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ALASKA'S APPROACH TO DETERMINING OIL RECOVERY RATES AND EFFICIENCIES

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ABSTRACT 299827:

The determination of effective daily recovery capacities for oil skimmers and pumps has been controversial and increasingly critical in recent years. Oil discharge events around the world have highlighted the importance of having effective oil spill response plans, equipment, and procedures in place and available for immediate activation. The Alaska Department of Environmental Conservation (ADEC) has determined that the standard practice of using an effective oil recovery capacity equal to 20 percent of the equipment manufacturer's rated throughput capacity over a 24-hour period is not always realistic for predicting recovery capabilities during an oil spill response. Additionally, always using 20 percent does not give equipment manufacturers incentives to develop improved equipment, nor are plan holders motivated to use best available technology in their response systems.

The development of ASTM International (ASTM) "F 2709-08 Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems" (hereafter called ASTM 2709-08) provided a starting point for the assessment of realistic oil recovery rates (ORR) and oil recovery efficiencies (ORE). The standard states, "This test method defines a method and measurement criteria to quantify the nameplate recovery rate (capacity) of a stationary skimmer system in ideal conditions."

The ADEC has worked with plan holders, oil spill response organizations, and oil shipping industry representatives to use the results of testing under ASTM 2709-08 (ideal conditions) as a baseline for determining ORR and ORE in realistic field conditions. This work has been based on a "systems approach" which takes into consideration the operating environments in which the skimmer will be used and the booms which will be used to concentrate and contain oil for skimming. The resulting "Request for Assessment of Skimmer

System Efficiency" provides a means for plan holders to convey information which the ADEC can use to make a determination about the skimming system's recovery capabilities.

INTRODUCTION:

Lakeview Gusher. *Exxon Valdez*. Deepwater Horizon. Kalamazoo River. Ixtoc. Persian Gulf. *Prestige*. Niger Delta. MT *Haven*. Just a few of the major oil spills which have occurred around the world in the last century. Spills which dumped millions of barrels of oil into the environment. Despite advances in oil spill prevention technologies, large oil spills continue to occur for a wide variety of reasons.

As our abilities to drill deeper and move larger loads advance, we have a concurrent increase in need for effective oil spill response plans, procedures, and equipment. This need is especially important to Alaska as vessel traffic through the Aleutian Islands and northern waters continues to increase and extend into longer seasons. Internationally, effective oil spill response capabilities are becoming ever more critical as the Arctic Ocean opens to development. In order to help determine if the equipment and plans developed for these and other regions will be sufficient to meet the potential response need, it is necessary to be able to predict effective daily recovery capacities for oil skimming systems.

State of Alaska regulations accept the standard practice of using an effective oil recovery capacity equal to 20 percent of the equipment manufacturer's rated throughput capacity over a 24-hour period (nameplate capacity). However, the ADEC has determined that the nameplate capacity does not always provide realistic predictions of recovery capabilities during an oil spill response. The same regulation allows the ADEC to approve use of another effective daily oil recovery capacity if adequate analysis is provided which supports the higher capacity rating.

Over the past five years, the ADEC has been working with plan holders, oil spill response organizations, and oil shipping industry representatives to use the results of testing under ASTM 2709-08 as a baseline for estimating ORR and ORE in realistic field conditions. This work has been based on a "systems approach" which takes into consideration the operating environments in which the skimmer will be used and the booms which will be used to concentrate and contain oil for skimming.

ASTM STANDARD TEST METHODS:

The development of ASTM 2709-08 provided a starting point for the assessment of realistic ORR and ORE. The standard defines its purpose as "a method and measurement criteria to quantify the nameplate recovery rate (capacity) of a stationary skimmer system in ideal conditions." It also says, "This test method and parameters are intended to provide ideal recovery conditions allowing the skimmer system to operate and collect oil at its maximum possible recovery rate."

This ASTM test method is designed to allow you to control all test parameters so that you can determine the skimmer's best possible ORR and ORE. Tests are conducted

- In a predefined containment area
- With a consistent oil thickness
- Under static conditions (the skimmer is stationary)
- After rotation speeds, weir heights, pump rates, etc. are optimized through multiple test cycles with the specific oil type used for the tests

Advantages of this test protocol include documenting the skimmer's best possible capabilities for baseline comparisons and allowing for easily duplicable tests.

The information derived from using the ASTM 2709-08 standard has limited applicability, however. Because it only gives the skimmer's capabilities under "ideal recovery conditions," users don't know how the skimmer will perform in the field under the less-than-ideal conditions that are bound to occur. In fact, the standard itself says, "It is accepted that the nameplate recovery rate as determined by this test method will not likely be achievable under actual conditions of a spill. The nameplate recovery rate should be used in conjunction with a derating factor to account for such issues as changing encounter rate, changes in other recovery conditions, changes in oil properties and slick thickness, number of daylight hours, operator downtime, less than ideal control of skimmer settings, and inclement weather."

In addition to ASTM 2709-08, ASTM International developed another skimmer testing methodology, "F 631-99 Standard Guide for Collecting Skimmer Performance Data in Controlled Environments" (hereafter called ASTM 631-99; the standard was reapproved in 2008). This standard states that its purpose is to provide "a guide for determining performance parameters of full-scale oil spill removal devices in recovering floating oil when tested in controlled environments." ASTM 631-99 was designed to allow oil type, skimmer speed, oil slick thickness, wave conditions, wave height, and debris to be test variables. However, the guide says, "Caution must be exercised whenever test data are used to predict performance in actual spill situations as the uncontrolled environmental conditions that affect performance in the field are rarely identical to conditions in the test tank. Other variables such as mechanical reliability, presence of debris, ease of repair, ease of deployment, required operator training, operator fatigue, seaworthiness, and transportability also affect performance in an actual spill but are not measured by this guide. These variables should be considered along with the test data when making comparisons or evaluation of spill removal devices."

FEDERAL EFFECTIVE DAILY RECOVERY CAPACITY METHODS:

In 2012, Genwest Systems, Inc. (Genwest) produced a final report on an effective daily recovery capacity project for the United States Bureau of Safety and Environmental Enforcement (BSEE). The goals of the project were "to conduct an objective and independent assessment of the existing Effective Daily Recovery Capacity (EDRC) planning standard," and to "consider improvements that might be made to the EDRC approach and recommend new methods and guidelines to either enhance or replace that method of calculating a recovery system's daily potential for removing oil spilled on water."

The result of the second goal was the development of the Estimated Recovery System Potential (ERSP) calculator. According to the Genwest report, the "ERSP calculator was developed to provide an encounter-rate, performance-based measure of daily recovery potential for skimming systems operating on water offshore or nearshore, in warm or cold climates, without the effects of ice, debris or extreme weather conditions." The user completes 12 fields in the calculator: name of system, speed, percent decant, on-board storage, nameplate recovery rate, decant pump rate, discharge pump rate, transit time, rig/derig time, throughput efficiency, and recovery efficiency. The calculator then uses this information, in conjunction with assumptions on average nominal slick thicknesses for three days, to project how much oil, emulsion, and water would be collected each day.

While the ERSP calculator might give reasonably accurate projections for oil recovery, it is dependent on the user knowing a great deal of specific information about the skimming system in question, and it does not allow for variation in the input parameters (for instance, the speed at which the boom is towed is assumed to be constant). In situations in which response systems are established and constant, it might be possible to input all of the required information, but for systems in flux or put together on the fly during a response, it could be difficult to obtain all of the information necessary to predict oil recovery capabilities in the short term. Such predictions would be useful for determining if an active response is likely to meet spill cleanup needs.

The calculator attempts to compensate for situations in which nameplate capabilities cannot be achieved by allowing for the input of throughput and recovery efficiencies. The project report includes figures based on historical data which can help the user in determining theoretical recovery efficiencies if actual validated values are not available for a given skimmer. However, Genwest specifically said that the ESRP calculator does not account for environmental factors which could greatly affect the skimmers performance (e.g., ice, debris, extreme weather conditions). As a result, the calculator's output may inaccurately estimate the oil recovery capabilities of the response system.

ALASKA'S APPROACH TO ORR AND ORE:

State of Alaska oil discharge prevention and contingency plan regulation 18 AAC 75.445(g)(5) requires that, for response planning purposes, a skimmer be allowed credit for only 20 percent of its nameplate capacity unless it can be demonstrated to the ADEC's satisfaction that a higher recovery rate is appropriate. The ADEC has to be able to uphold any final decision on a skimmer's recovery capability, and in order to do so, the process used to obtain the supporting information must be crystal clear.

The ADEC determined that data recorded during ASTM 2709-08 testing are a good starting point, but just a starting point, in providing adequate analyses to support higher recovery rates. After years of working with industry and government partners testing skimmers using ASTM 2709-08 protocols, the ADEC developed a method which will guide oil discharge prevention and contingency plan holders in providing sufficient information to apply for skimmer ORRs and OREs higher than 20 percent. This method was successfully used for the

Crucial, Inc. coated-disc oleophilic skimmers in Cook Inlet (see case study in the next section), and is currently being followed for the same skimmers in Prince William Sound.

Given that oil spills very rarely occur under "ideal recovery conditions," it is imperative to know how a skimmer will work in the real world. A few conditions which may affect a skimmer's performance include

- Sea States
- Water currents
- Air and water temperatures
- Debris (sea weed, logs, trash, flotsam and jetsam)
- Sea ice
- Oil thickness
- Oil type (crude, diesel, Jet A, etc.)
- Changes in oil over time (emulsification, evaporation, etc.)

To best predict how much oil you can expect to recover during a spill response, you have to evaluate the entire skimming system, not just the skimmer. The ADEC's method includes examining how the skimmer, booming systems, storage devices, and operational tactics work together during a response. A change in any one of these parts could result in a change in the system's ORR and ORE. Because the way a skimmer is used (operational tactics) can influence the skimmer's performance, the ADEC requires that requests for a determination of higher skimmer efficiency come from an oil discharge prevention and contingency plan holder, and subsequently specifies that the approved efficiency will only be applicable to that plan holder for the parameters described in the request. This policy is supported by language in State regulations which is also specific to plan holders.

The ADEC "Request for Assessment of Skimmer System Efficiency" requires general information about the applicant (plan holder); specifications about the skimmer for which an ORR and ORE determination is requested; results from ASTM 2709-08 testing or the equivalent; details about the operational environment in which the skimmer will be used; and operational tactics for skimmer use. The ADEC does not specifically require data obtained through testing under ASTM 631-99, however, it would consider any data presented as long as sufficient information was provided on the test methods used.

The following table (included in the Request) was designed to capture as much information as possible about the intended use of the skimming system.

Table 1: Skimmer System Efficiency Evaluation: Operations Information

	Required Information from Plan and/or Technical Manual	**Potential Effects on Skimmer Recovery Capacities and Other Comments**

	Required Information from Plan and/or Technical Manual	Potential Effects on Skimmer Recovery Capacities and Other Comments
The specific product the skimming system will be used to collect (e.g., crude oil, Jet A, diesel, etc.)		
Characteristics of the product and changes over time (e.g., viscosity, API gravity, weathering, anticipated natural emulsification of the product given the operating environment, etc.)		
The specific operating environment in which the skimming system is to be used (e.g., open water, containment area, river, ice, snow, etc.)		
Anticipated environmental conditions in the specific operating environment (e.g., sea state, temperature, snow/ice, debris encountered, etc.)		
Booming systems used to get oil/product to the skimmer (containment boom, harbor boom, current buster, etc.)		
Operational time frames (for example, recovery rates might be reduced for each day the skimmer is operational due to changes in oil thickness, viscosity, etc.)		
Storage type used for recovered product and potential filling limitations (micro barge, mini barge, sea slug, etc.)		
Pump head pressures		

Understanding how the skimming system fits into the overarching contingency plan is important to the decision-making process. Alaska's Article 4 oil discharge prevention and contingency plan regulations require a great deal of information specific to the plan holder's operations. Much of this information is related to demonstrating how the plan holder will meet the response planning standard, the amount of oil that must be contained, controlled or cleaned up within a defined time frame. Documented data on skimmer ORR and ORE are necessary for supporting this demonstration.

Most plan holders in Alaska rely on the services and equipment provided by a primary response action contractor (PRAC) to meet applicable response planning requirements. Often, much of the information about response equipment and tactics relied upon by the plan holder is contained in a PRAC's technical manual. The Required Information column in Table 1 requires plan holders to explain what information about the parameter listed is in either the contingency plan or the supporting technical manual. That information provides a starting point for

understanding the minimum operational requirements for the skimming system and the accepted information about conditions which might affect the skimmer.

There is one particular parameter for which assumptions in Alaska may differ from those in other areas: hours of operation. Frequently, it is assumed that skimming operations will only occur during daylight hours. This assumption is not reasonable in Alaska, at least for plan holders who operate year-round. In mid-winter, the number of daylight hours can drop to eight in the southernmost region (near Ketchikan) to zero on the North Slope. It is doubtful that plan holders in most of Alaska would be able to meet their response planning standard requirements if they only operated during daylight hours in midwinter, and they would be unlikely to contain or control a spill if operations did not continue during darkness. As a result, the ADEC assumes skimming operations would be able to continue 24 hours per day, if necessary, less any downtime required for maintenance, crew safety, debris removal, relocation of response efforts, and so on.

The Potential Effects column in Table 1 then asks the plan holder to consider how the parameters in the first column, given the information already provided in the contingency plan and technical manual, might be expected to affect the skimmer during real-world operations. The ADEC expects that the plan holder will conduct necessary testing of the skimming system, either in test tanks or in the field, to ensure that the conjectures listed in the Potential Effects column are as accurate as possible.

The first page of the "Request for Assessment of Skimmer System Efficiency" is guidance for the plan holder/applicant, and includes the statement: "The Department requires that Plan holders discuss this procedure and their proposals with the Department before beginning this process to help ensure that all questions are answered and that correct information is gathered the first time, thus reducing the possible need for additional testing." The ADEC highly recommends that plan holders actively involve ADEC staff in all aspects of the information gathering process (tank and field testing) in order to expedite the review process. Doing so also lends credibility to the process by ensuring transparency.

Once all of the information required in the Request is received, the ADEC uses it, in conjunction with staff knowledge, experience, and expertise, to evaluate the skimming system and determine what ORR and ORE it will approve for planning purposes for the plan holder's specific operations. If the plan holder wants to use the skimmer at the approved recovery capacities, the ADEC-approved oil discharge prevention and contingency plan must be amended before the skimmer is incorporated into response operations. The amendment must include all applicable information about the skimmer and the system which will support it, including boom, operational tactics, and any limitations on its use.

A CRUCIAL CASE STUDY:

In 2011, Tesoro Alaska Company (now Tesoro Maritime Company) requested that the ADEC perform a skimmer system efficiency assessment for the oleophilic coated-disc skimmers

manufactured by Crucial, Inc. Specifically, they wanted to use the 13- and 56-disc skimmers with NOFI CurrentBuster 2 and 4 booming systems in their Cook Inlet tank vessel plan.

In conjunction with other Prince William Sound crude oil shippers, Tesoro had been working with Crucial since 2009 conducting tests of the skimmers at the Ohmsett facility in New Jersey. Some of these tests were conducted per the ASTM 2709-08 methodology, while others were designed to answer specific questions related to information the ADEC required, including how the skimmers would handle debris and how they would perform when used continuously over 24+ hours. In order to determine the best possible ORR and ORE for the skimmer, samples of skimmed oil/water were collected numerous times while the skimmer discs were set to rotate at different speeds. Once the optimum disc rotation speed which would collect the most oil and least water possible was determined, testing and analysis per ASTM 2709-08 was conducted.

In addition to tank testing at Ohmsett, Tesoro also worked with Cook Inlet Spill Prevention and Response, Inc. (CISPRI), their PRAC in Cook Inlet, to carry out a variety of field tests designed to help assess how the skimming system would perform in real-world conditions, as well as provide opportunities for improving the system and developing operational tactics.

It was critical that during this process Tesoro involved the ADEC in all aspects of design, implementation, and evaluation of tank and field tests. Tesoro recognized early that involving the ADEC in every step of the process would address most questions and concerns up front, thus streamlining the entire process.

Once everyone was satisfied that the tests had answered as many questions as possible, Tesoro completed the ADEC's "Request for Assessment of Skimmer System Efficiency." The most difficult part of this process was ensuring that existing information was portrayed clearly and with sufficient detail in the Request. At the ADEC's urging, Tesoro submitted draft versions of the Request for review and comment before it was finalized and officially submitted for approval.

To allow the ADEC the opportunity to give the skimmers the highest possible ORR and ORE, Tesoro requested 100 percent of the nameplate recovery rates calculated for the Crucial skimmers based on the results of ASTM 2709-08 testing at Ohmsett (at that time, Crucial had not published a manufacturer's nameplate capacity). Given that those capacities were achieved under ideal conditions and after the skimmers' capabilities were optimized, Tesoro knew that the ADEC could not justify agreeing that those recovery rates could be duplicated during a response. Therefore, for response planning purposes, some derating factor had to be applied to the nameplate recovery rates.

Based on the results of tank and field testing, the requirements of Tesoro's Cook Inlet contingency plan, and the ADEC's best professional judgment, it was determined that Tesoro could plan on achieving 50 percent of the skimmers' ORR as determined by the ASTM 2709-08 tests, with an efficiency of 70 percent, but only when the skimmers were used in conjunction with CurrentBuster 2 or 4 booming systems and in the manner described for the systems in the CISPRI technical manual tactics. If the skimmers were used with any other booming system or

tactic, the derating would revert to 20 percent for response planning purposes. The final ORR and ORE values approved were ultimately subjectively determined as there is currently no method for accurately predicting the impacts of all environmental and other parameters on a skimming system's capabilities.

Including Tesoro, there are nearly 20 companies which rely on CISPRI to provide oil spill response services in Cook Inlet, Alaska. At their request, the ADEC allowed CISPRI to apply on behalf of all of its members for the same ORR and ORE for the Crucial skimmers as was approved for Tesoro. Because the equipment, tactics, and field response personnel used would be the same for all of CISPRI's member companies, the ADEC was willing to allow each of them to use, for planning purposes, the same ORR and ORE as Tesoro. However, as with Tesoro, if the given company chose to plan on using the skimmers with any other booming system or tactic, the derating would revert to 20 percent for response planning purposes.

SUMMARY:

The State of Alaska is committed to ensuring that oil exploration, production, refining, and transportation in Alaska is accompanied by excellent oil spill prevention and response systems. Given advances in production and transportation capabilities, especially in the Arctic environment, the need for predicting the effectiveness of those systems is ever more critical. Additionally, the ADEC wants to encourage its oil discharge prevention and contingency plan holders to seek out the best available technology for responding to oil spills, and wants to work with plan holders to ensure that they get appropriate credit for using advanced technologies. To that end, the ADEC will continue striving to ensure it is using excellent methods for predicting oil recovery capacities.

ASTM International and the United States Bureau of Safety and Environmental Enforcement should be applauded for their efforts to create methods for predicting the maximum volumes of oil a skimming system could be predicted to recover. The ADEC was pleased to be able to build on the information derived from the ASTM 2709-08 test methods in developing its skimmer system efficiency assessment protocols. Those plan holders who complete a "Request for Assessment of Skimmer System Efficiency" will find that the ADEC is willing to work with them to best predict a skimming system's capabilities in Alaska's real-world conditions.

REFERENCES:

Alaska Department of Environmental Conservation, Division of Spill Prevention and Response, Industry Preparedness Program. 2012. Request for Skimmer System Efficiency.

ASTM International. 1999. Designation: F 631 – 99. Standard Guide for Collecting Skimmer Performance Data in Controlled Environments.

ASTM International. 2008. Designation: F 2709 – 08. Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems.

Genwest Systems, Inc. 2012. EDRC Project Final Report. Under GSA Contract GS-00F-0002W, BSEE Order # E12-PD-00012.