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SOLICITATION AMENDMENT
MODIFICATION DE L'INVITATION

The referenced document is hereby revised; unless otherwise indicated, all other terms and conditions of the Solicitation remain the same.

Ce document est par la présente révisé; sauf indication contraire, les modalités de l'invitation demeurent les mêmes.

Comments - Commentaires

Vendor/Firm Name and Address
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V6Z 0B9

Title - Sujet EGD South Jetty Reconstruction	
Solicitation No. - N° de l'invitation EZ899-172412/B	**Amendment No. - N° modif.** 006
Client Reference No. - N° de référence du client	**Date** 2017-07-04
GETS Reference No. - N° de référence de SEAG PW-$PWY-026-8060	
File No. - N° de dossier PWY-6-39315 (026)	**CCC No./N° CCC - FMS No./N° VME**
Solicitation Closes - L'invitation prend fin **at - à 02:00 PM** **on - le 2017-07-26**	**Time Zone** **Fuseau horaire** Pacific Daylight Saving Time PDT
F.O.B. - F.A.B. **Plant-Usine:** ☐ **Destination:** ☑ **Other-Autre:** ☐	
Address Enquiries to: - Adresser toutes questions à: Yi (PWY), Patty	**Buyer Id - Id de l'acheteur** pwy026
Telephone No. - N° de téléphone (778) 919-2578 ( )	**FAX No. - N° de FAX** (604) 775-6633
Destination - of Goods, Services, and Construction: **Destination - des biens, services et construction:** PWGSC - South Jetty Reconstruction Esquimalt Graving Dock (EGD), Victoria, BC	

Instructions: See Herein

Instructions: Voir aux présentes

Delivery Required - Livraison exigée	**Delivery Offered - Livraison proposée**
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Name and title of person authorized to sign on behalf of Vendor/Firm (type or print) **Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)** **Signature**	**Date**

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Solicitation No. - N° de l'invitation	Amd. No. - N° de la modif.	Buyer ID - Id de l'acheteur
EZ899-172412/B	006	pwy026
Client Ref. No. - N° de réf. du client	File No. - N° du dossier	CCC No./N° CCC - FMS No./N° VME
	PWY-6-39315	

Amendment No. 006 is raised to incorporate a part of Addendum #1 which was missed in Amendment #005.

ALL OTHER TERMS AND CONDITIONS REMAIN UNCHANGED

Part 1 General

1.1 SCOPE OF WORK

.1 This Section covers the supply and installation of foam-filled Marine Fenders, including all the hardware required to install the fenders.

.2 This Section also covers the supply and installation of DD type extruded rubber rubbing strip "D" shape rubber fenders, including hardware to install the "D" shaped fenders.

1.2 RELATED SECTIONS

.1 Section 01 33 00 (Submittal Procedures)

.2 Section 01 11 55 (General Instructions)

.3 Section 03 39 00 (General Concrete Requirements)

.4 Section 03 41 00 (Precast Structural Concrete)

.5 Section 05 50 00 (Metal Fabrications)

.6 Section 09 97 19 (Painting Exterior Metal Surfaces)

1.3 MEASUREMENT AND PAYMENT

.1 Floating Fenders will be measured per unit incorporated into the work.

.2 Floating Fenders will be paid for at the unit price tendered for FLOATING FENDERS. Payment shall include for all costs to supply and install the complete fender system, including the floating marine fenders, pipe core central axis, bolts/fastenings, anchor bolts, steel brackets, chains, shackles, turnbuckles and all other materials and costs to complete the work as shown on the Drawings, as specified, and to the satisfaction of the Departmental Representative.

.3 Rubbing strip "D" shape rubber fenders will be measured per linear metre of extruded rubber fender incorporated into the work.

.4 Rubbing strip "D" shape rubber fenders will be paid for at the unit price tendered for RUBBING STRIP FENDERS. Payment shall include for all costs to supply and install the complete rubbing strip fender system, including rubber fenders, anchor bolts/fastenings and all other materials and costs to complete the work as shown on the Drawings, as specified, and to the satisfaction of the Departmental Representative.

1.4 REFERENCES

.1 CAN/CSA G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA-S16.1, Limit States Design of Steel Structures.

.3 CAN/CSA-W47.l, Certification of Companies for Fusion Welding of Steel.

.4 CAN/CSA-W48, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 CAN/CSA-W59, Welded Steel Construction.

.6 ASTM A36, Specification for Structural Steel.

.7 ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.8 ASTM A153/Al53M, Specification for Zinc Coating (Hot-dip) on Iron and Steel Hardware.

.9 ASTM A193, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.

.10 ASTM A194, Specification for Carbon and Alloy-Steel Nuts for Bolts for High Pressure and High Temperature Service.

.11 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60000 psi Tensile Strength.

.12 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength.

.13 A413/A413M – Carbon Steel Chains.

.14 D470 – Cross-Linked Insulations and Jackets for Wire and Cable.

.15 Test Method for Tire Cords, Tire Cord Fabrics, and Industrial Filament Yarns Made from Manmade Organic Base Fibers.

.16 ASTM A563, Specification for Carbon and Alloy-Steel Nuts.

.17 ASTM B695, Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

.18 ASTM D256, Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials.

.19 ASTM D395, Test Methods for Rubber Property - Compression Set.

.20 ASTM D412, Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.

.21 ASTM D624, Tear Strength of Conventional Vulcanized Rubber and Thermo Plastic Elastomers.

.22 ASTM D1052, Measuring Rubber Deterioration Method for Cut Growth Using Ross Flexing Apparatus.

.23 ASTM D1053, Test Method for Rubber Property-Stiffening at Low Temperatures: Flexible Polymers and Coated Fabrics.

.24 ASTM D1171, Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber.

.25 ASTM D1630, Rubber Property Abrasion Resistance, Tests for NBS Abrader.

.26 ASTM D1667, Flexible Cellular Materials – Vinyl Chloride Polymers and Co-Polymers (Closed Cell Foam).

.27 ASTM D2137, Test Methods for Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics.

.28 ASTM D2240, Test Method for Rubber Property - Durometer Hardness.

.29 ASTM D3575, Flexible Cellular Materials Made from Olefin Polymers.

.30 SSPC-SP10, Near-White Blast Cleaning.

.31 F2192-02 – Test Method for Determining and Reporting the Berthing Energy and Reaction of Marine Fenders.

.32 PIANC Guidelines for the Design of Fender Systems: 2002

1.5 DEFINITIONS

.1 Definitions are generally listed in Section 01 11 55 (General Instructions). However, definitions specific to marine fenders are listed here:

.1 Floating Fender: Each Floating Fender shall comprise a closed cell polyethylene foam core and an outer skin of reinforced polyurethane elastomer, internal chains and end fittings, support chains, turnbuckles, shackles, and anchor bolts/fastenings to the wharf structure, all as shown on the Drawings.

.2 Berthing Design Energy: The minimum energy to be absorbed by each Floating Fender at rated deflection. For each design vessel, the Berthing Design Energy is the nominal calculated berthing energy plus a 10% allowance for normal manufacturing tolerances, as stipulated in Table 1 in this Section.

.3 Velocity Correction Factor (VCF): A factor to account for the difference between the speed at which fender rating tests were conducted and design berthing velocity. VCF is incorporated by some fender manufacturers into their published energy/reaction curves without any indication as to its inclusion. Other manufacturers do not apply VCF.

1.6 MANUFACTURER QUALIFICATIONS – MARINE FLOATING FENDER

.1 Fender manufacturer shall meet the following minimum requirements.

.1 Experience - Minimum of 10 years' experience manufacturing foam filled fenders of the type specified.

.2 Provide a list of not less than 10 completed projects where a similar fender has been installed for a minimum of 8 years.

.3 Manufacturing - Facility in which the fenders are manufactured shall have the following certifications:

.1 Quality Management System - ISO9001:2008.

.2 Environmental Management System – ISO14001:2004

.3 ABS Type Approval certificate – foam filled marine fenders

1.7 DESIGN CRITERIA FOR FLOATING FENDERS

.1 Each Floating Fender shall be 1,350 mm outside diameter (O.D.), and 2,500 mm long ±4% for diameter and length. Each Floating Fender shall be capable of absorbing the Berthing Design Energy associated with the specified design ships, at rated deflection, at all tidal states. Design parameters for Floating Fenders are given in Table 1.

.2 Each Floating Fender shall exhibit a rated reaction no greater than 425 kN at rated deflection, for a berthing approach angle of zero degrees. No reaction adjustment allowance is required to account for normal manufacturing tolerances.

.3 The use of Velocity Correction Factor (VCF) will not be permitted. Fender approval submittals shall include a statement by the manufacturer that VCF has not been included in fendering selection.

TABLE 1 - DESIGN PARAMETERS FOR FLOATING FENDERS

Parameter	Halifax Class Patrol Frigate (FELEX program)	Protecteur Class Supply Ship (AOR)	Spirit "S" Class (BC Ferry)
Deadweight, DWT	835 tonne	9,462 tonne	2,645 tonne
Displacement,	5,235 tonne (max draft)	26,115 tonne (10,552 tonne light)	11,681 tonne
Length (overall), L	135.5 m	172.5 m	167.5 m
Beam, B	16.4 m (hull face)	23.20 m (hull face)	27.5 m (rubbing strip)
Maximum Draft, D_{MAX}	6.15 m (but 8.45 m to sonar dome)	* 10.3 m (no sonar dome)	5.03 m
Lightship Draft, D_{LT}	4.836 m	7.30 m	4.09 m
Maximum Hull Pressure	25 tonnes/m^2	25 tonnes/m^2	25 tonnes/m^2
Approach Velocity, V_N	0.15 m/sec	0.15 m/sec	0.15 m/sec
Berthing Approach Angle	10 degrees	10 degrees	10 degrees
Point of 1st Berthing Contact	¼ point	¼ point	¼ point
Number of Compression Cycles for Fender Design	Range 10 – 100	Range 10 – 100	Range 10 – 100
Nominal Berthing Energy	5.25 tonne-m	9.86 tonne-m	9.23 tonne-m
Berthing Design Energy (includes 10% allowance for normal manufacturing tolerances)	**5.78 tonne-m**	**10.85 tonne-m**	**10.15 tonne-m**

* Note: At maximum draft the HMCS Protecteur cannot berth at the South Jetty, so lightship condition is used as the fendering design criterion for this vessel.

1.8 SUBMITTALS

.1 At least twenty-eight (28) days before making any Foamed Filled Fenders, submit the following documentation to ensure compliance with technical requirements:

- .1 Evidence that the Foam Filled Fender Manufacturer meets the qualification requirements as outlined in section 1.6.
- .2 Shop Drawings
  - .1 General arrangement drawings.
  - .2 Mounting hardware details, as applicable.
- .3 Product Data
  - .1 Provide copies of manufacturer's catalog data sheets and product information.
  - .2 Dimensions, material specifications, and method of manufacture.
- .4 Design Data
  - .1 Include product engineering data sheets.
  - .2 Performance graphs with energy, reaction, and percent compression curves.
  - .3 Structural details and design calculations for chain system (including calculated chain loads), and fixings;
- .5 Foam fender full scale performance verification test plan outlining the following:
  - .1 Proposed location of test.
  - .2 Test Procedure.
  - .3 Selection of test fenders.
- .6 Manufacturer's Instructions
  - .1 Installation, Operation and Maintenance Instructions
  - .2 Warranty Certificate

.2 Submit the following documentation post production of fenders:

- .1 Performance Test Data.
- .2 Material Certificates
  - .1 Include supplier certificates for foam and all steel hardware.
  - .2 Include manufacturer certificates for urethane skin.
  - .3 Submit certificates of compliance certifying that the fender meets the requirements specified herein.
  - .4 Submit certificates of conformance for surface preparation, coverage, and thickness of galvanized steel hardware.

.3 Submit a satisfactory "type approval" certification in accordance with PIANC Guidelines for the Design of Fender Systems: 2002.

.4 At least twenty-eight (28) days before making any Rubbing Strip "D" shape rubber fenders, submit the following documentation to ensure compliance with technical requirements:

.1 Cross section of fender showing size and spacing of bolt holes.

.2 Test results showing that:

.1 Shore hardness exceeds 78

.2 Compound is Natural Rubber/SBR blend

.3 Density is less than 1.9g/m3

1.9 QUALITY ASSURANCE FOR FLOATING FENDERS

.1 Elastomer Skin: The elastomer skin of the fender shall be generally free from cracks, burrs, warpage, checks, chips, or blistered surfaces, and shall have a smooth surface.

.2 Steel Fabrication: The steel used in fabrication shall be free from kinks, burrs, sharp bends, and other conditions which would be detrimental to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. Make bends by controlled means to ensure uniformity of size and shape.

.3 Foam Core:

.1 The foam core shall be homogeneous fabricated construction and shall not be in chip or granular form. The foam core construction shall utilize only a heat-laminated process, and yield a single solid foam core. The foam core shall not contain scraps, strips, or sheets of foam either rolled or stuffed into the required shape unless pieces are bonded together in layers of uniform patterns to form a homogeneous, one-piece core. Homogeneous foam rings of adequate thickness to ensure performance of the fender is acceptable provided the Contractor could show a minimum 5-year performance of similar fenders.

.2 Tests shall be carried out on every batch of foam delivered, and shall be in accordance with ASTM D3575 or comparable ISO methods.

.3 All foam used shall be traceable to the manufacturer of the foam, by means of production data and lot number, or other positive means. Production/Quality Control records of the fender manufacturer shall record this information for each fender manufactured. The fender manufacturer's records must be able to trace all foam used in each fender back to the manufacturer of the foam, and identify the date the foam was manufactured and tested.

.4 The manufacturer of the foam shall provide certified test reports for each lot of foam delivered, and the fender manufacturer must maintain those records for a period of 10 years. The fender manufacturer shall provide proof that the sufficient quantity of foam was purchased to complete this

Contract. The fender manufacturer shall retain samples from each lot of foam used in the fenders. The samples shall be subject to re-tests at the request of the purchaser of the fenders.

.4 Welding: CSA W47.1: Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

.5 Delivery, Storage, and Handling:

.1 Fenders shall be undamaged when delivered and shall be handled and stored so as to prevent damage such as bending or abrading end fittings or cutting of skin.

.2 Protect fenders from exposure to damaging liquids, oils, and greases.

.6 Rejection:

.1 Fenders that are delivered to the site in a damaged condition or that are not in conformance with this specification are subject to rejection. Any rejected materials shall be removed from site immediately, and replaced with suitable materials, at no additional cost to the Owner.

.7 Warranty:

.1 Furnish the manufacturer's warranty. The warranty shall be issued directly to the customer and shall not be limited in dollar value. The warranty period shall be not less than 1 year from the date of acceptance of the work.

1.10 QUALITY CONTROL CERTIFICATION FOR FLOATING FENDERS

.1 Test Reports: Submit copies of reports of the tests specified herein:

.1 Fender compression test.

.2 Fender cyclic-compression test.

.3 Fender pull-through test.

.4 Skin thickness test.

.5 Fender material and dimensional testing.

.2 Test Sampling:

.1 Performance testing - 10% of the production lot.

.2 Cyclic compression - One of the production lot.

.3 Pull through - One of the production lot.

.4 Skin Thickness - 10% of the production lot.

.5 Material testing: - 100% of the production lot.

.3 Test Procedures: Testing of fenders selected at random from the production lot shall be as follows:

.1 **Fender Compression Test:**

Test 10% of fenders from the production lot. Compress the fender along its diameter between two parallel flat plate surfaces to a compressed dimension of 40 percent of its original diameter. Record load and the corresponding deflection at one-inch increments and plot as a graph of load versus deflection. The load-deflection curve shall then be integrated to generate an energy-deflection curve for the fender. The fender shall meet the energy and force performance requirements of the paragraph entitled "Performance Requirements." After compression of the fender to 40 percent of its original diameter (60 percent compression) the fender shall rebound to 90 percent of its original diameter within two minutes after the load is removed, and to 95 percent of its original diameter within 30 minutes after the load is removed.

Test Procedure:

.1 The test apparatus shall be equipped with a calibrated load cell (or pressure transducer) and linear transducer.

.2 The test apparatus shall be capable of recording and storing load- cell and transducer data of 0.01H-0.05H, where H is the fender's nominal height. Sample details/ calibration details shall be recorded.

.3 10% of the production order quantity of fenders shall be selected at random from the production lot to establish quality control testing.

.4 Before conducting the performance test, stabilise fender temperature at 23+ 5 deg C for at least 24 hours.

.5 Compression speed to be at 2-8mm/s constant velocity.

.6 Compression angle is 0 deg (vertical compression).

.7 Break in the test fender by deflecting one cycle to its rated deflection.

.8 Remove load and allow fender to recover up to one hour.

.9 Test fender performance by deflecting a second cycle to its rated deflection.

.10 Evaluate the recorded data and produce load vs deflection curves for energy and reaction force.

.11 Provide a written test report.

Pass/Fail: The fender shall absorb the specified energy (- 10 %) with a corresponding specified force (+ 10 %). This energy absorption performance shall be achieved prior to the point at which the deflection of the fender exceeds 60 % of its initial diameter. If one fender fails the performance test, an additional 10% of the production lot shall be tested. Failed fenders shall be replaced and retested

.2 **Fender Cyclic-Compression Test:**

Test one fender from the production lot. Compress the fender along its diameter between two parallel flat plate surfaces to a compressed dimension of 40 percent of its original diameter. Release the load and recompress as before. Repeat the compression and release cyclic loadings for a minimum of 10 full cycles of compression. The fender may be rotated 90 degrees after 5 cycles of compression. Both the loading and unloading shall last one (1) minute each. A five-minute interval shall be provided between cycles. Permanent deformation,

cracking, or tearing of the fender skin, fender core, or end fittings shall constitute failure of this test.

.3 **Fender Pull-Through Test:**
Test one fender from the production lot. Devise and perform a test that will measure the resistance of the end fittings and central chain member to pull through the longitudinal axis of the fender. Failure of the central chain member, end fittings or skin to resist the rated safe working end load shall constitute failure of this test. After loading, evidence of permanent deformation, cracking or tearing of the fender or end fittings shall also constitute failure of this test.

.4 **Skin Thickness Test:**
Test 10% of fenders from the production lot. Before delivery of all of the fenders to the construction site, perform a minimum of 2 skin thickness tests per each of test fender to be delivered. Test locations shall be mid-body and at one conical end. Each test shall consist of taking a 0.25 inch diameter (minimum) to 0.5 inch diameter (maximum) core from the fender skin, which can be removed from the skin and examined for thickness of elastomer and placement of reinforcing. Take skin thickness measurements from the core sample and record measurements noting placement of reinforcing. Where the skin thickness measurement is less than the specified minimum by more than 10 percent, reject the fender. In addition, if the average of skin thickness tests for one fender is not equal to or greater than the specified minimum, reject the fender. If the tested fender is rejected the Manufacturer shall then conduct thickness tests for an additional 10% of the production lot fenders. Replace rejected fenders with fenders meeting the provisions of this specification. Test replacement fenders for skin thickness as specified herein. Tests shall be witnessed by a certified, independent inspection agency, such as ABS. The manufacturer shall provide notification at least 10 working days prior to conducting skin thickness tests. After skin thickness testing, patch core holes with elastomer of the same composition and thickness as the specified elastomer skin. Nylon reinforcing is not required in core hole patches.

.5 **Fender Material and Dimensional Testing:**
Material and Dimensional Testing: The manufacturer shall test 100% of the fender order to be delivered. Tests shall be conducted at the factory by the quality control department in accordance with ISO and ABS standards.
Testing shall include:
Skin Thickness: 14mm (-10%)
Fender Diameter: 1,350mm (±4%)
Fender Length: 2,500mm (±4%)

1.11 OPERATING ENVIRONMENT

.1 For design purposes assume that the Floating Fenders and rubbing strip “D” shape rubber fenders will be intermittently exposed to:

.1 Partial and/or complete immersion in seawater;

.2 Wave attack in seawater splash zone; and,

.3 Abrasion under compression and/or shear against vessel hull and concrete wharf.

.2 The normal tidal range at Esquimalt Harbour is indicated on the Drawings. Extreme tidal elevations including surge effects will exceed the indicated tidal range.

.3 The design ambient temperature range is from -5° C minimum to 30° C maximum. Floating Fenders and rubbing strip "D" shape rubber fenders are to provide consistent service within the design ambient temperature range.

Part 2 Products

2.1 CONFIGURATION FOR FLOATING FENDERS

.1 Fenders shall have cylindrical mid-bodies with conical or hemispherical shaped ends terminating in an end fitting on the cylinder's centerline at each end. The diameter of the mid-body shall be 1,350mm minimum. If conical ends are provided, they shall have an angle of 60 to 75 degrees, when measured from the central axis of the fender. The fittings at either end shall be connected through a central bore of the fender by a central chain, and shall terminate in a swivel fitting which allows the end fitting to rotate freely on the axis of the fender. The length of the fender from eye to eye of the end fittings shall be a minimum of 2,500mm. End fitting shall be sized so as not to contact loading surfaces when the fender is compressed to 30 percent of its original diameter (70 percent compression).

.2 Dimensional Tolerance: ±4% for diameter and length.

2.2 MATERIALS FOR FLOATING FENDERS

.1 Foam Core

.1 The standard capacity energy absorbing foam core shall be of heat laminated construction using a resilient closed-cell, cross-linked polyethylene foam with the following properties. Use of chipped or granulated particulate foam is not acceptable. Use of adhesive to bond the foam together is not acceptable. The tests shown below all form a part of ASTM D-3575.

.1 Density: 52.8 to 68.9 kg/m^3

.2 Tensile strength: 0.296 MPa minimum

.3 Elongation: 95% minimum

.4 Water Absorption: less than 0.098 kg/m^2 of cut surface.

.2 Fender Skin

.1 The outer fender skin shall be minimum 14mm thick and constructed of elastomer as specified and filament reinforcing as specified. Separate filament reinforcing wraps shall be applied as specified under Filament Wrap. The filament wraps shall be evenly distributed in the inner 75 % to 90 % of the coating thickness. The outer 10 % to 25 % of elastomer shall have no filament reinforcement. The elastomer and filaments shall be

applied in a continuous manner to assure adhesion between the various layers.

.2 Dimensional Tolerance: -10% for skin thickness.

.3 Elastomer

.1 The elastomer used in the fender skin shall be non-marking and solvent free. It shall be the reaction product solely of toluene diisocyanate, polyether polyol, and an aromatic diamine. The elastomer shall meet the unreinforced properties:

.1 Shore A, Hardness: ASTM D2240, 75 minimum.

.2 Tensile Strength: ASTM D412, 13.8 MPa, minimum.

.3 Elongation (Ultimate): ASTM D412, 300 percent, minimum.

.4 Tear Strength: ASTM D470, 32.4N/mm, minimum.

.5 Flex Life (Ross): ASTM D1052, 250,000 cycles, minimum.

.6 Abrasion Resistance (NBS): ASTM D1630, 100 minimum.

.7 Color: Color shall be grey throughout the skin thickness.

.4 Filament Wrap

.1 Construct each filament-reinforcing wrap of continuous filaments applied in a helical pattern, at a helix angle of 45 to 60 degrees to the longitudinal axis of the buoy. A wrap shall consist of two such filament helixes of equal but opposing helix angles. The spacing between the filaments in the same helix shall be no more than 3mm, measured in a direction parallel to the longitudinal axis of the fender. Each wrap shall extend along the entire longitudinal axis of the fender and shall also encase the fender end fittings and secure them to the fender body.

.5 Filament Reinforcing

.1 The reinforcing filaments in the outer skin shall be nylon tire cord of 2520 denier weight with the following properties:

.2 Breaking Strength: 230 N minimum

.3 Elongation (Ultimate): ASTM D412, 16 percent.

.6 Reinforced Skin

.1 The reinforced skin, when constructed in accordance with this specification, shall exhibit the following properties when tested in accordance with the guidelines below:

.1 Tensile Strength: When a full-thickness specimen is tested in tension, with the direction of pull aligned with the filament direction (in one helix direction), the specimen shall have the following breaking strength: 4,500 psi minimum.

.2 Elongation (Ultimate): In the test for Tensile Strength, the specimen shall have the following elongation at break: 16% minimum.

.3 Tear Strength: When a full-thickness specimen is tested in tear, with the specimen shaped like Die C in ASTM D-624, and with the direction of pull aligned with the filament direction (in one helix direction), the specimen shall have the following tear strength: 450 lb./in).

.7 Hardware

.1 The end fittings of the fender shall be steel and galvanized per ASTM A-123. The end fittings and internal connecting chain shall be designed and sized to transmit the safe working load and accept the shackle size specified.

.8 Fender End Fittings

.1 The fender shall employ a fitting at each end of the fender body located on the central axis of the fender inside the foam core of the fender. The fitting shall include a tubular central member located on the central axis of the fender and a truncated cone-shaped annular seat integral with the central member. The cone-shaped annular seat of each fitting shall cooperate with the axially adjacent conical shaped end of the fender to extend the conical shape of that end to the central member. The fitting shall also have an attachment element including an annular flange affixed to the end of the central member and one or more plates for attaching the end of the fender to a structure by means of a mooring chain or the like.

.2 The elastomeric fender skin shall integrally encase the foam core and the central tubular member and truncated cone-shaped annular seat of each end fitting. The fibers of the filament reinforcing wrap shall also integrally encircle the foam core and the annular seat of each end fitting.

.3 The end fittings at the ends of the fender shall connect to the central chain passing through the center of the fender and the tubular central members so that loads are transferred from the mooring chains to the attachment elements through the central chain. The connection between the end fittings and the central chain shall allow for tensioning or adjustment of the tension in the central chain.

.9 Fender Identification: Emboss, permanently attach or otherwise provide unique identification on each elastomeric fender outer skin as follows:

.1 Each fender shall have the manufacturer's name, and a unique reference identifying nominal size, date of manufacture, and identifier for that specific fender.

.2 Fender identifications shall be located at both ends and in areas where abrasion or other mechanisms will not cause removal. Fender identifications shall be repeated around the perimeter of the fender

sufficient times to enable them to be read from the jetty deck with the fender in any orientation.

.10 Internal Chain and End Fittings: Fittings at either end of the fender body shall be connected through the centre of the fender by a tight chain, and shall terminate in a swivel clevis fitting which allows the end fitting to rotate freely on the axis of the fender. Conform to the following details:

.1 End fittings and internal chain shall be steel, of a heavy duty design, and galvanized per ASTM A123 or A153 as applicable.

.2 Design and size internal connecting chain and fender end fittings so that they will not fail when subjected to three (3) times the safe working load of the weakest component in the fender internal and attachment hardware.

.3 Ensure that each end clevis is of appropriate size for support chain/shackle attachment by others.

.4 Interconnect fender end fittings using cast swivels and tight stud link chain or a comparable linkage, subject to the approval of Departmental Representative.

.5 Arrange internal fender end-fitting linkage so that it will not kink or permanently interlock during abusive fender usage, and so that it will be sufficiently tight to immediately transmit lateral forces without impact.

.6 Design fender end fittings to bear on sufficient fender material so that they will fail before permanently damaging the fender material.

.7 Design fender end zones so that the integrity of the fender will not be damaged by axial forces in the end fittings.

.8 Emboss end fittings and swivels with the name of the manufacturer and a reference mark to enable clear identification of the piece, unless otherwise approved by Departmental Representative.

.11 Fender attaching bolts shall conform to the following:

.1 Bolts, nuts and washers for attaching fenders to the chain system and for attaching the chain system to the precast fender support structure, shall be of size and quantity recommended by fender manufacturer.

.2 Bolts shall conform to ASTM A307, galvanized per ASTM A153 or B695, 316SS per ASTM A193, class 2, grade B8M2.

.3 Washers shall be carbon steel, galvanized per ASTM A153 or B695, 316SS.

.4 Nuts shall conform to ASTM A563, grade A heavy hex galvanized per ASTM A153 or B695, 316SS per ASTM A194, grade 8M heavy hex.

.5 Locking nuts (or cotter pins) shall be provided at all fender attaching bolts.

.12 Chain Assemblies: Chains shall be provided as necessary for proper functioning of the system within the constraints of the Specification. Each chain shall be selected to withstand its maximum design load with a minimum factor of safety (based on breaking) of three (3.0). All chain assembly components shall be

galvanized in accordance with ASTM A123 or A153, as applicable. Shackles, turnbuckles, and other fittings shall be of same grade material and shall have strength comparable to the chain.

.13 Fender Anchors/Concrete Embedments: Concrete embedments (anchor bolts, anchor bolt inserts, sleeves and chain anchors) shall be no closer than 250 mm to an edge of a concrete structure, and designed to resist a pullout of 25 % greater than the breaking strength of the male threads or chains attached to them. Concrete pullout resistance shall be based on concrete compressive strength of 35 MPa.

2.3 Acceptable Products:

.1 SeaGuard Foam Fender

.2 Ocean Guard

.3 Trelleborg

2.4 MATERIALS FOR RUBBER STRIP FENDERS

.1 Rubbing strip fenders shall be 250mm x 250mm DD type “D” shape rubber fenders. The fenders shall be elastomeric marine fenders moulded (or extruded) from rubber, homogeneous and free from any defects, impurities, pores or cracks.

.2 Rubbing strip fenders shall be sized as shown on the Drawings, and shall be capable of absorbing a Berthing Design Energy of at least **8.5 kNm** at 50% deflection.

.3 The rubber from which the rubbing strip fenders are formed shall be natural or synthetic material tested to the requirements of ASTM Standards D2240 (hardness), D412 (tensile strength and elongation), D573 (heat resistance), D395 (compression set), Dl171 (resistance to ozone), D471 (water resistance), D2137 (low temperature resistance), or alternative equivalent national standards.

.1 Shore (A) Durometer hardness: 75 +/- 5 (ASTM D2240).

.2 Tensile strength: 13.8 MPa minimum (ASTM D412).

.3 Elongation: 400 % minimum (ultimate) (ASTM D412).

.4 Fender attaching bolts and backing plates: conforming to Clause 2.1.11 of this Section.

Part 3 Execution

3.1 STEEL FABRICATION

.1 Welding shall only be performed by a fabricator certified by the Canadian Welding Bureau to the requirements of CAN/CSA-W47.1 for Division 1 or 2.

.2 Welding shall be in accordance with CAN/CSA-W59. All welds shall be continuous and watertight. Exposed welds shall be ground smooth and flush with adjacent metal.

.3 Holes shall be drilled and tapped as shown on the approved shop drawings.

3.2 INSTALLATION

.1 Install all components of Floating Fenders in accordance with manufacturer's instructions and as indicated on the Drawings.

.2 Do not make alteration to Floating Fender system components without written permission of Departmental Representative.

.3 Adequate provision shall be made to keep all components of the Floating Fenders plumb and in true alignment during installation.

.4 Prevent damage in storing, handling and installing the Floating Fenders.

.5 Miscellaneous metal fabrications to be embedded in concrete, or grouted, shall be accurately set and held firmly in position while concrete or grout is being placed and cured. Any embedded fabrications that are incorrectly placed or that move during embedment to an extent that will affect their proper operation shall be removed and replaced correctly or shall be corrected by other approved means.

.6 All damage to coatings shall be restored by touch-up to provide an unbroken coating film equal to the original coating.

.7 Floating Fenders shall be installed in accordance with the approved shop drawings and the manufacturer's instructions. Alterations to the Floating Fender components shall not be made without the written permission of Departmental Representative.

END OF SECTION