This means that, at some time in the future, we will have a fully regulated vessel, but in actual fact the vessel is regulated through numerous non uniform and fragmented inspection and regulation approaches. It should be realized that this is just a VGP/MARPOL overlay, and does not include ISPS, SOLAS, STCW and many other regulatory issues that are part of the QESTH systems today.

From the Crew and Owner point of view, we presently have a forest with so many trees that the forest is completely invisible. While forests may be beautiful things to the uninitiated or the creator, they are actually filled with traps, unknowns and hazards to those who have to traverse them. From the Crew and Owner point of view, the QESTH world would be a much more attractive and less stressful place if it looked more like a park with clear paths, proper directions and clearly identified trees.

Today!



Future?

It only takes a cursory examination to determine that, at present, we have created a bizarre forest of regulations and that we need to do some serious landscaping. As a simple example it is

actually really weird to realize that while Owners and Crews might be willing to think of ships as pieces of equipment that generate emissions, we are actually forcing them to navigate MARPOL regulations and numerous local regulations to actually figure out what they are supposed to do at what time. By the time they find the proper regulation for a particular emission they are so sick and tired of looking that they can be fairly expected to throw in the towel.[16]

This appears to be a miserable situation, but actually this confusion is a measure of our industry's success at having made such amazing headway in a mutual international willingness to serve the public at large and we have arrived at the cusp of a new era. From a QESTH regulation development point of view, we are moving away from an emergency response (we need to reduce oil pollution as soon as possible) mode to a refinement and improvement mode (How do we get everybody to readily and willingly respond).

As such, it is time we start to look at how we can streamline the overall QESTH system and associated regulations.

If we were to make the regulations Crew and Owner centric (and actually also random stake holder centric) it makes much more sense to think of environmental regulations as a collection of waste streams and to think of safety as a set of hazards or mishaps that may result in injury to Crews, Owners or the public at large.

Crews and Owners can then determine if their ships produce those waste streams and if the Crews, Owners and the public at large are exposed to those hazards and then provide approaches and regulations to manage the waste streams and hazards.

With regard to environmental waste streams (Invasive species, engine air emissions, sanitary waste treatment, waste oil, incineration, garbage, etc.) the VGP has already required ships to identify them. Unfortunately while there is only a limited number of specific ship generated waste streams, these waste streams are recorded in as many different formats and locations as can be imaged, instead of an orderly sequence that at a certain stage becomes recognizable by every Crew, Owner, Regulator, Law enforcer, consultant, shipbuilder, ship designer or random member of the public. At present it is the task of the consultant to clothe each waste stream with the appropriate regulations while simultaneously the regulators are continually readdressing and interpreting each waste stream regulation in a random order that results in continual QESTH system destabilizations at the Crew level.

All of this would become much easier if IMO were to provide one standardized list of shipboard waste streams (and a standardized list of hazards such as stability, security, and training standards) to the world and to consolidate its rules and regulations to each waste stream. Some may argue that to some extent IMO is already doing that with the numbered MARPOL annexes, but the term "to some extent" is a huge barrier to general understanding and acceptance by people who do not live and sleep with these regulations every day.

It is simply unrealistic to expect Crews and Owners to understand the rules to an extent that cannot even be achieved by the biggest IMO regulation maven. Instead everybody should simply be able to say: "I am dealing with waste oil, let me go to the place where the waste oil regulations exist in a consolidated and predictable fashion", or "I am dealing with sanitary waste and let me go to the single place where all these regulations exist in up to date fashion." And ideally, without going to a different place, the crews will also be able to see the Owner's procedures to deal with that waste stream on their particular ship.

Crews try to follow procedures as well as they can, but for each ship and each company there are different procedures and interpretations and they are generally too voluminous to be comprehensible at a human level. While it is unlikely that all ships and shipping companies can produce the same QESTH systems, at the very least we can all start from the same point and this, again, points back to providing Crews and Owners with a starting reference point and waste stream and hazard sequence, which is clear, consistent and the same for everyone.[17]

Today that situation simply does not exist. Owners and their consultants do realize that IMO regulations are not easy to figure out and incorporate IMO requirement in their QESTH systems without specific reference to IMO requirements. But while each vessel is required to carry a copy of the latest SOLAS and MARPOL book, it is almost impossible to explain why a Crew member would have any use for SOLAS and MARPOL books aboard his ship. The books are difficult to read and completely un-indexed and unreferenced, and the moment they are published, they are out of date. For Crews to actually find the applicable regulation at any moment in time they also have to hunt down the various unincorporated IMO amendments and interpretations which are not even required to be aboard the vessel.

It might be much better not to carry these books, not just because the books are inscrutable, but also because already Owners try to incorporate the latest MARPOL and SOLAS directives into their QESTH procedures and to provide Crews with a less than useful additional reference is simply a distraction.

[16] At each QESTH conference that the author is involved in, it has become a tradition to explain the MARPOL book regulation arrangement to the attendees. It is the only presentation the author cannot make from memory because its arrangement is just too confusing. If presenters cannot memorize it, it is entirely unrealistic to expect Crews, who also have to worry about many other issues, to remember it.

[17] It is noted that it has become apparent during MCRIP style conferences that not only Crews, but also Owners, have very little 30,000 feet understanding of the vessel regulatory process and, as such, feel like mushrooms, rather than actual process participants (see http://en.m.wikipedia.org/wiki/mushroom_management). In response to this awareness, the authors are spending more time providing Crews and Owners with 30,000 feet training at conferences.

The bottom line is that, from the trenches, it should be possible to take an orderly walk through the procedures and regulations and to arrive at the highest possible level of policy making without unnecessary detours and confusions.

RECOMMENDATIONS FOR A UNIFIED QESTH SYSTEM APPROACH

Based on the above it would be of tremendous benefit to the industry if the following could be accomplished as near term goals:

1. IMO to publish a standard sequence of QESTH subjects that will be used to consolidate its regulations and that will be the uniform reference sequence for all international shipping QESTH systems.
2. IMO to consolidate and reconfigure its rules and regulations to the uniform reference sequence.
3. IMO to provide consolidated Tech Memos (IMO already has a system of circulars that contain valuable information) properly referenced to the uniform reference sequence and provide a Common Body of Knowledge (CBOK).
4. Ship owners to rearrange their QESTH systems to the uniform reference sequence.
5. Ship owners to encourage CARs and tech memo updates from their crew that will be consolidated and published to all stake holders with the goal of incorporating the best data into the IMO tech memos and CBOK noted above.
6. IMO to publish a schedule that results in an orderly update and rewrite of its rules and regulations, such that training and retraining and equipment upgrade and design becomes a predictable program instead of a rush to the deadline with unknowns that unnecessarily burden all stake holders.
7. IMO to focus on regulations upgrades that are based on openly discussed and argued technical considerations (Tech Memos) rather than legal defense considerations (lawsuits and criminal prosecutions) or assumed lack of good faith assumptions (very extensive record keeping and verification requirements that burden honest and dishonest crews and Owners alike).
8. IMO and industry stake holders to enable a migration of international regulations verification to automated systems to reduce unnecessary Crew and Owner burdens and to increase transparency

The above recommendations are well within the industry's present capabilities and will result in tremendous environmental and safety benefits and efficiency increases.

When considering the original QESTH Information Flow Diagram shown earlier the above recommendation would redraw the diagram as follows:

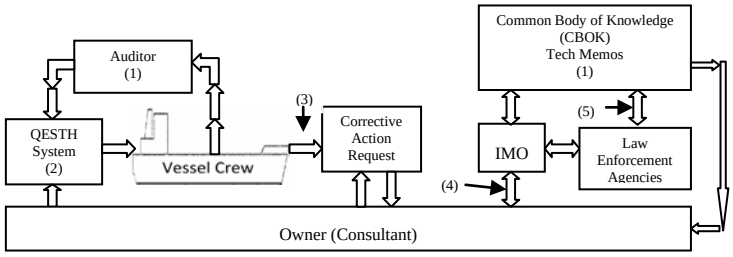


Fig. 6: Recommended QESTH Information Flow

The following comments apply to this diagram:

1. The system has acquired a feature that did not previously exist in the form of a Common Body of Knowledge (CBOK). From a systems point of view, it has become time to establish such a common body of knowledge with regard to QESTH system implementation. Undoubtedly there is a cost associated with this work, but remarkably, by all indications, this cost is already being incurred due to the incredible fragmentation of all QESTH system management efforts. Since no new legislation will be required (except a simple directive to initiate the Common Body of Knowledge (CBOK) and agreement that computerized time stamped record can serve as handwritten logs), the regulatory effort to initiate the CBOK is minimal. The actual development of the CBOK also is not tremendously large and can be achieved by a team of four of five knowledgeable people who sequester themselves for less than a year to standardize and publish the standardized approach. In many ways the CBOK is no different from SNAME's Principals of Naval Architecture, which despite being subject to an ever increasing body of knowledge has managed to be the "Go To" reference for Naval Architecture with relatively minor changes in structure for over 50 years.
2. Contrary to the earlier system diagram, the QESTH system is now a semi standardized system that has a specific format that is similar for all ships.
3. CARs now take on new meaning as a device that is significantly more public and provides the basis for Tech Memo development.
4. The Owner sends relevant CARs to IMO for inclusion into the CBOK by IMO
5. The involvement of Law Enforcement in the QESTH system development is now strictly through IMO and CBOK interaction and is no longer directed towards the individual Owners.

CONCLUSIONS

As noted, the present QESTH regulatory and system situation is a measure of our impressive, but at present imperfectly executed, success at initiating international responses to worldwide maritime safety and environmental threats. Our next step in this process should focus on improving the execution of

the international agreements that have been arrived at to date, since this is where the most impressive improvements can be achieved.

At this stage this can be most effectively achieved by turning the process upside down and, instead of focusing on agreement and implementation at the highest international level, the largest improvements can now be achieved by bringing the rest of the maritime community, the Owners and the Crews, into the fold by the introduction of enabling systems and technologies, by identifying the best shipboard and company level practices and making the Crews and Owners part of the solution.

To date Crews and Owners have not been part of the solution in the rush to actually establish a level of international regulation. Now it is becoming time to access the vast but presently hidden knowledge base that exists at the Owner and Crew level and to make them part of the solution too. The above examples show that in the proper setting the improvements and solutions often exist but have not been properly collected.

ACKNOWLEDGEMENTS

The author has been involved in the issues described in this paper for over 20 years. A large portion of those years have been frustrating and needlessly inefficient, sometimes simply due to systematic issues that are simply the result of game theory realities and sometimes due to plain lack of care or cowardice of individuals and organizations. But on many occasions the author has been deeply impressed and moved by individual acts of deep courage and conviction to do the right thing and to do better for our shipmates, colleagues and the public at large. The author has a deep urge to mention specific names for those who have shown courage, but when those can be named without risk of negative repercussion, it also means that other deserving individuals cannot be named. Instead the author thanks those who have had the courage and conviction to take action when needed and hope that those who deserve praise are aware that he, and so many others who have worked on the issues described, will not forget them. While names will not be mentioned, the author can honestly state that individual acts of courage have been provided almost equally by members or all stakeholder groups, whether Crews, Owners, Port State Control officers, Regulators, Law enforcement officers, or even consultants and, as such, salutes all stake holders equally. This realization also means that when things look darkest there will be individuals within any of the stakeholder groups who can and will provide the helping hand that is needed to do the right thing. If at any time anybody who has provided specific input and innovation on these issues would like, or needs, to be credited, the author, and, he is sure, many others who have worked on these issues, stand ready to do so in the appropriate forums. A specific acknowledgement goes to Armand Medeiros and Marshall Wright who, as the technical consolidators, illustrators and content managers, were of vital importance in functioning as the CBOK for this paper.

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APPENDICES

NOTE ON APPENDICES: The tech memos provided can also be downloaded as .PDF and .DOC files at the EC-7 website[18].

I. *Bilge and Sludge Tank Naming Convention.* Technical Memorandum. May 2012

II. *Accuracy Considerations in Tank Soundings and ORB Volume Recording.* Technical Memorandum. May 2012.

III. *Production Capacity of OWS Equipment.* Technical Memorandum. May 2012.

IV. *Incinerator Use Considerations in Specific Trades.* Technical Memorandum. May 2012.

V. *Use of Unified Format Stamps in ORB Recording.* Technical Memorandum. May 2012.

VI. *Use of Excel Spreadsheets to Generate ORB Entries.* Technical Memorandum. May 2012.

[18] http://www.sname.org/ec7environmentalmanagement/home/

APPENDIX I
TECHNICAL MEMORANDUM
Date: May 2012
SUBJECT: BILGE AND SLUDGE TANK NAMING CONVENTION

BACKGROUND

When designing procedures for bilge and waste oil management and troubleshooting these systems it has become apparent that there is a tremendous amount of variation in the naming of tanks that collect those liquids. The great variety in tank names makes it difficult for crews, port engineering staff and inspectors to communicate on the subject and to verify the function of these tanks.

This has become particularly clear when an IOPP (International Oil Pollution Prevention) certificate review of a fleet of 20 vessels (with 7 classes of vessels) showed that there were over 15 bilge tank names and over 30 sludge tank names with some names that were used in both categories.

This document sets out a bilge and waste oil tank naming convention. It is expected that implementation of a standardized tank naming convention will result in a reduced level of confusion with regard to bilge and waste oil treatment and reduced workload when entering data and during inspections.

The “Practical Implementation” section of this document sets out the application of the naming convention on a specific fleet of vessels.

NAMING CONVENTION

The naming convention is designed to be hierarchal. Since the IOPP certificate distinguishes between “holding tanks for the retention of oily bilge water” (sections 2.5.2 and section 3.3) and “oil residue (sludge) tanks”, there will be two types of tanks: Bilge Tanks and Sludge Tanks.

Bilge Tanks accept and hold bilge water and may be treated to various levels of pretreatment, and Sludge Tanks receive wastes that will be ultimately incinerated or delivered to shore.

When there is more than one tank with an identical function, the tank will receive a number, or preferably, will be provided with the tank's actual designated number.

As such, Bilge Holding Tank 2 (there is no need to write “No. 2”) may be acceptable, but if the tank is already number designated 14P the preferred name will be Bilge Holding Tank 14P.

If there is a unique designated tank name, that name will always be included in the IOPP. As such, if there is one Sludge Tank aboard the vessel and this tank happens to have a unique number MA1, the tank's official name will be Sludge Tank MA1.

Bilge tanks may be further designated according to their function.

If a tank holds bilge water that has been pretreated to any extent, the tank is named Clean Bilge Tank.

The below listing shows presently acceptable bilge tank designations.

Similarly, sludge tanks may also be further designated, generally according to the source of the oil waste it receives. As such, a FO Sludge Tank will receive fuel oil sludge.

If a vessel has only one tank for holding waste oil, the tank will be named Sludge Tank, since it does not receive any type of specific waste oil.

If a vessel has two tanks that can receive any type of waste oil, the tanks will be named Sludge Tank 1 and Sludge Tank 2, or something like Sludge Tank 12P and Sludge Tank 13P if tank numbers are available.
There also may be other sludge tank names that have traditional names with specific functions and specifically allowed names are listed below.

Tank names are written with capitals and may be abbreviated as shown below.

APPROVED TANK NAMES

The following tank names may be used:

Bilge Tank Names:

Bilge Holding Tank (BHT): Any tank aboard the vessel that receives bilge water, often pumped directly from the vessel's bilges.
Clean Bilge Tank (CBT): A tank that receives bilge water that has received some level of pretreatment prior to going through the OWS.
Bilge Pretreatment Tank (BPT): A tank that is specially configured to perform bilge water pretreatment, such as to skim oil or to drain sediment.

Bilge Storage Tank (BST): A tank that may be fitted to hold bilge water on rare occasions when the OWS is not operable and is used as a storage tank that is not fitted in the normal OWS stream.

Sludge Tank Names:

Sludge Tank (ST): A tank that receives engine room waste containing significant amounts of oil.
FO Sludge Tank (FOST): A tank that receives mostly fuel oil sludge, such as separator drains.
LO Sludge Tank (LOST): A tank that receives mostly waste lube oil.
OWS Sludge Tank (OWSST): A tank that uniquely receives the oil that is separated in the OWS.
Incinerator Tank (IT): A tank that is specifically fitted to supply waste oil to the incinerator.

A tank that has a very specific use and very specific drainage content, upon approval by technical management, may carry a specific name. As such, **ME Scavenge Air Box Drain Tank (MESDT)** and **Soot Collection Tank (SCT)** are presently specifically approved.

Always request approval for tank names not specifically provided above.

Note: Any tank names containing names such as “Slop”, ”Residue”, “Settling”, “Waste” or “Service” are specifically retired in IOPP engine room bilge use and will need to be renamed as above. The term “Slop” will be reserved for cargo hold or tank cleaning waste.

Please also note that this naming convention was developed to provide a reader of the IOPP with some guidance on the type of treatment and storage system that exists aboard the vessel. As such an IOPP with a Bilge Holding Tank and a Clean Bilge Tank probably describes a vessel that has a mechanical treatment device of some sort that pretreats the bilge water. While an IOPP with a Bilge Holding Tank and a Bilge Pretreatment Tank, and no Clean Bilge Tank will probably have some tank that pretreats bilge water immediately prior to sending the bilge water to the OWS.

TANK NAME USEAGE

The above tank names will be provided in the IOPP certificate and will be written out in standard abbreviation with the full tank name behind it in parentheses.

For example: BHT14P (Bilge Holding Tank 14P)

All tank names will be provided in a specific sequence in the IOPP, and the ship is to use that sequence consistently in sounding logs and the ORB. The ship will have input in providing the listing sequence to facilitate the taking of soundings in the same sequence.

These names will be carried on all name tags, unless lack of space precludes the use of the full name at which time the standard abbreviation may be used. The abbreviation needs to be written in capital letters.

The full names, following the abbreviation, must be listed in the beginning of any log that records the tank levels on a regular basis (sounding log, ORB, possibly ER log), but once listed in the beginning of the log, the abbreviation may be used.

These abbreviations and names will also be entered into the trim and stability booklets, stability programs, and GA diagrams.

Even in scrap notebooks the proper abbreviation and/or names are to be used.

In the (hopefully rare) case that the abbreviation causes ambiguity, as when IT (Incinerator Tank) and IT (Information Technology) are used in the same sentence, the tank abbreviation can be written as ITk, which will specifically identify it as a tank (or use the full name). Only use this convention when specifically required for clarity.

In all correspondence that clearly deals with tanks the abbreviations can be used.

PRACTICAL IMPLEMENTATION

The above naming convention was used as the guide to develop a unified approach in the naming of IOPP tanks in the above mentioned fleet of 20 vessels. The vessels ranged from very old to quite recent vintage (2004) and included steam vessels and diesel ships.

After intense study it was found that wholesale adaptation of the convention was not altogether practical for many reasons, ranging from the difficulty of getting crews that had been long associated with these vessels to use the new names, confusions that might arise during the implementation period (it would be impossible to change all names at all ships at the same time), training factors (one crew would switch the name plates and the next crew would be confronted with the new names), the occasionally surprisingly large number of tank name changes (which would be in addition to earlier unofficial name changes) and plain depth of complexity when the names are changed

(tank name changes involves drawing changes, manual changes, operating instruction changes, tank indicator name changes and valve wheel name changes)
Instead the operators chose a unified and hybrid approach as follows:

1. The series of new ships received complete tank name changes according to the above convention. For these ships it was considered to be worthwhile to make these vessels the example of the proper way to name tanks in the future.

2. The older ships received name changes that were recorded in the revised IOPP as the official standardized abbreviations only but would carry the old name in parentheses. The crew would be directed to apply the abbreviated name in all aspects of the ship's operation and over time the old name may simply disappear from use at which time the old name in parentheses can simply be removed from the IOPP. (And to make the IOPP identical in style to the newer vessels, the official full name can then be added.)

It is expected that, with occasional reminders to the crew and technical personnel, this process will result in consistent tank naming and a much more transparent and unified waste oil and bilge management process. From the day of implementation it will result in tank names that mean the same on all vessels in the fleet and will result in the most identical tank names within vessel classes.

APPENDIX II
TECHNICAL MEMORANDUM
DATE: May 2012
SUBJECT: ACCURACY CONSIDERATIONS IN TANK SOUNDINGS AND ORB VOLUME RECORDING

MARPOL regulations require that tank volumes are recorded in cubic meters to a reasonable degree of accuracy in Oil Record Books (ORB). However, what constitutes a reasonable degree of accuracy is not firmly established. This document discusses accuracy considerations and sets a reasonable standard for ORB volume recording as based on engineering considerations.

Based on the below discussion, it is concluded that, from an ORB recording point of view, the operator should only record tank levels to a tenth of a cubic meter in the ORB. This means the operator measures tanks to the accuracy available, makes the needed conversions and rounds the result to the nearest tenth of a cubic meter. This document notes that tank volumes can vary reasonably outside that accuracy range, and therefore may reflect such variations in the ORB. However, such variations do not need to be considered unless the operator notes volume anomalies that fall outside normal accuracy considerations for a particular tank.

BACKGROUND

Ships use a variety of tanks to process bilge water and engine room waste liquids (sludge). Traditionally these tanks are not sounded and monitored in a consistent fashion. However MARPOL requires that a ship maintains an oil record book (ORB). The ORB records volumes of waste and bilge liquid transfers aboard the vessel, and periodically (generally weekly) records the volumes in tanks aboard the vessel.

This process can be confusing since a volume transfer measurement in a certain tank may not show up consistently when the tank is measured at a later instant. It is possible that during the transfer, the transfer volumes are recorded at 5.1 cubic meters, while a later measurement of the source tank indicates that the tank has lost 6.0 cubic meters. This can lead one to conclude that 0.9 cubic meters have been lost.

This inconsistency can be a pure error, but can also be related to inherent limitations in measurement accuracies.

There might be a tendency by ship's crews to consolidate such inconsistencies. The officer in charge (OIC) may choose to split the difference or decide to use one measurement rather than another, but inevitably this will become a very time

consuming, ultimately inaccurate and, from an engineering point of view, senseless exercise.

Instead, it is necessary to deal with this problem on an engineering measurement level. Engineers never record exact numbers, knowing that ultimately a measurement will always have inherent inaccuracies. Engineers avoid this by measuring to reasonable accuracy. Indeed, very few engineering measurements have accuracies above 99%.

Since there is an, often misconstrued, assumption that ORB measurements are bookkeeping records (as in the dollars have to add up), rather than engineering measurements, very significant disputes can arise when the numbers do not appear to "add up".

As such, a methodology needs to be established with regard to shipboard tank measurement and recording that passes appropriate and reasonable engineering standards, which then can be applied to ORB volumes. This document establishes such a standard.

SHIPBOARD TANK MEASUREMENT ACCURACIES:

Shipboard volume measurements are particularly difficult to achieve to accuracies of 99% or more for the following reasons:

1. Measurements are taking by measurement of the tank liquid level. Tank level measurements may be by sounding tape or by electronic or pneumatic reading device. Inherently these measurements have limited accuracy. A sounding tape cannot be measured to much better than one centimeter, which on a tank that may have only 30 centimeters of liquid in it, already represents a 3% error. Pneumercators use head pressure to determine tank levels. LevelCom gauges, a typical brand, are electronic/pneumatic gauges. Inherently these systems are accurate +/- 2 cm, which, again, on a low tank level may result in spectacular inaccuracies. Furthermore, with these gauges the user needs to know the density of the tank's liquid since these gauges can only be accurate to one specific liquid density, which on high tank levels can result in significant errors.
2. Tank level measurements are sensitive to ship's list and trim. Most longitudinally oriented tanks are measured at the tank's aft end. This means that the measurer needs to know the vessel trim to be able to correct his tank measurement.
3. Tank shape can have a very significant effect on the ability to take accurate measurements. A double bottom tank can contain a significant amount of liquid even though it may sound as empty.
4. Ship motions will affect tank measurement due to liquid movement. Sounding tapes will wet to the highest tank level during movement of liquid in the tank. As such, sounding tape measurements in a seaway will be inherently higher than during calm weather. At some stage ship motions can make tank measurements with sounding tapes meaningless. Electronic and pneumercator systems can also have difficulties establishing reasonable tank levels during heavy weather.
5. Tank levels are converted to volume measurements using sounding tables. Sounding tables list tank levels and read across to tank volumes. Sounding tables are developed by shipyards, but may not be completely accurate, and inaccuracies may not be discovered while the ship is in operation due to the above measurement restrictions.
6. The sounding tables may or may not include appropriate trim and heel corrections.
7. It may not be reasonable to require ship's crews to provide trim conversions on engine room tank volume measurements, either from a work load point of view or due to a simple lack of accurate vessel trim measurement while the ship is underway.
8. The sounding tables may or may not be provided in appropriate volume units which may introduce conversion errors.
9. Some tanks may not have detailed sounding tables and may only have been provided with sounding graphs which inherently do not provide reasonable accuracy.
10. Unpumpable tank residue will affect the accuracy of tank volume estimates based on soundings.

The above shows that on occasion errors may be as high as 10% (low tank volumes, ship motions and long shallow tanks) or more.

However, for purposes of ORB recording there are various measures that can be implemented that will allow recording to higher levels of accuracy.

MEASUREMENT SYSTEM CONSIDERATIONS

Noting that very often the measurements that are most relevant are transfer measurements, it becomes important that repeatability accuracy is high. There are some positive considerations in this regard. For example, while LevelCom gauges have tank level measurement accuracies of +/- 2cm, at the same time they have high repeatability. Therefore a transfer from such a tank will show to a higher degree of accuracy as long as the tank level is not very low in the tank.

Typically a high volume/low depth tank aboard a commercial ocean going vessel may have a sounding rate of 0.2 cubic meters per centimeter.

Therefore when transferring tank liquids, assuming that the vessel's trim is known and the sea is reasonably smooth, liquids from these tanks can be measured to an accuracy of 0.2 cubic meters, if there is accurate liquid level to volume conversion.

This is the highest possible accuracy from the largest tanks aboard ocean going vessels. Smaller tanks may provide higher reading accuracies on the ability to measure volume transfers as long as the tanks are reasonably full.

This, however, is still related to liquid measurement levels, and conversion to volumes may introduce further errors.
Worst case volume transfer accuracies are expected to be in the range of +/-0.4 cubic meters (+/- 0.2 cubic meters level measurement plus +/-0.2 cubic meter conversion accuracy) in optimal conditions (no seaway, etc.). At the same time it is known that measurement accuracies of 0.01 cubic meters are not achievable even on the smallest tanks.

The above indicates that measurement recording to 0.1 cubic meters accuracy is barely achievable, and that on tank volume records, depending on the tank and conditions, the last digit (representing a tenth of a cubic meter, 100 liters) is inherently questionable.

ORB RECORDING STRATEGY

The above indicates that recording volumes on large tanks to accuracies higher than whole cubic meters is barely relevant from an accuracy point of view. However, from a recording efficiency point of view, it appears that for ORB recording purposes it would be reasonable to record tank levels to a tenth of a cubic meter. This means the operator measures tanks to the accuracy available, makes the needed conversions and rounds the result to the nearest tenth of a cubic meter.

It is understood that invariably there will be variations and inconsistencies in the last tenth of levels and volumes.

These inconsistencies do not need to be specifically analyzed by shipboard crews, but inconsistencies that arise in larger quantities (more than a cubic meter in large shallow tanks, or more than 0.3 cubic meters in small tanks) need to be investigated and, if they cannot be resolved aboard the vessel, or reasonable ascribed to tank measurement problems (heavy weather, changed trim, etc.) need to be reported, recorded, and processed through management systems.

There will also potentially be issues with measurement consistencies related to the presence of solid sludge in tanks, tank evaporation and inherent measurement inaccuracies in tanks that are nearly empty. Such issues should be reasonably recorded in the ORB once an operator becomes aware of them.

Recording conditions truthfully in the ORB can never get anybody in trouble therefore do not interpret and adjust records to make the ORB look "nice".

If there is a switch from a remote to a manual tank measurement (or vice versa) this should be recorded in the sounding log. If this appears to result in confusion in the ORB a category "I" note should be provided in the ORB.

Since this document is the only known document that provides any type of guidance with regard to ORB recording accuracies, it is considered to be applicable as of this date until further notice and is considered to be a state of the art document.

APPENDIX III
TECHNICAL MEMORANDUM
DATE: May 2012
SUBJECT: PRODUCTION CAPACITY OF OWS EQUIPMENT

BACKGROUND

Oily water separator capacity often becomes the subject of discussion during OWS procedural developments and audits. In extreme cases certain parties may argue that an OWS that is reported to produce more or less than its rated capacity inherently must involve some type of misoperation, misrecording or inaccuracies. This memo discusses various factors that affect actual OWS production rates as compared to their rated capacities. This memo concludes that while the rated capacity of the OWS is a guide to an OWS's ability to process bilge water there are many factors that could reasonably cause an OWS to process more or less bilge water than its rated capacity. In extreme cases it is possible that the OWS processes 50% more than its rated capacity or only a very small fraction of its rated capacity. This memo is a work in progress but as far as known is the most complete document with regard to OWS production rates and capacities and will be updated as needed.

TECHNICAL DISCUSSION

Each flag state approved OWS has a rated capacity that is listed on the type approval certificate for the equipment model.
This rated capacity is determined in a laboratory. The rated capacity is affected by three issues:

1. While there is some attempt by flag state and regulatory agencies to accurately state the unit's capacity there is no agreed definition of flow rate in any of the IMO Resolutions. This leads to differing methods of testing and calculation and potentially different results.
2. It is not definitely set forth that this rate is the highest rate that allows separation of the test liquid up to 15ppm. As such, a different criterion could be applied.
3. Manufacturers may approach determination of an OWS's stated capacity from a different point of view. The manufacturer may be less concerned with a certification rate and rather would state a capacity that is its minimum capacity to separate test liquids. This would avoid customer complaints if, once installed aboard a vessel, the unit produces measurably less than its rated capacity.

At this stage no further data with regard to the above issues are available. However with regard to regulatory requirements, the various OWS IMO resolutions which detail test specifications indicate a trend towards achieving less variability in actual approved production capacities.

As such, the following is noted:

MARPOL Test Specifications for Oily Water Separators allow a variety of pump capacities:

- Resolution A.233(VII), October 1971 requires a pump delivery capacity of not less than 1.5 times the rated capacity of the OWS. It also requires that the test be carried out at a supply rate equal to the full throughput of the OWS and that any excess pump capacity be dissipated by a by-pass on the pump suction side or by throttle valve or standard orifice plate control on the discharge side.
- Resolution A.393(X), November 14, 1978 and MEPC.60(33), October 30, 1992 requires that, if the OWS is fitted with an integrated pump, it be tested at its rated capacity. If the OWS is fed by a ship's bilge pump then it is tested using a pump with a delivery capacity of not less than 1.5 times the rated capacity of the OWS. It also requires that the test be carried out at a supply rate equal to the full throughput of the OWS and that any excess pump capacity be dissipated by a by-pass on the pump suction side or by throttle valve or standard orifice plate control on the discharge side.
- MEPC.107(49), July 18, 2003 requires that, if the OWS is fitted with an integrated pump, it be tested at the full OWS rated capacity. If the OWS is fed by a ship's bilge pump then it is tested using a pump with a delivery capacity of not less than 1.1 times the rated capacity of the OWS. However the test should be carried out with a supply rate equal to the full throughput for which the OWS is designed.

The Test Specifications (above) for OWS units with regards to the capacity of integral or non-integral feed pumps should be distinguished from the Installation Requirements (below) within these resolutions which can confuse the issue further.
The MARPOL Installation Requirements for Oily Water Separators state a variety of pump capacities as follows:

- A.233 states that means should be in place to ensure in practice the rated capacity of the OWS is not exceeded.
- A.393(X) and MEPC.60(33) state that means should be in place ensuring that, in practice, the OWS rated capacity is not exceeded. This should be accomplished by either connecting a pump of equal to or less than the OWS rating capacity or permanently restricting the discharge to the equipment

where a larger pump is connected. However, the pump capacity cannot exceed 150% of the OWS rated capacity.

- MEPC.107(49) requires that the OWS supply pump does not exceed 110% of the OWS rated capacity and that the pump size and rating should be on the unit Type Approval Certification.

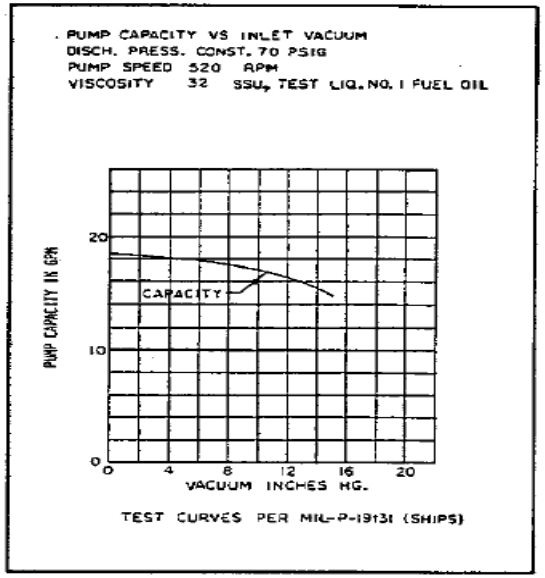
It is noted that the vast majority of OWS units manufactured are fitted with positive displacement pumps. Some of those pumps are manufacturer supplied, and specified, but there are OWS units that are supplied without a pump and simply use a ship's bilge pump (which generally is a positive displacement pump and is ship owner, designer or builder selected).

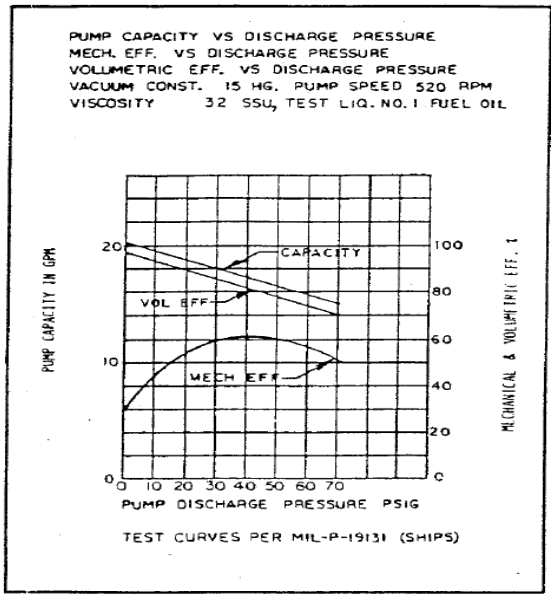
POSITIVE DISPLACEMENT PUMPS TECHNICAL BACKGROUND

A common type of positive displacement pump in OWS systems is a progressive cavity pump and is also known as an (eccentric) screw pump or even just cavity pump. It transfers fluid by means of the progress, through the pump, of a sequence of small, fixed shape, discrete cavities, as its rotor is turned. This leads to the volumetric flow rate being proportional to the rotation rate (bidirectionally) and to low levels of shearing being applied to the pumped fluid.

Its pumping action is accomplished by the sealed cavities, like a piston pump, and so has similar operational characteristics, such as being able to pump at extremely low rates, even to high pressure. When the rotor is rotated, it rolls around the inside surface of the cavity.

A typical progressive cavity pump has the following typical flow versus pressure performance curves:





These curves provided by the manufacturer show that flow volume will decrease with increasing suction vacuum and also decrease with increasing discharge pressure. Conversely, positive suction pressure will result in an increased pumping capacity.

It is noted that pumps of this type are not sold with a specific capacity. Instead it appears that pumps are matched to a specific system with certain assumed system frictions and therefore depending on system frictions the flow rates can vary up or down.

OPERATIONS

During operation, the Oil Content Meter may detect oil above 15ppm in the OWS discharge or may detect an accumulation of oil within the OWS. If it does, it goes into a recirculation mode and no oily water is processed. The number of recirculation cycles is dependent on the percentage of oil in the incoming oil/water mixture. The greater the inlet oil content, the more frequently the system will recirculate and the fewer net gallons of oily water will be processed. Conversely when the unit is processing near clean water there are no purge cycles and the unit's capacity will increase.

Discussions with an OWS supplier indicate that the operating capacity of their OWS is also affected by the quality of the oil water mixture. The rated capacity is based on the size of the bead bed when using the MARPOL test fluid. If the quality of the oil/water mixture is better than the MARPOL test fluid then the bead bed has the capacity to handle more oil/water fluid than the rated capacity.

Typical OWS Production Rate Variation Factors

Based upon the above technical discussion the following factors may affect OWS production rates:

1. Variation in pump capacity according to IMO Resolution pump sizing requirements. Pumps may be as much as 150% of OWS rated capacity.
2. Bilge pump supply back pressure issues. Some bilge holding tanks may operate with considerable positive head which will affect the bilge pump throughput.
3. OWS back pressure issues. Since the operating back pressure on the OWS may not be identical to the laboratory test back pressure, there may be considerable rate changes.
4. Unmatched bilge OWS supply pumps. One model OWS may be sold at two capacities with two separate approval certificates, but the only difference being the size of the pump supplied with the OWS. During the life of the OWS it is possible that a larger pump was installed without affecting the OWS's ability to process water down to 15ppm. This situation should be avoided, but has occurred.
5. Quality of the liquid being processed in the OWS. Liquids with high oil content will result in frequent back flushing or purging which reduces production rates, while clean liquids will not result in the same number of back flushes as would be encountered in the laboratory setting.
6. Piping and valve arrangements. Shipboard piping and valve arrangements may result in different system frictions from the laboratory setting thereby affecting production rates.
7. Bilge Pumps are selected for the ship's piping arrangement, and reasonably matched to provide OWS flow that approximates the OWS full rated capacity, but there are no indications that ship designers make any specific effort to ensure that an OWS may not produce more than its rated capacity.
8. It is possible that the actual throughput of an OWS was never tested after it was installed aboard the vessel.

CONCLUSION

The actual flow through an OWS unit may differ from its stated nominal capacity as noted above. For ORB recording purposes, OWS throughput aboard a vessel should be established by tank level differences and operating periods and should not be established using its rated capacity. If there are significant changes or variations within reasonable measurement accuracies (for further guidance see Tech Memo: Accuracy Considerations in Tank Soundings and ORB Volume Recording), a specific determination of the causes of these variations would be warranted and should be recorded in corrective action reports.

APPENDIX IV
TECHNICAL MEMO
DATE: May 2012
SUBJECT: INCINERATOR USE CONSIDERATIONS IN SPECIFIC TRADES

During the MCRIP conferences and surveys of vessels in a specific trade it became apparent that there are some unique bilge water and sludge management issues that deserve further consideration.

The subject vessels have a sound and effective bilge and sludge management system, but certain aspects may require a higher level of regulatory interpretation to ensure that all stake holders agree that the process has been fully optimized. These issues are summarized in this tech memo, and relate to fuel regeneration in the composite boiler and sludge incineration.

This tech memo is prepared to promote a unified approach to determine the optimal solution that reduces the shipboard workload and meets (and exceeds where possible) all MARPOL and Flag State requirements. Initially this tech memo is circulated between shipboard personnel and shipboard technical personnel that are familiar with technical and operational aspects of these vessels to ensure that the information contained in the memo is correct and to select the optimal approaches from a workload point of view.

*****Eventually the updated memo will be provided to ABS and USCG for review and the final memo will be incorporated into the vessel bilge water management procedures. (Engine Room Bilge Water and Waste Oil (Sludge) Management Procedure (MARPOL Annex I) for Northwest US trade vessels)***

BACKGROUND: FUEL REGENERATION:

The vessels are fitted with an Aalborg composite boiler that provides auxiliary steam to the ship's plant. These boilers also serve as the vessel's fuel regenerators and, as such, these boilers are fitted with a sludge burner to allow that function.

This boiler is listed for sludge disposal on the vessels' IOPP's and described as follows in the vessel's operation description:

Through fuel regeneration, these vessels can fully incinerate all sludge that is produced aboard the vessels in these boilers, and due to steam needs during maneuvering the sludge is generally incinerated in this boiler during the vessel's long port approaches in Puget Sound and various Alaskan port approaches. During full steaming periods offshore, the boiler is not used and plant steam needs are provided through the economizer.

This process is effective and adequately allows combustion as fuel of sludge during these "inshore" periods in combination with boiler fuel.

A question was raised whether it is appropriate to burn sludge in port approaches since this may be interpreted as a method to dispose of undesirable fuel components in areas that may have emission restrictions. (The auxiliary boiler is never fueled with heavy fuel oil or sludge along the berth due to concerns raised by longshoremen.)
In particular MARPOL Annex VI regulation 16.5 (as per MARPOL consolidated edition 2006. It is regulation 16.4 in the "Revised Annex VI" booklet)[19] states "Shipboard incineration in auxiliary boilers of sludge oil generated during the normal operation of a ship shall not take place inside ports, harbors and estuaries".

This regulation indicates that this type of incineration is not allowed in the large estuaries in which the vessels operate.

It is noted that the use of an ANNEX VI approved incinerator is not specifically prohibited in MARPOL Annex VI (see Regulation 16.1 both in consolidated 2006 and "Revised Annex VI") inside ports, harbors and estuaries.

Technically it is not clear why Annex VI restricts auxiliary boiler incineration through fuel regeneration, but not stand alone incinerators, since the stack discharges will not be different as far as sludge pollutant levels is concerned. It is also not clear if Puget Sound or Cook inlet fits the definition of "estuary" noting that it is possible to be more than 12 miles from shore (probably the most applicable distance where ship discharges are not "inshore"), and while it is rumored that MARPOL somewhere defines the term "estuary", it is not an ANNEX VI definition. There may also be additional Washington State or Alaska State regulations.

MEPC. 1/ Circ. 736 supports the type of sludge incineration that takes place aboard these vessels, where example #9 in this circular provides an entry for regeneration of fuel from sludge.

[19] Shipboard personnel will tend to refer to the latest MARPOL consolidated edition (2006 at this time of writing), where it is regulation 16.5. IMO has rewritten Annex VI, but not yet issued it as a consolidated MARPOL revision and in the "Revised Annex VI" (officially named: ANNEX 13 RESOLUTION MEPC.176(58), adopted on 10 October 2008, AMENDMENTS TO THE ANNEX OF THE PROTOCOL OF 1997 TO AMEND THE INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS, 1973, AS MODIFIED BY THE PROTOCOL OF 1978 RELATING THERETO (Revised MARPOL Annex VI)) it is now Regulation 16.4. It could be argued that shipboard personnel should be aware of this latest regulation numbering, but this would require that ships are issued with non-consolidated MARPOL regulations. This "Revised Annex VI" is available in booklet form.

The regeneration of sludge into fuel is much preferred over simply incinerating sludge since incineration increases a vessel's carbon footprint, while the use of sludge as a fuel reduces fuel consumption and carbon footprint. If the vessels were to use the auxiliary boiler as an offshore incinerator when adequate economizer steam is available, it would simply result in poor sludge combustion (since the boiler is not operating at optimal load and fuel/sludge ratios), increased carbon footprint, increased fuel consumption and increased operational workload.

It is significant to note that sludge, by itself, does not contain excess pollutants of the type that are being tracked in air emission standards such as SOX producers (NOX producers are negligible in incinerator and boiler operation) (Since purifiers do not separate sulfur from fuel oil, sludge does not contain a higher percentage sulfur than the purified fuel oil). The sludge that is produced does contain catalytic fines, some of which are metals, ash and low grade oils. Since sludge is a relatively small percentage of the fuel burned in the auxiliary boiler it is not clear if combustion of sludge in combination with regular fuel (which, even when purified, still contains many of the impurities noted above) in an estuary is any more harmful than combustion offshore, and offshore combustion of sludge is inherently more wasteful since it does not produce useful steam.

As such, the following questions are raised:

1. Is the present approach legally acceptable?
2. Is there a specific point where an estuary starts and ends?
3. Can the present practice continue?
4. Are there alternatives?

Without being the least cynical, the MARPOL approach to incineration is to solve pollution through dilution (burn offshore for greater dispersal of any potential pollutants)

Within this context, the issue can be formulated as follows:

Use sludge to reduce carbon footprint with a possible lower dispersal of potential pollutants in estuaries?

Or

Burn sludge offshore with greater dispersal of potential pollutants but increase carbon footprint?

The established alternatives are:

1. Delivery of shipboard sludge to ports for shore disposal, but we do not have concise technical information that shore disposal is more environmentally effective than combustion in the auxiliary boiler for useful steam generation in estuaries[20].
2. Potentially, the installation of a dedicated incinerator, but a dedicated incinerator does not produce useful steam or reduce pollutants. Oddly, at present, it appears that a dedicated incinerator can be operated in estuaries.

The issue was background researched during the period June through August 2011, with ship personnel discussions and discussions at MCRIP conferences. In addition, an investigation was made to determine if the Aalborg auxiliary boiler sludge burning capacity was equivalent to a standalone incinerator.

We received the following response from Aalborg:

> Unfortunately it will not be possible to reclassify the boiler as "incinerator" because for an incinerator there are requirements for minimum furnace and exhaust gas temperatures that are impossible to meet with a boiler, which - despite of a furnace temperature around 1150 degrees C - has normally exhaust gas temperatures less than 400°C. MARPOL stipulates 850°C minimum during continuous feeding (liquid waste). Practically these temperatures are exceeded inside a boiler furnace but theoretically (and that is what counts in the papers) the measurable exhaust gas temperature of the boiler is way less than the MARPOL limit.
>
> However, I do think that you can continue to burn sludge oil and waste oil in the boilers, at least if properly blended, so that no visible emissions are created. Even with the new MARPOL regulations in force, boilers are still an accepted means of sludge/waste oil disposal.
>
> We have recently equipped a brand new vessel for coastal trade in Canada with a boiler/burner system that features

[20] Even the most responsible trucking and processing of sludge increases carbon footprint. Next, it is not clear if shore disposed sludge is simply incinerated ashore, landfilled, transshipped to third world countries or reblended into ship fuels.

automatic blending to a stable mixture whenever sludge/waste oil is fired. We are using HFO for blending as this is emulgating best with the sludge. Whenever this vessels boiler runs on sludge, the blend consists of stable fractions of 50% sludge and 50% HFO.

The complete system has been designed, commissioned and approved as a means of sludge oil disposal. The sludge oil itself of course has to meet the requirements for max. heavy metal content, but that has nothing to do with the hardware but is an operational issue.

Actually waste motor oil from cars, which is not that far off from the average content of the marine waste oil tank, is burnt in land-based boilers (also in Alaska) with full approval from authorities.

http://www.columbiaboiler.com/waste_oil/

http://www.cleanburn.com/index.html

Therefore I am pretty confident that you should not run into any problems regarding your method of waste oil disposal on subject vessels. If the performance is in doubt or the emissions from the boiler when operating in sludge/waste oil mode need to be confirmed, a full combustion measurement and proof of emissions should be sufficient to satisfy port state control or other authorities.

Based on the above, it is noted that these boilers cannot function as incinerators, but at the same time there is no significant technical argument for not allowing sludge combustion in the port approaches where a MARPOL incinerator can be used. (Regardless, the operator will continue its policy of not incinerating sludge alongside the berth.)

SLUDGE INCINERATION PROPOSED SOLUTION APPROACH:

Based on available information on August 2011 the following solution approach was suggested as technically optimal:

1. For this class of vessels (which are in dedicated service) establish specific operational areas where auxiliary boiler steam production takes place.
2. Determine the reasonable amount of required auxiliary boiler incineration time for normal levels of produced sludge.
3. Prepare a specific incineration track (area) for these vessels that achieves incineration as far from shores as possible while auxiliary boiler steam is being produced.
4. Discuss this procedure with all stake holders.
5. Obtain USCG and ABS approval of the procedure.

This approach remains technically the most valid since it aims to optimize the use of sludge for useful steam generation.

The simplest solution is to restrict sludge combustion to offshore passages only and to generate useful steam. However, at this stage it is not entirely clear if offshore combustion of sludge combustion generates any useful steam, noting that probably the economizer generates sufficient steam.

At the time of the writing of this memo, and in weighing the alternatives, there is a developing consensus that sludge will be burned in the boilers during offshore passages regardless of the ability to generate useful steam and regular fuel will be used to generate steam during the port approaches, but as noted above this approach is open to improvement from a pure environmental, technical and efficiency approach.

APPENDIX V
TECHNICAL MEMO
DATE: May 2012
SUBJECT: USE OF UNIFIED FORMAT STAMPS IN ORB RECORDING

During a senior office shipping company conference it was noted that there was limited uniformity in the way ORB's are filled out. To promote a unified approach, it was suggested that it may be helpful to use formal stamps that ORB recorders can stamp into the ORB in the proper location, which then leaves blanks that require specific details to be filled out. This tech memo further investigates this suggestion, and will be used to determine whether the use of such stamps will support the unified approach, reduce the shipboard workload and will meet all MARPOL and Flag State requirements.

BACKGROUND

Recent ORB recording procedure updates have required evaluation of many issues related to this subject including the following consideration:

1. IMO has issued MEPC. 1/Circ. 736, which provides guidelines for the recording of operations in the ORB.
2. MEPC. 1/Circ. 736 contains inconsistencies. For fleet use, only corrected copies of this circular should be used.
3. The MEPC circular has a rather inefficient entry format for the weekly 3.1 (sludge) tank volumes. This format requires the recorder to reenter dates and codes for as many tanks that are aboard the vessel. The USCG draft ORB shows a more efficient approach. This approach is adopted for the proposed stamp below. The USCG approach would require only one date entry (two if one counts the generally redundant date behind the officer signature) for all tanks instead of dates and signatures for each tank.
4. The USCG is developing a new oil record book. It is intended that this "Stamp" effort will be coordinated with the new ORB format. At this time the USCG draft is not in conformance with the MEPC circular. Generally the USCG draft appears to be a more efficient approach.
5. Vessel evaluations have indicated that, at present, there is little uniformity in ORB recording practices.
6. Increased uniformity, as far as can be fitted within a unified approach, should reduce crew workloads and increase transparency and review ease by management and regulatory inspectors.
7. Since ORB recording is not a continuous activity, but rather is a once per day, or less frequent, activity, it may take a significant amount of time and effort before all shipboard personnel has developed the most uniform approach.
8. Instituting a unified approach requires a feedback loop (ORB recorders are directed to do one thing, and there are checkers who catch aberrations and return with feedback to the ORB recorders) or requires a recording system that resists variations that break the unified approach (as would be promoted by stamps).
9. The ORB is supposed to be provided with handwritten entries. It is not clear if using a stamp to prompt crews to fill in the blanks still is considered to be a handwritten entry.

PROPOSED SOLUTION APPROACH:

The following solution approach is proposed:

1. Obtain full agreement and approval from all stake holders (ISM auditor, Flag State, ship operators, Crew).
2. Upon release of the new USCG ORB, selected entry codes (see proposed list of stamps) will be selected as "Stamp" entries.
3. Stamp entries will be produced for each ship. Most stamps will be identical for all ships. The weekly tank volume stamp will vary from ship to ship depending on the tanks listed on the IOPP.
4. Stamps will be issued for routine entries only (Suggest: Transfer between tanks, transfer to shore, OWS use, incineration, weekly tank volumes, bunkering, bilge well pumping)
5. The stamps will be issued to each ship including a procedure that will be attached to the ORB in case foreign flag state inspectors question the use of stamps.
6. The stamp procedure will be incorporated into the overall OWS/ORB procedure

Upon further review and discussion this approach may be adopted, modified or rejected in its entirety.

STAMP DESCRIPTION:

The following are sample stamp descriptions. Please note that the weekly tank volume design is different from the sample design in the MEPC circular.

The design for Oily water separator use; codes D 13, 14 and 15.1

06-DEC-2010	D	13	___ m^3 bilge water from _____, Cap: ___ m^3, Ret: ____ m^3
		14	Start __:__ - Stop __:__
		15.1	__°__' N x __°__'W – Start
			__°__' N x __°__'W - Stop
			Signed: Rank:

Note: the dark outline indicates the stamp border.

Also note that this stamp design does not prompt for a second date entry after the signature. The USCG draft ORB does not show this requirement in their examples, while the MEPC circ. does.

Other stamps like transfers, incinerator, etc will have a similar appearance.

The design for the weekly tank volumes; code C 11 is proposed as follows:

11-OCT-2010	C			Capacity	Ret.
		11.1/11.2	ST #6	40 m^3	m^3
		11.1/11.2	ST #12	25 m^3	m^3
		11.3	Total Retained on Board		m^3
			Signed:	Rank:	

Note: the dark outline indicates the stamp border.

This particular stamp will be ship class (IOPP) specific. In this example only official tank abbreviations are used, but the stamp could also facilitate entry of the full IOPP tank name. Strictly speaking only entry of Sludge tanks is required. An argument could be made for also entering weekly volumes for bilge tanks.

Also note that this stamp design does not prompt for a second date entry after the signature. The USCG draft ORB does not show this requirement in their examples, while the MEPC circ. does.

Also note that code 11.3 is listed as total retention for all tanks in the USCG ORB draft instructions, but appears to relate to the total volume retained in each tank in MEPC. 1/Circ. 736.

APPENDIX VI
TECHNICAL MEMO
DATE: May, 2012
SUBJECT: USE OF EXCEL SPREADSHEETS FOR ORB RECORDING

ORB entries have been highlighted as time consuming, as sometimes confusing and the source of frustration through discussion of shipboard experience and through conference exercises.

Furthermore it is noted that there is a general industry trend to make an IOPP tank sounding log a shipboard requirement.

This led to discussions as to what form the IOPP tank sounding book should take.

An official log book would be bound, but the sounding log is not an official log.

In response to operator direction to produce a sounding log for their vessel, the crew of one vessel developed a spreadsheet approach with the aim of producing consistent, accurate and efficient sounding entries. The spreadsheet requires manual entry of tank soundings, OWS and pump operation times and vessel positions but then also, subsequently, automatically generates the correct ORB entries in a spreadsheet format.

The tank sounding portion of the spreadsheet was printed and kept as an IOPP tank sounding log and these spreadsheet generated ORB entries were then copied by hand into the vessel's ORB.

This document details the background to the issue, the spreadsheet function as it currently stands and proposes future development to work towards a spreadsheet approach to ORB entries for IOPP vessels that would reduce crew workload, improve the consistency and quality of ORB entries and which will meet MARPOL and USCG requirements.

SPREADSHEET DESCRIPTION:

The spreadsheet developed by the C/E is very specific to the vessel, despite the vessel being one of three sister ships. It comprises two sheets, the first sheet titled "ORB Daily Entries Info" contains data entry fields for bilge and sludge tanks, showing tank volumes before and after pumping, sludge incineration, bilge water evaporation and OWS operations. In this case, operations detailed on the spreadsheet are:

- Transfer of bilge water to bilge holding tanks.
- Transfer of bilge water between bilge holding tanks.

- Operation of the OWS 15ppm equipment.
- Transfer of sludge to sludge tanks.
- Transfer of sludge between sludge tanks.
- Transfer of sludge to incinerators for burning.
- Water drain from sludge tanks.

At present the spreadsheet does not include all of the vessel's sludge tanks[21] and it is not up to date in terms of tank names that have been subject to review and update through other tech memo (see the tank naming memo).

Additionally, the structure and terminology of the data recording in Sheet 1 is more characteristic of the crew's knowledge and understanding of processing of bilge water and sludge waste streams aboard the vessel than it is of correct ORB terminology and operation codes. In other words, Sheet 1 has been designed and formatted by the crew for use by crew as they know, understand and manage the bilge and sludge waste streams aboard the vessel.

However, the output from Sheet 1 to Sheet 2 is the important step. Here, effort and attention has been paid to developing automatic generation of the required ORB entries for the bilge water and sludge processing operations recorded in Sheet 1, removing the need to refer back to MEPC 1/Circ.736/Rev.1 or ORB documentation type guidance. The result is a spreadsheet version of the required ORB entries for the daily operations that can be copied by the C/E into the ORB in the knowledge that the copied entries will be correct (assuming correct soundings and data entry into Sheet 1, and good copying skills).

Examples of Sheet 1 and Sheet 2 of the spreadsheet follow:

Sheet 1 as completed on May 03, 2011:

ORB ENTRIES DAILY INFO

SLUDGE AGITATING TANK

DATE	BEFORE DRAINING M	BEFORE DRAINING M^3	AFTER DRAINING M	AFTER DRAINING M^3	BEFORE PUMPING OUT M	BEFORE PUMPING OUT M^3	AFTER PUMPING OUT M	AFTER PUMPING OUT M^3	BEFORE PUMPING TO M	BEFORE PUMPING TO M^3	AFTER PUMPING TO M	AFTER PUMPING TO M^3	SLUDGE SERV M^3
5/3/11		1.46		1.12		1.12		0.21		0.21		0.86	2.60

BURNING SLUDGE FROM SLUDGE SERVICE TANK

DATE	START BURNING M^3	STOP BURNING M^3	TOTAL BURN TIME (HOURS) By Quarter Hour

NOTE: IF TWO BURNS IN ONE DAY PUT IN TOTAL BURNED AND TOTAL TIME.

EVAPORATING WATER FROM MIXING TANK and REFILLING FROM ENGINE ROOM BILGES

DATE	START OF EVAPORATION M^3	END OF EVAPORATION M^3	END OF REFILL M^3	PUMP START TIME	PUMP STOP TIME
				0000	0000

OPERATING OWS FROM BILGE SETTLING TANK

DATE	START VOLUME M^3	STOP VOLUME M^3	START TIME	STOP TIME
			0000	0000
START POSITION				
STOP POSITION				

TRANSFER FROM BILGE HOLDING TO BILGE SETTLING

DATE	HOLDING TANK VOLUME M^3 START	HOLDING TANK VOLUME M^3 STOP	SETTLING TANK VOLUME M^3 START	SETTLING TANK VOLUME M^3 STOP	PUMP TIME 0000 START	PUMP TIME 0000 STOP

Sheet 2 (currently untitled) then automatically generates the required ORB entries in the proper current format, using simple cell formulae to process the data entered in Sheet 1 with formatted text and fields for date and signature below the entry.

[21] The vessel is fitted with seven small purifier sludge tanks. These tanks were not originally considered to be part of the IOPP. These tanks all drain into a larger sludge holding tank. Recording the tank levels in these small tanks and recording these tank transfers into the ORB is a significant manpower burden. There was significant discussion about the need to record these tank volumes in the ORB. To prevent having to engage in this recording activity, the ship operator could choose to eliminate these tanks and drain everything directly into the larger holding tank. This would simplify record keeping, but it would reduce the crew's ability to rationally and optimally manage waste oils. It was agreed that these tanks would be drained in the morning and the drained total content would be recorded in the larger collection tank.

Sheet 2 as generated by data entry in Sheet 1 on May 03, 2011:

1	Draining water from Sludge Agitating tank to Bilge Settling Tank							Ex. #4
	5/3/11	C	12.2	0.3	m^3 drained from sludge agitating tank,			
				1.1	m^3 retained,			
				to bilge settling tank				
					Signature, Pc	Position,	5/3/11	
2	Transfer from Sludge Agitating Tank to Sludge Service Tank							Ex. #5
	5/3/11	C	12.2	0.9	m^3 sludge transferred from Sludge Agitating Tank,			
				0.2	m^3 retained, to Sludge Service Tank,			
				2.6	m^3 retained.			
					Signature,	Position,	5/3/11	
3	Collecting from purifier sludge tanks or DG sumps to Bilge Agitating Tank							Ex. #2
	5/3/11	C	11.1	Sludge Agitating Tank				
			11.2	3.5	m^3 capacity.			
			11.3	0.9	m^3 retained.			
			11.4	0.7	m^3 collected from purifier sludge tanks (OR DG SUMP).			
					Signature,	Position,	5/3/11	
4	Burning sludge in Auxiliary Boiler.							Ex. #7
	1/0/00	C	12.4	0.0	m^3 sludge from Sludge Service Tank,			
				0.0	m^3 retained,			
				Burned in boiler for		0.00	hours	
					Signature,	Position,	1/0/00	
5	Evaporation of water from Mixing Tank							Ex. #8
	1/0/00	C	12.4	0.0	m^3 water evaporated from Mixing Tank,			
				0.0	m^3 retained.			
					Signature,	Position,	1/0/00	
6	Pumping from engine room bilges to Mixing Tank							Ex #10
	1/0/00	D	13	0.0	m^3 bilge water from engine room bilge wells			
			14	start:	0	stop:	0	
			15.3	To mixing tank,	retained in tank	0.0	m^3	
					Signature,	Position,	1/0/00	
7	Processing water from Bilge Settling Tank through OWS.							Ex. #12
	1/0/00	D	13	0.0	m^3 bilge water from Bilge Settling Tank			
				Capacity 17.1 m^3,		0.0	m^3 retained	
			14	start:	0	stop:	0	
			15.1	Through 15 ppm equipment overboard				
				Position start:	0.0			
				Position stop:	0.0			
					Signature,	Position,	1/0/00	
8	Transfer from Bilge Holding Tank to Bilge Settling Tank							Ex. #11
	1/0/00	D	13	0.0	m^3 bilge water from bilge holding tank,			
				0.0	m^3 retained,			
			14	start:	0	stop:	0	
			15.3	to bilge settling tank,		retained in tank	0.0	m^3
					Signature,	Position,	1/0/00	

Some of the spreadsheet generated entries are not quite in conformance with the latest standards, but this is simply a matter of spreadsheet modification.

However, once developed for a specific vessel, proper implementation of ORB policy is simply a matter of spreadsheet data entry and hand copying into the ORB.

OPERATIONAL CONSIDERATIONS:

1. IMO has issued MEPC. 1/Circ. 736/Rev.1 (25 August, 2011), which provides guidelines for the recording of operations in the ORB. While this circular contains errors, it tries to promulgate a uniform (or at least unified) approach.
2. This circular is meant to provide input for a new version of the USCG standard ORB. This ORB will probably correct some of the errors in the circular and will make some adjustments that save entry time beyond what MEPC. 1/Circ. 726 promulgates.
3. It has been surveyed and estimated that currently it can take up to 5 man-hours per day to properly sound tanks, manually record those soundings in a ship's sounding log, and calculate tank, transfer and disposal volumes to make and record the required entries in the ORB. Typically these ORB tasks take 2 man-hours split between the C/E and other engine room personnel.
4. It is also noted that with the man-hours required, and the multiple steps of recording data, the completion of daily ORB entries is not consistent with a human factors based approach to accurate and error-free data processing.
5. It is anticipated by the crew that if the hand-copied entries were replaced by the generated and printed spreadsheet but still signed and dated by the C/E (and the Master, say, on a weekly basis), significant time savings and elimination of errors could be achieved. Due to the regulatory requirement that a preprinted and bound ORB needs to be used, this methodology is presently not acceptable.
6. At present, the spreadsheet approach has only been developed and trialed by one vessel crew to include bilge water and sludge waste stream processes.
7. Since fleets and individual vessel crews struggle to fill in the ORB in a unified fashion, a spreadsheet driven approach with automatically generated ORB entries (using a customized spreadsheet for each ship) would be beneficial.
8. It is anticipated that there is potential to increase the scope of the spreadsheet to incorporate additional ORB entries in a unified approach.
9. Since ORB recording is not a continuous activity, but rather is a once per day, or less frequent, activity, it may take a significant amount of time and effort before all shipboard personnel has developed the most uniform approach.
10. Instituting a unified approach requires a feedback loop (ORB recorders are directed to do one thing, and there are checkers who catch aberrations and return with feedback to the ORB recorders, which then modified the record keeper's process) or requires a recording system that resists variations that break the unified approach (as would be promoted by spreadsheets).
11. Hand copying computer generated information is wasteful, and results in its own source of inaccuracies and confusions.

12. The present spreadsheet system is a daily event approach; it does not perform a book keeping check where it checks to see if volumes add up over a longer period of time. It is not clear if a spreadsheet approach that performs a book keeping check is helpful aboard ships since it may cause ship's crews to have to deal with book keeping issues and consistency checks beyond what would be reasonably performed and achievable aboard ships (In other words why not let the consistency checks take place somewhere else?). This consistency burden is discussed in other tech memos such as the tank level accuracy memo.
13. Modern computerized maintenance and inspection systems such as ABS' NS-5 have a very rugged time stamping capability. As such, a chief engineer could simply submit a printout of spreadsheet pages into the system and they will be recorded as having been submitted by the Chief Engineer at a specific time and can no longer be modified after they have been submitted. This would be a more effective and reliable "log" than a handwritten log that can be "adjusted" over the course of multiple entries during the length of a voyage.

PROPOSED SOLUTION APPROACH:

The following solution approach is proposed:

1. Obtain full feedback, agreement and approval from all stake holders about the general approach (Ship Owners, Crews, ABS, Port State, Flag State, IMO?).
2. In order to be able to test this approach prior to international agreement, this approach could possibly be first applied for a single Flag State/Port State ship operator such as a Jones Act operator.
3. Upon release of the new USCG ORB, locate ship operators who will prepare spreadsheet sounding logs that automatically generate correct ORB entries in a format approved by the USCG.
4. Spreadsheet sounding logs will be produced for each ship. Spreadsheets will be specific to each vessel and reflect updated tank names on the vessel's IOPP and the OWS/ORB procedure and have a first page entry sheet that reflects agreed waste oil and bilge water handling processes for the specific vessel.
5. The spreadsheet would be security protected to only allow data entry to generate the printout sheets.
6. The automatic output from the sheets would be submitted through a NS-5 type integrated maintenance and inspection recording system.
7. Further processing and review tasks (such as long term volume book keeping checks) could be performed by additional software.
8. The submitted spreadsheet data can be reviewed by any stake holder the moment it is submitted.
9. This system could be conducive to further automation such as automated tank level/volume recording through further vessel automation, which in turn could generate more fully automated ORB style entries.