DET NORSKE VERITAS

Classification Society Tug Review for PWSRCAC

Contract No: 801.11.01

Prince William Sound Regional Citizens' Advisory Council

The opinions expressed in this PWSRCAC-commissioned report are not necessarily those of PWSRCAC

Report No./DNV Reg No.: / 1392NFK-7
Rev 1, 2011-10-24

Classification Society Tug Review for PWSRCAC	DET NORSKE VERITAS CLASSIFICATION (AMERICAS) INC 1600 Sawgrass Corporate Parkway 33323 Sunrise, United States Tel: (954) 838-0055 Fax: (954) 838-0551 http://www.dnv.com Org. No:
For: Prince William Sound Regional Citizens' Advisory Council	
Account Ref.: RFP: 801 Classification Society Tug Review	

Date of First Issue:	2011-10-11	Project No.:	PP009757
Report No.:	1392NFK-7	Organisation Unit:	Advisory Services
Revision No.:	1	Subject Group:	

Summary:

The Prince William Sound Regional Citizens' Advisory Council (PWSRCAC) has requested DNV to review specifications and performance testing data for Prince William Sound escort tugs with appropriate Class society standards for escort tugs. DNV's own accepted Classification Society Standards for escort service are used to assess the performance of the Ship Escort Response System's (SERVS) Prevention and Response Tugs (PRT) and Enhanced Tractor Tugs (EET) used for escort duty in Prince William Sound. This assessment determines the extent to which these tugs are in compliance with the DNV Classification Rules, specifically, the ESCORT notation.

Prepared by:	*Name and Position* Heather Davis / Marcin Polawski Senior Engineer / Approval Engineer	*Signature*
Verified by:	*Name and Position* Dag Sandal / Senior Consultants	*Signature*
Approved by:	*Name and Position* Helge Hemmundsgård Business Development Manager	*Signature*

Rev. No. / Date:	Reason for Issue:	Prepared by:	Verified by:	Accepted by:

Table of Contents

1 INTRODUCTION

The Prince William Sound Regional Citizens' Advisory Council (PWSRCAC) has requested DNV to review specifications and performance testing data for Prince William Sound escort tugs with appropriate Class society standards for escort tugs. DNV understands that one of the main objectives of the PWSRCAC is to safeguard the Prince William Sound from potential damaging consequences from oil spill and terminal and tanker operations by advising stakeholders (like the Alyeska Pipeline Service Company), verifying practices and identifying improvement opportunities. The verification to Class standards of the available escort tugs in Prince William Sound fits directly into this objective as it verifies whether the tugs are fit for service.

DNV's own accepted Classification Society Standards for escort service are used to assess the performance of the Ship Escort Response System's (SERVS) Prevention and Response Tugs (PRT) and Enhanced Tractor Tugs (EET) used for escort duty in Prince William Sound. This assessment determines the extent to which these tugs are in compliance with the DNV Classification Rules, specifically, the ESCORT notation.

The requirements as listed in the Oil Pollution Act signed into law in August 1990, OPA90 were also looked at for applicability to this assessment. This act was largely in response to rising public concern following the Exxon Valdez incident and its intent is to improve the ability to prevent and respond to oil spills.

2 DOCUMENTS RECEIVED

Table 2-1: Documents Received

Document No.	Rev	Title
99498-843-03	-	Trim and Stability Calculations (140' Z-Drive Tug)
99498-835-05	-	Tank Capacity Plan (140' Z-Drive Tug)
99498-843-02	-	Inclining Test Results M/V Alert (1st of 3)
-	-	Markey machinery Company, Inc. Winch Conversion Project / Three (3) Crowley PRt-Class Tugs
-	-	Markey Machinery Company, Inc. VMS 140' x 10,000 HP ASD Tugs – Stern Towing Winch
-	-	Markey Machinery Company, Inc. Modification Task – List
		ABS Stability Letter – Aware (July 19, 2000)
		ABS Stability Letter – Tan'erliq (May 6, 1999)
		ABS Stability Letter – Nanuq (Feb 5, 1999)
		M/V Alert – Principal Characteristics Sheet
		M/V Tan'erliq – Principal Characteristics Sheet
		ABS Statement of Fact Survey – M.v. Aware Bollard Pull certificate (July 17, 2000)
		Design Specifications for 140x42x20 ft. 10,000 HP General Purpose

		Tug (May 11, 1998)
99498-801-02	B	General Arrangments Outboard Profile (140' Z-Drive Tug)
99498-801-01	C	General arrangements Focsle & Bridge Deck (140' Z-Drive Tug) Sht. 1 of 2
99498-801-01	C	General Arrangements Hold & Main Deck (140' Z-Drive Tug) Sht. 2 of 2
99498-801-03	B	General Arrangements Inboard Profile (140' Z-Drive Tug)
99498-100-01	A	Structural Arrangements Long'l Sections (140' Z-Drive Tug)
S36056-X	-	M.V. Nanuq Bollard Pull Certificate (Jan 12, 1999)
		Technical Specifications of 153x48x20 ft. Tanker Escort/Spill response Tug (July 1, 1997)
86697-801-02	-	General Arrangment Outboard Profile (153' Tractor Tug)
86697-801-01	-	General Arrangement Hold Arrangement (153' Tractor Tug) Sht. 1 of 3
86697-801-01	-	General Arrangement Main Deck Arrangement (153' Tractor Tug) Sht. 2 of 3
86697-801-01	-	General Arrangement Focsle Dk & Pilothouse (153' Tractor Tug) Sht. 3 of 3
86697-801-03	-	General Arrangment Inboard Profile (153' Tractor Tug)
86697-100-01	-	Structural Arrangements Inboard Profile (153' Tractor Tug)
86697-100-02	-	General Arrangements Lines Drawing (153' Tractor Tug)
86697-111-01	-	Structural Arrangements Bottom Shell PL & FR (153' Tractor Tug)
86697-111-02	-	Structural Arrangements Side Shell & Bulwark (153' Tractor Tug)
86697-114-01	-	Structural Arrangements Propeller Guard & Skeg (153' Tractor Tug) Sht. 1 of 2
86697-114-01	-	Structural Arrangements Skeg Details (153' Tractor Tug) Sht. 2 of 2
86697-117-01	-	Structural Arrangements Midship Section (153' Tractor Tug)
86697-131-01	-	Structural Arrrangements Deck Scantlings (153' Tractor Tug) Shts. 1 and 2
86697-150-01	-	Structural Arrangement Deckhouse Sides & BHDS (153' Tractor Tug)
86697-155-01	-	Structural Arrangements Pilot Scantlings (153' Tractor Tug) Shts. 1 and 2
86697-163-01	-	Structural Arrangements Seachest Arrangement & Det. (153' Tractor Tug) Shts. 1 and 2
86697-171-01	-	Structural Arrangements Mast Structure (153' Tractor Tug)
86697-182-01	-	Structural Arrangements MN Eng & Propeller Fdn (153' Tractor Tug) Sht. 1 to 4

86697-256-01	-	Machinery Colling Water System Schematic (153' Tractor Tug) Shts. 1 and 2
86697-259-10	-	Exhaust Piping Arrangement & Details (153' Tractor Tug) Shts. 1 to 4
86697-264-01	-	Lube Oil Piping Schematic (153' Tractor Tug) Sht.s 1 and 2
86697-320-01	-	One Line Diagram – Mn Swbd Pnls P400, P408 (153' Tractor Tug) Shts. 1 to 6
86697-331-01	-	Lighting Deck Plan (153' Tractor Tug) Shts. 1 to 4
86697-422-01	-	Navigation Lighting (153' Tractor Tug) Shts. 1 and 2
86697-501-01	-	Machinery Arrangement (153' Tractor Tug) Shts. 1 to 3
86697-506-01	-	Fills, Vents & Sndg Tubes Diagram (153' Tractor Tug) Shts. 1 and 2
86697-513-01	-	Machinery Space Ventilation Diagram (153' Tractor Tug) Shts. 1 and 2
86697-522-01	-	Firefighting System Schematic (153' Tractor Tug)
86697-528-01	-	Black & Grey Water Schematic (153' Tractor Tug) Shts. 1 to 3
86697-529-01	-	Bilge, Ballast & Firemain Schematic (153' Tractor Tug)
86697-541-01	-	Fuel Transfer System Diagram (153' Tractor Tug)
86697-541-02	-	Fuel Service System Diagram (153' Tractor Tug)
86697-551-01	-	Compressed Air System Schematic (153' Tractor Tug) Shts. 1 and 2
86697-581-01	-	Anchoring, Mooring and Towing Arrangement (153' Tractor Tug) Shts. 1 and 2
86697-582-01	-	Fendering A&D (153' Tractor Tug) Shts. 1 and 2
86697-583-05	-	Safety Plan (153' Tractor Tug) Shts. 1 and 2
86697-635-01	-	Insulation Schedule (153' Tractor Tug) Shts. 1 to 4
D-41489	-	Elec / Hyd Connections (153' Tractor Tug)
86697-835-05	-	Tank Capacity Plan (153' Tractor Tug)
-	-	Markey Machinery Company, Inc. MMCo. Preliminary "Connection Sketch", D-41489 – Nanuq (June 20, 1997)
-	-	Markey Machinery Company, Inc. Crowely Valdez Tugs, S/N 17291-1 and 17291-2, Propsed Hawser Winch Width Change – Nanuq and Tan'erliq (Feb 5, 1998)
		Markey Machinery Company, Inc. Braking capacity – DYSDS-62 Hawser Winch for Valdex Tractor Tugs - Nanuq and Tan'erliq (Oct 30, 1997)

Additional documentation/clarification was also requested. A record of this can be found in Appendix A of this report.

3 REVIEW OF DNV STANDARDS

PWSRCAC provided DNV with information for two types of escort tugs operating in Prince William Sound; PRT and EET tugs. The PRT tugs consist of vessels Aware, Alert and Attentive, while the EET tugs consist of vessels Nanuq and Tan'erliq. Aware, Alert and Attentive are assumed to be sister vessels, i.e. identical design with identical equipment installed. Nanuq and Tan'erliq are also assumed to be sister vessels.

DNV's TUG notation requirements apply to vessels intended for towing services in harbour and open waters and the pushing of floating structures. The objective of the requirements is to provide a design standard for safe and reliable towing operation.

DNV's ESCORT notation requirements apply to vessels specially intended for escort service. The term Escort service includes steering, braking and otherwise controlling the assisted vessel. Part 5 Chapter 7 Section 13 of DNV Ship Rules contains the requirements for the ESCORT notation. These requirements however assume that the requirements in Part 5 Chapter 7 Section 12 for the TUG notation are also met. Requirements for both have therefore been evaluated in this report. A compliance matrix for each category of requirements has been made for each vessel type. DNV has also commented on the criticality of each requirement, meaning whether the requirement can be taken for information or whether it is critical to the assessment of the vessel performance.

To ease the review of the findings DNV have implemented a colour code to identify compliance/non-compliance and criticality of a requirement to the conclusion of the report:

Green	Found to comply with requirements
Yellow	No information available or identified non-compliance, but not critical to the conclusion
Red	Identified non-compliance with a direct impact on conclusion

3.1 PRT Tug Evaluation

3.1.1 Tug Requirements (Pt.5 Ch.7 Sec.12)

According to collected data and Pt.5 Ch.7 Sec.12:

Bollard Pull (BP) = 305,000 lbs = 138.3 tons

Reference Load (RL) = 2.0BP (for BP > 90 tons) = 276.6 tons

Winch Specification for this vessel type: DYS-52/WYW-20 Hawser Winch with Auxiliary Windlass

Table 3-1: Certification Requirements

Requirement	Status	DNV Comment
Towing Winch Product Certificate (DNV)	Not received/available	
Towing Hook Product Certificate (DNV)	Not relevant	The vessel does not have fixed towing hook on

		deck.
Towing hook with attachment Material Certificate (DNV)	Not relevant	The vessel does not have fixed towing hook on deck.
Winch Drum and Flanges Material Certificate (DNV)	Not received/available	
Shafts for Drum Material Certificate (DNV)	Not received/available	
Brake Components Material Certificate (DNV)	Not received/available	
Coupling Works Material Certificate	Not received/available	
Winch Framework Works Material Certificate	Not received/available	
Gear Shaft and Wheels Works Material Certificate	Not received/available	

Table 3-2: Load Test Requirements

Requirement	Status	DNV Comment
Winch shall be load tested during hoisting, braking and pay out.	Not received/available	
Towing hook to be load tested with a load equal to BP (BP = 138.3 tons)	Not relevant	The vessel does not have fixed towing hook on deck.

Table 3-3: Test Procedure Requirements

Requirement	Status	DNV Comment
Proposed test program shall be submitted prior to testing	Not received/available	
During testing of continuous static BP the main engines shall be run at the manufacturer's recommended maximum continuous rating (MCR)	Not received/available	
During testing of overload pull, the main engines shall be run at the manufacturer's recommended maximum rating that can be maintained for a minimum of 1 hour. The overload test may be omitted.	Not received/available	Required to document engines ability to work at max pull for extended period.
The propellers fitted when performing the test shall be the propellers used when the vessel is in normal operation.	Not received/available	Assumed to be OK

All auxiliary equipment which are driven from the main engines or propeller shafts in normal operation of the vessel shall be connected during the test.	Not received/available	Assumed to be OK
The water depth at the test location shall not be less than 20m within a radius of 100m of the vessel.	Water depth during testing = 60 ft (18.2 m)	Ok
The test shall be carried out with the vessel's displacement corresponding to full ballast and half fuel capacity.	Not received/available	Assumed to be OK
The vessel shall be trimmed at even keel or at a trim by stern not exceeding 2% of the vessel's length.	Not received/available	Assumed to be OK
The vessel shall be able to maintain a fixed course for not less than 10 minutes while pulling as specified.	Not received/available	Required to document vessel's steering stability under max pull.
The test shall be performed with a fair wind speed not exceeding 5m/s.	Wind speed during testing = 5 knots (2.57 m/s)	Ok
The co-current at the test location shall not exceed 1 knot.	Current during testing = 1 knot or less	Ok
The load cell used for the test shall be approved by DNV and be calibrated at least once a year. The accuracy of the load cell shall be +-2% within a temperature range and a load range relevant for the test.	Test performed on 17 July 2000, calibration on 24 January 2000	Ok
An instrument giving a continuous read-out and also a recording instrument recording the bollard pull graphically as a function of the time shall both be connected to the load cell. The load cell shall be fitted between the eye of the towline and the bollard.	Not received/available	
The arrangement of bollard, towline and load cell shall ensure a force reading in horizontal direction as being maintained without any tendency to decline for a duration of not less than 10 minutes.	Force reading only for 5 minutes during testing	
The figure certified as the vessel's continuous static BP shall be the towing force recorded as being maintained without any tendency to decline for a duration of not less than 10 minutes.	Force reading only for 5 minutes during testing	

Certification of BP figures recorded when running the engines at overload, reduced r.p.m. or with a reduced or an increased number of engines or propulsion devices shall be recorded.	Not received/available	
Both the load cell reading, engine power, and other essential parameters shall be continuously available to the DNV surveyor.	Not received/available	
The recorded load cell readings shall be made available to the DNV surveyor immediately upon completion of the test.	Not received/available	

Table 3-4: Arrangement and Component Requirements

Requirement	Status	DNV Comment
Towing Arrangement: The arrangement shall be such that the towline is led to the winch drum in a controlled manner under all foreseeable conditions (directions of the towline) and provide proper spooling on drum.	No level winder or similar fitted.	Level winder or similar to be fitted.
Towing Hook: Design and scantlings of the towing hook with attachment shall be capable of withstanding a load of minimum 2.5 times the BP. Towing hooks shall be provided with reliable release arrangement, so that in case of a critical situation, the towline can be immediately released regardless of angle of heel and of direction of towline. The releasing device shall be operable from the bridge.	Not relevant	No towing hook is fitted.
Emergency Release: The action to release the drum shall be possible locally at the winch and from a position at the bridge with full view and control of the operation. Identical means of equipment for the release operation to be used on all release stations.	Sightline can be seen from drawing: 99498-801-03 Rev. B According to e-mail from Crowley, the winch can be controlled from the Wheel House & Deck local control station. The winch has a Free Wheel Function that overrides all other modes.	Ok
Drum: The drum diameter for steel wire rope should not be less than 14 times the maximum	Main Line AmSteel Blue 10 inch circumference (MBS 411 MT) with eye to eye	Drum diameter is greater than required therefore

intended diameter of the rope. However, for all rope types, the rope bending specified by the rope manufacturer should not be exceeded.	splice to an AmSteel Blue 10 inch circumference pendant (MBS 411 MT) Rope diameter = 3.183 in = 80.85 mm 14 * rope diameter = 44.56 in = 1132 mm Drum diameter = 55 in (approx) = 1397 mm	Ok
Towline Attachment: The end attachment of the towline to the winch barrel shall be of limited strength making a weak link in case the towline has to be run out.	Main Line AmSteel Blue 10 inch circumference (MBS 411 MT) with eye to eye splice to an AmSteel Blue 10 inch circumference pendant (MBS 411 MT)	Main line and pendant have same MBS and therefore no weak link is apparent.
Drum Brake: The brake is normally to act directly on drum and should be capable of holding the RL at inner layer, it shall be arranged for manual operation or other means for activation during failure of the power supply or control system.	RL = 276.6 tons Drum Brake = 320,000 lbs = 145.15 tons band-type brake with a hydraulic cylinder providing quick set and release and a manual handwheel override. Winch spec. from internet states: Braking Capacity = 480,000 lbs @ mid drum, = 320,000 lbs using hydraulic cylinder only	Not clear what the brake capacity at the inner layer is.

3.1.2 ESCORT Notation Requirements (Pt.5 Ch.7 Sec.13)

Table 3-5: ESCORT Notation Requirements - Arrangement

Requirement	Status	DNV Comment
Arrangement: The towing winch shall have a load reducing system in order to prevent overload caused by dynamic oscillation in the towing line. Normal escort operation shall not be based on use of brakes on the towing winch. The	Load reducing system on winch not documented Towline breaking strength =	Braking strength is Ok. Load reducing system on winch not documented.

towing winch shall be able to pay out towing line if the pull exceeds 50% of the breaking strength of towing line. The towing line shall have a breaking strength of at least 2.2 times the maximum mean towing pull as measured during the test.	411 tons 2.2 * maximum mean towing pull = 2.2*138.3 = 304.26 tons	
Escort Rating Number: The escort rating number, (n, V), is to be based on full scale measurements at 8 and or 10 knots. n = FS*C (tones) FS = steering force from tug C = k28/t or 1, whichever is less k = 1.1 (28s is the manoeuvring time required by Pt.4 Ch.14 Sec.1 B400) t = maneuvering time in sec. from maintained oblique position of tug giving maximum steering force on one side of assisted vessel to mirror position on the other side. Towline angle need not be taken less than 30 deg.	From the data submitted it seems that a steering test was not performed for the PRT Tugs.	Test not performed. It is therefore not possible to establish an escort rating number in accordance with DNV Rules.

3.1.3 Stability Requirements Evaluation (Pt.5 Ch.7 Sec.13)

In order to meet the requirements for ESCORT notations, stability requirements for Tug notation, as per DNV Ship Rules Pt.5 Ch.7 Sec.12 need to be met, along with the additional requirements for the ESCORT notation, as per DNV Ship Rules Pt.5 Ch.7 Sec.13.

Assessment of compliance with regards to DNV Stability Requirements is based on information given in following documents:

- Alert_GPA 99498-843-03-12 (GHS 00-02-04).pdf
- Alert_GPA 99498-843-03-12 (GHS 00-02-07).pdf

TUG Notation Criterion Assessment

a) BP : 138.3 t
b) 60% of BP applied in the calculations (ref DNV Rules January 2010 Pt.5 Ch.7 Sec.2 E102)
   Drive : 2x Ulstein Azimuth.
c) Heeling arm (a) = 7.3 m.
d) Heeling arm reduced by Cosines of heeling angle

Status OK indicated below means that the transverse heeling arm is not exceeding 50% of the righting arm.

Table 3-6: Summary of compliance

Condition name:	DNV TUG criterion (Pt.5 Ch.7 Sec.2 E103 January 2010) status.	Recommendation in order to meet the requirement :
1 Departure	Ok	
3 Midway	Ok	-
4 Midway	NOT OK	Reduce BP and/or modify condition
5 Midway	NOT OK	Reduce BP and/or modify condition
5a Midway	NOT OK	Reduce BP and/or modify condition
6 Midway	NOT OK	Reduce BP and/or modify condition
2 Arrival	NOT OK	Reduce BP and/or modify condition
2a Arrival	NOT OK	Reduce BP and/or modify condition
2b Arrival	NOT OK	Reduce BP and/or modify condition
2c Arrival	NOT OK	Reduce BP and/or modify condition
2d Arrival	NOT OK	Reduce BP and/or modify condition

The vessel shall comply with all applicable stability criteria in every loading condition, therefore the midway and arrival conditions need to be adjusted. Additional calculation & study would be required in order to conclude how much the BP needs to be reduced in combination with alterations of the loading condition and how this affects the operation of the vessel.

We note that the presented GZ curves start from equilibrium angel, not from 0 deg as is normally required for detail calculations. This may have influence on the accuracy of results and shall be corrected if new stability documentation is prepared in accordance with DNV rules.

Please note that DNV stability requirements for TUG notation have been changed, ref July 2011 Pt.5 Ch.7 Sec.12 E. These requirements may also be considered if it is intended to calculate allowable BP for which the TUG criterion is met. Agreement of which Rules edition will be used in case new limiting BP is calculated should be agreed in advance.

ESCORT Notation Criteria Assessment
Assessment against stability requirement for ESCORT notation has not been carried out due to missing information on heeling moment and escort loading conditions.

3.2 EET Tug Evaluation

3.2.1 Tug Requirements (Pt.5 Ch.7 Sec.12)

According to collected data and Pt.5 Ch.7 Sec.12:
Bollard Pull (BP) = 210,500 lbs = 95.48 tons
Reference Load (RL) = 2.0BP (for BP > 90 tons) = 190.96 tons

Winch Specification for this vessel type: DYSDS-62 Hawser Winch

Table 3-7: Certification Requirements

Requirement	Status	DNV Comment
Towing Winch Product Certificate (DNV)	Not received/available	
Towing Hook Product Certificate (DNV)	Not relevant	The vessel does not have fixed towing hook on deck.
Towing hook with attachment Material Certificate (DNV)	Not relevant	The vessel does not have fixed towing hook on deck.
Winch Drum and Flanges Material Certificate (DNV)	Not received/available	
Shafts for Drum Material Certificate (DNV)	Not received/available	
Brake Components Material Certificate (DNV)	Not received/available	
Coupling Works Material Certificate	Not received/available	
Winch Framework Works Material Certificate	Not received/available	
Gear Shaft and Wheels Works Material Certificate	Not received/available	

Table 3-8: Load Test Requirements

Requirement	Status	DNV Comment
Winch shall be load tested during hoisting, braking and pay out.	Not received/available	
Towing hook to be load tested with a load equal to BP (BP = 95.48 tons)	Not relevant	The vessel does not have a fixed towing hook on deck.

Table 3-9: Test Procedure Requirements

Requirement	Status	DNV Comment
Proposed test program shall be submitted prior to testing	Not received/available	
During testing of continuous static BP the main engines shall be run at the manufacturer's recommended maximum continuous rating (MCR)	Not received/available	
During testing of overload pull, the main engines shall be run at the manufacturer's recommended maximum rating that can be maintained for a minimum of 1 hour. The overload test may be omitted.	Not received/available	Required to document engines ability to work at max pull for extended period.
The propellers fitted when performing the test shall be the propellers used when the vessel is in normal operation.	Not received/available	Assumed to be OK
All auxiliary equipment which are driven from the main engines or propeller shafts in normal operation of the vessel shall be connected during the test.	Not received/available	Assumed to be OK
The water depth at the test location shall not be less than 20m within a radius of 100m of the vessel.	Water depth during testing = 54 ft (16.5 m)	OK/accepted
The test shall be carried out with the vessel's displacement corresponding to full ballast and half fuel capacity.	Not received/available	Assumed to be OK
The vessel shall be trimmed at even keel or at a trim by stern not exceeding 2% of the vessel's length.	Not received/available	Assumed to be OK
The vessel shall be able to maintain a fixed course for not less than 10 minutes while pulling as specified.	Not received/available	Required to document vessel's steering stability under max pull.
The test shall be performed with a fair wind speed not exceeding 5m/s.	Wind speed during testing = 0-5 knots (2.57 m/s max)	Ok
The co-current at the test location shall not exceed 1 knot.	Current during testing = Ebb Tide	Ok
The load cell used for the test shall be approved by DNV and be calibrated at least once a year. The accuracy of the load cell shall be +-2% within a temperature range and	Test performed on 12 January 1999, calibration on 6 January 1999	Ok

a load range relevant for the test.		
An instrument giving a continuous read-out and also a recording instrument recording the bollard pull graphically as a function of the time shall both be connected to the load cell. The load cell shall be fitted between the eye of the towline and the bollard.	Not received/available	
The arrangement of bollard, towline and load cell shall ensure a force reading in horizontal direction as being maintained without any tendency to decline for a duration of not less than 10 minutes.	Nothing stated on Bollard Pull Certificate	It is unclear if the requirements of 10 minute duration are met.
The figure certified as the vessel's continuous static BP shall be the towing force recorded as being maintained without any tendency to decline for a duration of not less than 10 minutes.	Nothing stated on Bollard Pull Certificate	It is unclear if the requirements of 10 minute duration are met.
Certification of BP figures recorded when running the engines at overload, reduced r.p.m. or with a reduced or an increased number of engines or propulsion devices shall be recorded.	Not received/available	
Both the load cell reading, engine power, and other essential parameters shall be continuously available to the DNV surveyor.	Not received/available	
The recorded load cell readings shall be made available to the DNV surveyor immediately upon completion of the test.	Not received/available	

Table 3-10: Arrangement and Component Requirements

Requirement	Status	DNV Comment
Towing Arrangement: The arrangement shall be such that the towline is led to the winch drum in a controlled manner under all foreseeable conditions (directions of the towline) and provide proper spooling on drum.	No level winder or similar fitted.	Level winder or similar to be fitted.
Towing Hook: Design and scantlings of the towing hook with attachment shall be capable of withstanding a load of minimum 2.5 times the BP. Towing hooks shall be provided with reliable release arrangement, so that in case of a critical situation, the towline can be	Not relevant	No towing hook is fitted.

immediately released regardless of angle of heel and of direction of towline. The releasing device shall be operable from the bridge.		
Emergency Release: The action to release the drum shall be possible locally at the winch and from a position at the bridge with full view and control of the operation. Identical means of equipment for the release operation to be used on all release stations.	Sightline can be seen from drawing: 86697-801-03 From Wheel House only; Free Wheel Function over rides all other modes.	Sightline Ok. Drum release function at the winch is missing.
Drum: The drum diameter for steel wire rope should not be less than 14 times the maximum intended diameter of the rope. However, for all rope types, the rope bending specified by the rope manufacturer should not be exceeded.	Main Line NEUTRON-8, 11 inch circumference (MBS 538 MT) with eye to eye splice to an AmSteel Blue 10 inch circumference pendant (MBS 411 MT) Rope diameter = 3.5 in = 88.9 mm 14 * Rope diameter = 49 in = 1244.6 mm Drum diameter = 84 in (approx) = 2133.6 mm	Drum diameter is greater than required therefore Ok
Towline Attachment: The end attachment of the towline to the winch barrel shall be of limited strength making a weak link in case the towline has to be run out.	Main Line NEUTRON-8, 11 inch circumference (MBS 538 MT) with eye to eye splice to an AmSteel Blue 10 inch circumference pendant (MBS 411 MT)	Main line has larger MBS than pendant therefore a weak link is present. This assumes that the pendant is the end attachment.
Drum Brake: The brake is normally to act directly on drum and should be capable of holding the RL at inner layer, it shall be arranged for manual operation or other means for activation during failure of the power supply or control system.	RL = 190.96 tons Braking Capacity of Drum = 600,000 lbs @ top layer = 272.16 tons = 1,498,267 lbs @ barrel layer = 679.6 tons	Ok

3.2.2 ESCORT Notation Requirements (Pt.5 Ch.7 Sec.13)

Table 3-11: ESCORT Notation Requirements

Requirement	Status	DNV Comment
Arrangement: The towing winch shall have a load reducing system in order to prevent overload caused by dynamic oscillation in the towing line. Normal escort operation shall not be based on use of brakes on the towing winch. The towing winch shall be able to pay out towing line if the pull exceeds 50% of the breaking strength of towing line. The towing line shall have a breaking strength of at least 2.2 times the maximum mean towing pull as measured during the test.	Load reducing system on winch not documented Towline breaking strength = 538 tons 2.2 * maximum mean towing pull = 2.2*95.48 = 210.06 tons	Braking strength is Ok. Load reducing system on winch not documented.
Escort Rating Number: The escort rating number, (n, V), is to be based on full scale measurements at 8 and or 10 knots. n = FS*C (tones) FS = steering force from tug C = k28/t or 1, whichever is less k = 1.1 (28s is the maneuvering time required by Pt.4 Ch.14 Sec.1 B400) t = maneuvering time in sec. from maintained oblique position of tug giving maximum steering force on one side of assisted vessel to mirror position on the other side. Towline angle need not be taken less than 30 deg.	From the data submitted it seems that a steering test was not performed for the EET Tugs.	Test not performed. It is therefore not possible to establish an escort rating number in accordance with DNV Rules.

3.2.3 Stability Requirements Evaluation (Pt.5 Ch.7 Sec.13)

In order to meet the requirements for ESCORT notations, stability requirements for Tug notation, as per DNV Ship Rules Pt.5 Ch.7 Sec.12 need to be met, along with the additional requirements for the ESCORT notation, as per DNV Ship Rules Pt.5 Ch.7 Sec.13. Assessment of compliance with regards to DNV Stability Requirements is based on information given in following documents:

- ETT Tech Specs (1 Jul 1997) - Appendix A.pdf, DWG 86697-843-03 "Scientific Trim&Stability calcs".

TUG Notation Criterion Assessment

a) BP : 92.25 t (Value taken from the Specification sheet. Stability criteria will not be met if BP is increased)
b) 60% of BP not applied in the calculations due to TT drive : 2 x V&S.
c) heeling arm (a) not given = 9.8 m based on "Structural arrangements" (assumed to mid of V&S drive)
d) Heeling arm reduced by Cosines of heeling angle

Status OK indicated below means that the transverse heeling arm is not exceeding 50% of the righting arm.

Table 3-12: Summary of compliance

Condition name:	DNV TUG criterion (Pt.5 Ch.7 Sec.2 E103 January 2010) status	Comments
03 Normal Departure	Ok	
03 Ice Normal Departure	Ok	
Arrival condition	Not received/available	

The documentation lists additional conditions (reference summary Sheet 6-5), but without necessary details, these conditions are therefore not covered by this assessment.

As a minimum requirement, stability has to be checked in both departure and arrival conditions. In this assessment we were not able to verify stability in arrival condition as it was not provided in the received documentation.

ESCORT Notation Criteria Assessment

a) Speed : 8 kn
b) Heeling moment 1628,322 LTFT

Table 3-13: Summary of compliance with speed 8knots

Condition name:	DNV ESCORT criterion (Pt.5 Ch.7 Sec.13 D 201 & 203)	Comments
03 Normal Departure	Ok	
Arrival condition	Not received/available	

a) Speed : 10 kn
b) Heeling moment 2436,744 LTFT

Table 3-14: Summary of compliance with speed 10 knots

Condition name:	DNV ESCORT criterion (Pt.5 Ch.7 Sec.13 D 201 & 203)	Comments
03 Normal Departure	Ok	
Arrival condition	Not received/available	

The documentation lists compliance with ESCORT requirements in Conditions: "4 Midway" and "5 Burnout" (ref summary Sheet 8-42) but without detailed calculations. These conditions are therefore not covered by this assessment.

3.3 Escort Service Capabilities

Each ship has unique steering characteristics and rudder forces at different speeds and rudder angle. IMO has issued rules for ships' manoeuvrability (IMO 751 – 10/10 zigzag manoeuvre criterion), and published graphs showing steering forces for different tanker sizes at 10 knots. These graphs can be used to give a coarse estimation of what tanker sizes the tugs are capable to handle, provided that the Steering force of the tugs are known.

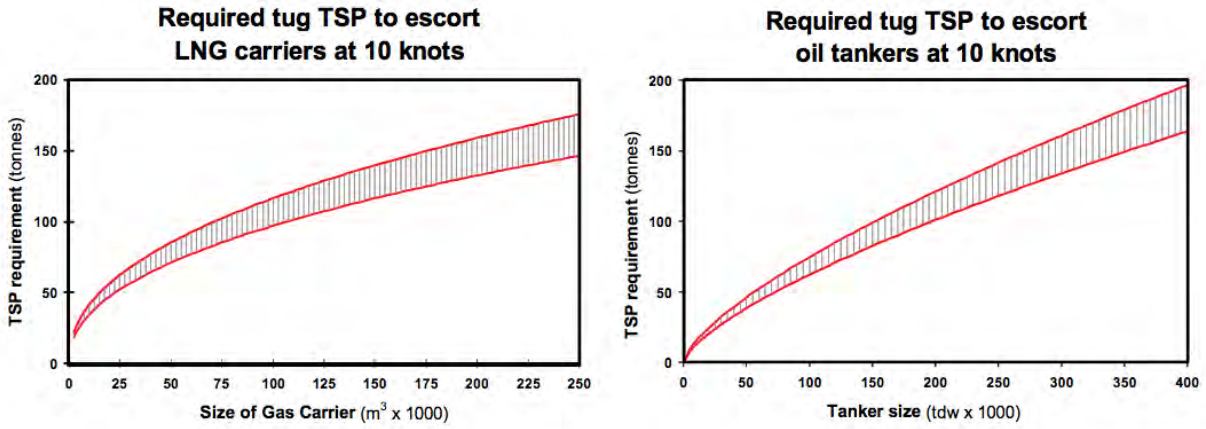

Figure 1: Steering force at 10knots

According to Washington State Department (ref. http://www.pwsrcac.org/docs/d0019800.pdf) the size of the tankers trading in the Trans-Alaska Pipeline System is up to 125.000 dwt. (figure 2).

#	Tanker Name	Operator – top line Owner – bottom line	Date of Build or Scheduled Date of Build	Hull Configuration and Deadweight Tonnage	Conversion Date If Single-Hull or Double-Bottom	Retirement Date
1.	ALASKAN FRONTIER	Alaska Tanker Company, LLC BP Oil Shipping Company, USA	2004	Double Hull 124,999	N/A	N/A
2.	ALASKAN EXPLORER	Alaska Tanker Company, LLC BP Oil Shipping Company, USA	2005	Double Hull 124,999	N/A	N/A
3.	ALASKAN NAVIGATOR	Alaska Tanker Company, LLC BP Oil Shipping Company, USA	2005	Double Hull 124,999	N/A	N/A
4.	ALASKAN LEGEND	Alaska Tanker Company, LLC BP Oil Shipping Company, USA	2006	Double Hull 124,999	N/A	N/A
5.	POLAR ENDEAVOUR	Polar Tankers, Inc. Polar Tankers, Inc.	2001	Double Hull 124,999	N/A	N/A
6.	POLAR RESOLUTION	Polar Tankers, Inc. Polar Tankers, Inc.	2002	Double Hull 124,999	N/A	N/A
7.	POLAR DISCOVERY	Polar Tankers, Inc. Polar Tankers, Inc.	2003	Double Hull 124,999	N/A	N/A
8.	POLAR ADVENTURE	Polar Tankers, Inc. Polar Tankers, Inc.	2004	Double Hull 124,999	N/A	N/A
9.	POLAR ENTERPRISE	Polar Tankers, Inc. Polar Tankers, Inc.	2006	Double Hull 124,999	N/A	N/A
10.	SEARIVER LONG BEACH	SeaRiver Maritime Inc. SeaRiver Maritime Inc.	1987	**Single Hull** 124,999	No conversion planned	01/01/10
11.	KODIAK (ex TONSINA)	SeaRiver Maritime Inc. SeaRiver Maritime Inc.	1978	Double Hull 123,113	N/A	N/A
12.	SIERRA (ex KENAI)	SeaRiver Maritime Inc. SeaRiver Maritime Inc.	1979	Double Hull 123,113	N/A	N/A
13.	SEABULK ARCTIC (ex CAPE LOOKOUT SHOALS)	Seabulk Tankers Inc. Seabulk Tankers Inc.	1998	Double Hull 46,094	N/A	N/A

Figure 2: Tanker fleet calling Valdez Marine Terminal

It is stated in the factsheet (SERVS Tugs in Prince William Sound) provided by PWSRCAC that the EET tugs can deliver steering pull of 110 tonnes (210 at 12 knots). This will make them capable of escorting the largest tankers calling Valdez Marine Terminal according to figure 2. But as commented in chapter 3.2, no documentation of tested steering pull has been received and a full scale test would be required.

Nanuq Tan'erliq	Prince William Sound	Enhanced Tractor Tug (ETT), Voith Schneider, Cycloidal tractor	10,192 Voith Schneider	Twin cat. 3612B	105 direct, 110 indirect, 210 indirect at 12 knots	153	Boom, skimmers, towing, firefighting, dispersant-spraying	Preferred primary tanker escort, oil spill response, docking, firefighting	Yes

Figure 3: Specifications of EET tugs

4 REVIEW OF OIL POLLUTION ACT (OPA90)

According to OPA90 and DNV's interpretation of the requirements, the only requirement related to the escort tugs and this assessment would be Title 33 – Navigation and Navigable Waters, Chapter 40 – Oil Pollution, Subchapter II – Prince William Sound Provisions. Section 2735, Equipment and personnel requirements under tank vessel and facility response plans, states that practice exercises be held not less than 2 times per year in order to test the capacity of the equipment and personnel required and that periodic testing and certification of equipment is required. The requirement of testing would automatically be satisfied by having the vessels enrolled with a class society as the vessel would be a part of a regular inspection program.

The Code of Federal Regulations, Title 33 – Navigation and Navigable Waters, Chapter I – Coast Guard, Department of Homeland Security, Part 168 – Escort Requirements for Certain Tankers has specific requirements for the escort of laden, single hull tankers over 5,000 GT. This tanker type is required to be escorted by at least two escort vessels. The escort vessels must be operated

within their performance capabilities taking into account the speed, sea and weather conditions as well as navigational considerations. Performance and operational requirements are outlined in this chapter as well. The escort vessels must be capable of towing the tanker at 4 knots in calm conditions while holding a position against a 45 knot headwind, holding the tanker on a steady course against a 35 degree locker rudder at 6 knots and turning the tanker 90 degrees assuming a free-swinging rudder and speed of 6 knots. These conditions could be satisfied by utilizing one or more escort vessels in combination depending on capabilities of the escort vessels. These requirements can not be satisfied by considering only the assessment carried out in this report. A separate hydrodynamic study would be useful to establish whether the escort vessels are capable of performing/providing towing and steering assistance to the range of tanker sizes seen in this area with relevant weather/environmental conditions.

5 CONCLUSIONS AND RECOMMENDATIONS

Based on the gap assessment tables presented in Section 3 above, certain critical items/ information have been identified (highlighted in RED) as missing or not meeting the requirements as defined in the Rules. In particular documentation of steering pull tests has not been received and it has therefore not been possible to assess the tugs capabilities in escort service.

A stability assessment in terms of the requirements as per the TUG notation and the ESCORT notation was also carried out for both vessel types.

For the PRT vessel type, the departure condition and one midway condition meet the stability requirements according to the TUG notation. The remaining midway conditions along with the arrival conditions do not meet the requirements and would require adjustments to the conditions in combination with a reduction of the BP. Further assessment/calculations would be required to establish these alterations.

In terms of the ESCORT notation for the PRT vessels, this assessment could not be carried out as information was missing on the heeling moment and escort loading conditions.

For the EET vessel type, the normal departure and ice normal departure conditions meet the stability requirements for the TUG notation. The received documentation lists additional conditions but details were missing and therefore these conditions were not covered in the assessment. The arrival condition was also missing from the documentation and is required to be assessed in order to meet stability requirements.

The normal departure condition meets the ESCORT notation stability requirements however the arrival condition was not provided and is needed in order to fully comply with the requirements.

It is important to note that the ESCORT notation does not indicate whether the vessels are capable of performing/providing towing and steering assistance to the tankers in relevant weather/environmental conditions. A separate hydrodynamic study of the actual forces would be required to be conducted to establish this.

It is important to note that the structural integrity of both vessels was not part of this assessment and is assumed to be in accordance with Class Rules.

If bollard pull tests can be properly documented, steering tests are performed according to above requirements and the winches are modified with local release and level winder, the vessels would qualify for class notation DNV 1A1 TUG ESCORT (n,V) provided that stability requirements are also met. The capacity of the drum brake on the PRT tugs should also be confirmed; i.e. that it is capable of holding the RL at the inner layer.

Therefore, the following recommendations are made:

- Both PRT & EET: Modification to winches with local release and level winder as per the requirements is recommended.
- PRT: Verify that the capacity of the drum brake at the inner layer can hold the RL.
- Both PRT & EET: Full scale Bollard Pull and Steering Pull tests according to the requirements above are recommended for both vessels.
- Both PRT & EET: Evaluation of Bollard Pull and Steering Bull capacity of tugs compared to actual tankers and relevant environmental conditions.
- PRT: Further stability assessments to identify required adjustments to the conditions in combination with a reduction of the BP to comply with TUG notation stability requirements.
- PRT: Further stability assessment of escort loading conditions (not provided in received documentation) to verify compliance with ESCORT notation stability requirements.
- EET: Further stability assessment to verify that the arrival condition complies with requirements for TUG and ESCORT notations

A superficial check against the ABS rule requirements (other than stability requirements) for these vessel types has also been performed. Based on DNV's interpretation of ABS Rules for Steel Vessels Under 90 Meters In Length, 2011, Part 5 – Specialized Vessels and Services, the conclusion as to the assessment performed above would be more or less the same. Notable differences however include:

- Reference Load (RL) is defined with slightly different requirements however this should not have a significant effect on the assessment.
- ABS does not provide the *Escort rating number* (n.V) as DNV does.

6 REFERENCES

/1/ DNV Rules for Classification of Ships, January 2011

/2/ ABS Rules for Steel Vessels Under 90 Meters In Length, Part 5 – Specialized Vessels and Services, 2011

/3/ Oil Pollution Act – www.epa.gov/oem/content/lawsregs/opaover.htm

/4/ Code of Federal Regulations – www.gpoaccess.gov/cfr/index.html

APPENDIX 1

LIST OF REQUESTED ADDITIONAL DOCUMENTATION/INFORMATION

- o0o -

		Documents Requested			Documents Received		
Category	**Vessel Class**	**Information**	**Sent Date**	**Re-sent Date(s)**	**Document Name**	**Comments from Crowley**	**Recieved Date**
Stability	PRT	Stability documentation (righting arm curve etc.) Stability Test Results for M/V Alert" GPA No. 99498-843-02	3/22/2011	5/27/2011	Inclining test results M/V Alert		7/21/2011
Towing winch / hook	PRT & ETT	Braking strength of the towline	3/22/2011		E-mail with comment	**PRT:** Main Line AmSteel Blue, 10 inch circumference (MBS 411.0 MT) with eye to eye splice to an AmSteel Blue 10 inch circumference pendant (MBS 411 MT) **ETT:** Main Line NEUTRON- 8, 11 inch circumference (MBS 538 MT) with eye to eye splice to an AmSteel Blue 10 inch circumference pendant (MBS 411 MT)	4/26/2011
	PRT & ETT	Winch manufacturer's specification and certificates (brakes, quick release information etc.)	3/22/2011	5/27/2011			
	PRT & ETT	Certificates for towing hook, or if no certificates exisit, a work certificate from maker specifying the rating			E-mail with comment	The tugs do not have towing hooks	5/31/2011
	PRT & ETT	Confirmation if level wind device is fitted or if other systems are fitted onboard ensuring the wire to be led to the drum in a controlled manner (information to include max fleet angle)				**PRT**: Not Fitted. Load line under tension during installation and typically deploy/utilize a standard amount of line out on their escorts to eliminate any soft lay turns remaining on the drum. **ETT:** Not Fitted. Load line under tension during installation and typically deploy/utilize a standard amount of line out on their escorts to eliminate any soft lay turns remaining on the drum.	6/3/2011
	PRT & ETT	Documentation or statement confirming "free wheeling" function			E-mail with comment	**PRT:** YES from the WH & Deck local control station, Free Wheel Function over rides all other modes. **ETT:** YES, from WH only. Free Wheel Function over rides all other modes	6/3/2011
Steering tests	PRT & ETT	Braking strength and steering tests	3/22/2011	5/27/2011			
	ETT	Operational criteria (steering force and braking force for different speeds)	3/22/2011	5/27/2011	Document not available	The requested operational criteria (Steering Force and Braking Force for different speeds) for Alert, Attentive and Aware vessels have not been located. I do not believe they were calculated except for the direct BP testing.	

Det Norske Veritas:

Det Norske Veritas (DNV) is a leading, independent provider of services for managing risk with a global presence and a network of 300 offices in 100 different countries. DNV's objective is to safeguard life, property and the environment.

DNV assists its customers in managing risk by providing three categories of service: classification, certification and consultancy. Since establishment as an independent foundation in 1864, DNV has become an internationally recognised provider of technical and managerial consultancy services and one of the world's leading classification societies. This means continuously developing new approaches to health, safety, quality and environmental management, so businesses can run smoothly in a world full of surprises.

Global impact for a safe and sustainable future:

Learn more on www.dnv.com