

Volume 1, Annex D, Appendix 3

Bid Evaluation Plan
System Performance Assessment

Underwater Warfare Suite Upgrade

31 January 2017

ID		Requirement Type	Compliance Demonstration Method	Bidder's Response	Evaluation of Bidder's Response	Compliance (Y/N)
SPD-1	Volume 1, Annex D, Appendix 3 to W8472-135462 Bid Evaluation Plan - System Performance Assessment Dated: 31 January 2017	Heading	N/A			
SPD-2	Volume 1, Annex D, Appendix 3 Bid Evaluation Plan System Performance Assessment Underwater Warfare Suite Upgrade 31 January 2017	Heading	N/A			
SPD-3	1 Objective	Heading	N/A			
SPD-4	1.1 The objective of this portion of the Bid Evaluation is for the Bidder to demonstrate that the performance of their proposed solution will meet minimum requirements for the UWSS in terms of detection ranges.	Information	N/A			
SPD-6	2 Method	Heading	N/A			
SPD-7	2.1 Included with this appendix are eight scenarios against which the Bidder must assess the performance of their proposed system using modelling, defined by Tables 1 through 3 below, and by UWSU_TestCases.zip, Volume 1, Annex D, Appendix 6 of the RFP.	Mandatory	W			
SPD-726	2.2 Each scenario is some combination of environment, target (whether submarine or torpedo) and target depth (whether deep or shallow).	Information	N/A			
SPD-792	2.3 The two targets described in Table 2 each include a required minimum detection range to be demonstrated by the Bidder in each of the scenarios. The minimum detection range is the same for both environments.	Information	N/A			
SPD-184	2.4 The information presented below is unclassified, based on hypothetical environments, targets and scenarios.	Information	N/A			

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SPD-261	2.5 Table 1: Environments							Information	N/A			
	Environment	Water depth	Wind speed	Seabed type	Seabed density ratio	Seabed sound Speed ratio	Seabed loss parameter					
	1	400 m	10 knots	silty-clay	1.1463	0.9765	0.0016					
	2	5400 m	18 knots	silty-clay	1.1463	0.9765	0.0016					

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SPD-185	2.6 Table 2: Targets			Information	N/A			
	Target Parameter	Submarine	Torpedo					
	Speed	5 knots	40 knots					
	Heading	Parallel to ownship	Towards ownship					
	Bearing	90 degrees relative to ownship	90 degrees relative to ownship					
	LF Target Strength	+12 dB at 1 - 3 kHz	-15 dB at 1 - 3 kHz					
	MF Target Strength	+15 dB at 6 - 10 kHz	-15 dB at 6 - 10 kHz					
	Narrowband source tonal level	125 dB at 100 Hz	136 dB at 100 Hz					
	Narrowband tonal frequency resolution	0.1 Hz	1.0 Hz					
	Broadband source spectral level	80 dB	120 dB					
	Broadband source frequency bandwidth	100-200 Hz	100-200 Hz					
	Minimum Detection Range to be demonstrated by the modelling	10 km	6 km					

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SPD-186	2.7 Table 3: Scenarios					Information	N/A			
		Shallow Target		Deep Target						
	Environment	Submarine	Torpedo	Submarine	Torpedo					
	1	Scenario 1.S.s Target Depth = 15 m	Scenario 1.T.s Target Depth = 10 m	Scenario 1.S.d Target Depth = 250 m	Scenario 1.T.d Target Depth = 45 m					
	2	Scenario 2.S.s Target Depth = 15 m	Scenario 2.T.s Target Depth = 10 m	Scenario 2.S.d Target Depth = 250 m	Scenario 2.T.d Target Depth = 45 m					
SPD-549	2.8 The Sound Velocity Profiles versus depth, ambient noise levels versus frequency, absorption coefficients versus frequency, bottom reflection and scattering versus frequency and angle of incidence, and surface reflection and scattering versus frequency and angle of incidence for Environment 1 and 2 are provided in file UWSU_TestCases.zip, Volume 1, Annex D, Appendix 6 of the RFP, and are listed in Table 4.					Information	N/A			
SPD-767	2.9 Table 4: Test Case Details					Information	N/A			
	Environment	Ambient Noise	Bottom Reflection and Scattering	Surface Reflection and Scattering	Sound Velocity Profile					
	1	AmbientNoise_Shallow.csv	Boundary_Shallow_BotRef.csv Boundary_Shallow_BotScat.csv	Boundary_Shallow_SurfRef.csv Boundary_Shallow_SurfScat.csv	SSP_Shallow.csv					
	2	AmbientNoise_Deep.csv	Boundary_Deep_BotRef.csv Boundary_Deep_BotScat.csv	Boundary_Deep_SurfRef.csv Boundary_Deep_SurfScat.csv	SSP_Deep.csv					

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SPD-106	2.10 While the seabed sediment properties and surface sea-state conditions are included for completeness, Bidders must use the effects of sea-surface and seabed reflection loss and backscatter strength as a function of grazing angle and frequency that are provided for each scenario.	Mandatory	A			
SPD-115	2.11 Volumetric scattering (e.g. due to fish) may be ignored.	Information	N/A			
SPD-178	2.12 In order to respond to this section of the Bid Evaluation, Bidders must model the results that their proposed systems will achieve against each of the scenarios.	Mandatory	A			
SPD-107	2.13 The Bidder may use the modelling tools of their choice, provided they meet minimum criteria described later in this Appendix.	Information	N/A			
SPD-108	2.14 The Bidder must provide to Canada sufficient information such that Canada may re-create and verify the results demonstrated by the Bidder's modelling.	Mandatory	A			
SPD-122	2.15 The following assumptions, constraints and requirements apply to all of the scenarios presented:	Introductory Text	N/A			
SPD-92	2.15.1 All scenarios are based on a single-ship deployer scenario.	Information	N/A			
SPD-75	2.15.2 All scenarios assume sonobuoys are not deployed, and there is no support from maritime air assets.	Information	N/A			
SPD-26	2.15.3 The surface sea-state and ambient noise spectral level are assumed to be parameterized by a wind speed at 10 m height. This assumes fully-developed, wind-driven sea conditions.	Information	N/A			
SPD-180	2.15.4 The effects of rainfall on ambient noise may be ignored.	Information	N/A			
SPD-121	2.15.5 Seawater properties (e.g. acoustic absorption) must be calculated assuming a salinity of 34 ppt.	Mandatory	A			
SPD-126	2.15.6 The target echo strength provided in each scenario can be assumed to be independent of incidence angle.	Information	N/A			
SPD-124	2.15.7 The Bidder may vary the ship speed in the scenario in order to achieve realistic towed sensor depths.	Information	N/A			
SPD-176	2.15.8 The Bidder's modelling of the scenario must be constrained to an ownship speed in the range 5 to 15 knots.	Mandatory	A			

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SPD-764	2.15.9 The Bidder must model each scenario as if the ship is in a 360 degree azimuthal search mode.	Mandatory	A			
SPD-125	2.15.10 The Bidder must include estimates of ship-radiated noise interference at the Bidders' specified ownship speed with the sonar performance estimates.	Mandatory	A			
SPD-177	2.15.11 Ownship radiated noise can be assumed to radiate from the propeller location, and the received noise level may be corrected for sensor to propeller distance using a spherical spreading assumption.	Information	N/A			
SPD-179	2.15.12 When interpolating between data points versus depth in the provided sound speed profiles, the Bidder must use linear interpolation.	Mandatory	A			
SPD-109	2.16 The Bidder's modelling of the performance must only use the UWSS HMS or TAPS USCs or combinations thereof as contained in the bid as proposed solutions to meet the SRD requirements.	Mandatory	D			
SPD-110	2.17 The Bidder's modelling of the performance of their proposed solution must not employ sonobuoys, maritime air assets, or TORSIC as part of their response, as these are outside the scope of this part of the evaluation.	Mandatory	A			
SPD-103	2.18 Signal Excess (SE) is defined as the difference in decibels between target signal/echo received Sound Pressure Level and the sum of total noise and reverberation levels minus a Detection Threshold determined by signal processing considerations. This must be based on the use of a Detection Threshold calculated using Swerling II statistical models with Probability of Detection (P_d) = 50% and a Probability of False Alarm (P_{fa}) = 0.01%.	Information	N/A			
SPD-102	2.19 Detection Range is defined as that range where the SE drops permanently below 0 dB. Drop-outs in SE less than 0.5 km in range extent may be ignored.	Information	N/A			
SPD-105	2.20 The Detection Threshold must include processing gain, array gain, and quantitative HMI recognition differentials. This is only applicable outside of short-range (i.e. < 0.5 km) vertical beam-pattern effects.	Mandatory	A			

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SPD-173	2.21 For the calculation of Detection Threshold in passive detection cases, Bidders must not exceed the following upper limits on the integration time:	Mandatory	A			
SPD-174	(a) 60 s for submarine targets; and	Mandatory	A			
SPD-175	(b) 10 s for torpedo targets.	Mandatory	A			
SPD-36	3 Bidders' Responses	Heading	N/A			
SPD-32	3.1 The underwater acoustic modelling tool utilized in this work by the Bidder must model accurately internal refraction, seawater and bubble absorption, and seabed and sea-surface reflection and reverberation.	Mandatory	D or S			
SPD-112	3.2 The model must predict utilizing arbitrary input sound speed versus depth profiles.	Mandatory	D or S			
SPD-113	3.3 The model must include frequency-dependent bubble extinction losses near the sea-surface.	Mandatory	D or S			
SPD-114	3.4 The model must utilize externally generated predicted reflection and scattering models versus grazing angle for a variety of seabed types.	Mandatory	D or S			
SPD-111	3.5 As part of their response, the Bidder must provide a full and detailed description of the tools used to perform the modelling of the scenarios, including at a minimum the following information:	Mandatory	W			
SPD-116	(a) the general acoustic modeling approach (e.g. ray-tracing, Parabolic equation);	Mandatory	D			
SPD-117	(b) a history of the model's development, verification, and validation;	Mandatory	D			
SPD-120	(c) a description of the seawater absorption model;	Mandatory	D			
SPD-181	(d) a description of the bubble extinction model; and	Mandatory	D			
SPD-182	(e) a description of the ambient noise model.	Mandatory	D			
SPD-166	3.6 The Bidder's tools description required at paragraph 3.5 will be rated and the rating will be recorded in tab 'R7 System Performance' in the Point Rated Requirements Evaluation Worksheet, Volume 1 Annex D Appendix 2, Index R7.1.	Information	N/A			
SPD-37	3.7 The results of the Bidder's modelling of the performance of their proposed solution against each of the eight provided scenarios must be included with the bid.	Mandatory	W			

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SPD-84	3.8 As part of their response, the Bidder must provide a full and detailed description of the derivation and substantiation of recognition differential and processing gains used in the modelling.	Mandatory	W			
SPD-167	3.9 The Bidder's derivation and substantiation of recognition differential and processing gains required at paragraph 3.8 will be rated and the rating will be recorded in tab 'R7 System Performance' in the Point Rated Requirements Evaluation Worksheet, Volume 1 Annex D Appendix 2, Index R7.2.	Information	N/A			
SPD-765	3.10 As part of their response, the Bidder must provide a full and detailed explanation of the impact of active contact update rates while in full 360 degree azimuthal search mode, and the ability of the modelled system to detect and maintain contact with new targets, for both HMS and TAPS USCs.	Mandatory	W			
SPD-766	3.11 The Bidder's explanation of the impact of update rates required at paragraph 3.10 will be rated and the rating will be recorded in tab 'R7 System Performance' in the Point Rated Requirements Evaluation Worksheet, Volume 1 Annex D Appendix 2, Index R7.3.	Information	N/A			
SPD-38	3.12 The Bidder's modelling of the performance must only use the UWSS HMS or TAPS USCs or combinations thereof as contained in the bid as proposed solutions to meet the SRD requirements.	Mandatory	A			
SPD-87	3.13 The Bidder may model each scenario using the HMS and TAPS USCs, singly or in combination, including in an ownship bistatic mode, in order to maximize the detection range results.	Information	N/A			
SPD-34	3.14 For modeling purposes, the Bidder may place the towed sensors anywhere in order to maximize the detection range results.	Information	N/A			
SPD-127	3.15 The chosen depth for towed sensors must be within their normal operating depth limits, as applicable to the solution being proposed by the Bidder in response to the SRD.	Mandatory	A			
SPD-76	3.16 In all scenarios, the depth chosen by the Bidder for towed sensors must be greater than 10 meters above the seabed.	Mandatory	A			
SPD-88	3.17 Ownship bistatic modes must only be used in modelling the scenarios if such a capability has been offered in the bid.	Mandatory	A			

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SPD-73	3.18 The Bidder may choose details of the sensor deployment in order to maximize the Detection Range for each scenario modelled.	Information	N/A			
SPD-82	3.19 The depth of the HMS USC is given as 6 meters.	Information	N/A			
SPD-57	3.20 Modelling of the SPS USC and TORSIC USC will not be included in the assessment.	Information	N/A			
SPD-171	3.21 Modelling of Mine Avoidance capabilities will not be included in the assessment.	Information	N/A			
SPD-40	3.22 For each of the eight scenarios provided in Table 3, the Bidder must provide a detailed discussion of the scenario and the Bidder's approach to modelling of the scenario in terms of the employed USCs.	Mandatory	W			
SPD-135	3.23 For each of the eight scenarios provided in Table 3, the Bidder must provide the Detection Range predicted by the Bidder's model (km) in Table 5 below.	Mandatory	W			
SPD-133	3.24 For each of the eight scenarios provided in Table 3, the Bidder must specify which USC or combination of USCs that achieved the predicted Detection Range.	Mandatory	W			
SPD-41	3.25 For each of the eight scenarios provided in Table 3, the Bidder must provide the following parameters of the USCs employed in the modelling, as applicable for active detection:	Mandatory	W			
SPD-43	(a) Frequency (Hz);	Mandatory	W			
SPD-44	(b) Bandwidth (Hz);	Mandatory	W			
SPD-45	(c) Pulse length (s);	Mandatory	W			
SPD-46	(d) Mute time (s);	Mandatory	W			
SPD-47	(e) Description of Pulse type;	Mandatory	W			
SPD-48	(f) Transmission Source Level (dB re 1 mPa @ 1m);	Mandatory	W			
SPD-49	(g) Beam patterns for the active transmit at the employed frequency;	Mandatory	W			
SPD-50	(h) Beam patterns for the active receive at the employed frequency;	Mandatory	W			
SPD-129	(i) Chosen ownship speed (knots);	Mandatory	W			
SPD-51	(j) Predicted self-noise and flow noise of the active receive array over the employed active frequencies at the chosen ownship speed (dB re $\mu\text{Pa}^2/\text{Hz}$);	Mandatory	W			

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SPD-128	(k) number of elements, inter-element spacing (m), and individual sensor beam-patterns for the active receive array;	Mandatory	W			
SPD-52	(l) Directivity Index (dB);	Mandatory	W			
SPD-53	(m) Array gain on active receive (dB);	Mandatory	W			
SPD-54	(n) Port and Starboard discrimination levels on active receive (dB);	Mandatory	W			
SPD-55	(o) Depth of transducer, active transmit;	Mandatory	W			
SPD-56	(p) Depth of sensor, active receive;	Mandatory	W			
SPD-85	(q) Distance of towed sensor behind ownship, active transmit;	Mandatory	W			
SPD-86	(r) Distance of towed sensor behind ownship, active receive; and	Mandatory	W			
SPD-130	(s) Assumed processing algorithm and detection threshold, including specifics of processing gain, array gain, and quantitative HMI recognition differentials.	Mandatory	W			
SPD-58	3.26 For each of the eight scenarios provided in Table 3, the Bidder must provide the following parameters of the USCs employed in the modelling, as applicable for passive detection:	Mandatory	W			
SPD-59	(a) Operating Frequency Range (Hz);	Mandatory	W			
SPD-60	(b) Processing bandwidth (Hz);	Mandatory	W			
SPD-61	(c) Beam Patterns for the passive frequencies employed for detection in the scenario;	Mandatory	W			
SPD-67	(d) Predicted self noise and flow noise of the passive receive array over the active operating frequencies at the designated ownship speed (dB re $\mu\text{Pa}^2/\text{Hz}$);	Mandatory	W			
SPD-131	(e) the number of elements and inter-element spacing (m) for the passive receive array;	Mandatory	W			
SPD-68	(f) Directivity Index (dB);	Mandatory	W			
SPD-69	(g) Array gain on passive receive (dB);	Mandatory	W			

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SPD-72	(h) Depth of sensor, passive receive; and	Mandatory	W			
SPD-132	(i) Assumed processing algorithm and detection threshold, including specifics of processing gain, array gain, and quantitative HMI recognition differentials.	Mandatory	W			
SPD-77	3.27 For each of the eight scenarios provided in Table 3, the Bidder must provide a Transmission Loss (dB) plot versus range for the applicable target depth and the proposed sensor depths, in both graphical and tabular (comma separated variable) format.	Mandatory	W			
SPD-134	3.28 For each of the eight scenarios provided in Table 3, the Bidder must provide a Signal Excess (dB) plot versus range for the applicable target depth and the proposed sensor depths, in both graphical and tabular (comma separated variable) format.	Mandatory	W			
SPD-81	3.29 For each of the eight scenarios provided in Table 3, for active sonar USCs, the Bidder must provide the seabed, sea-surface and total reverberation versus time or range after transmit for the Bidder's chosen sensor placement, in both graphical and tabular (comma separated variable) format.	Mandatory	W			

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SPD-740	3.30 Table 5: Modelling Results		Mandatory	W		
		Shallow Target				
	Environment	Submarine				
	Torpedo	Submarine				
	1	Scenario 1.S.s Detection Range = km	Scenario 1.T.s Detection Range = km	Scenario 1.S.d Detection Range = km	Scenario 1.T.d Detection Range = km	
	2	Scenario 2.S.s Detection Range = km	Scenario 2.T.s Detection Range = km	Scenario 2.S.d Detection Range = km	Scenario 2.T.d Detection Range = km	
SPD-738	3.31 For each of the scenarios 1.S.s, 1.S.d, 2.S.s and 2.S.d defined in tables 1 through 4, the Bidder's modelling must demonstrate that the minimum detection range defined in Table 2 has been achieved.		Mandatory	D		
SPD-739	3.32 For each of the scenarios 1.T.s, 1.T.d, 2.T.s and 2.T.d provided in Table 3, the Bidder's modelling must demonstrate that the minimum detection range defined in Table 2 above has been achieved.		Mandatory	D		
SPD-98	4 Evaluation of Results		Heading	N/A		
SPD-28	4.1 The Bidder must self-assess their responses to the rated items that form this part of the Bid Evaluation, specifically Indices R7.1 and R7.3 in tab 'R7 System Performance' in the Point Rated Requirements Evaluation Worksheet, Volume 1 Annex D Appendix 2.		Mandatory	W		

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SPD-159	4.2 The results of the System Performance Assessment will be entered by Evaluators into Table 3 of the Bid Evaluation Plan, Volume 1 Annex D.	Information	N/A			
SPD-163	4.3 Using the information provided by the Bidder, Canada may conduct its own modelling of the scenarios in order to provide independent verification of the Bidder's results.	Information	N/A			
SPD-170	4.4 Canada reserves the right to choose to conduct independent verification of all of the submitted Bidder's results.	Information	N/A			