



RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:
Bid Receiving Public Works and Government
Services Canada/Réception des soumissions
Travaux publics et Services gouvernementaux
Canada
1713 Bedford Row
Halifax, N.S./Halifax, (N.É.)
B3J 1T3
Bid Fax: (902) 496-5016

REQUEST FOR PROPOSAL DEMANDE DE PROPOSITION

Proposal To: Public Works and Government
Services Canada

We hereby offer to sell to Her Majesty the Queen in right of Canada, in accordance with the terms and conditions set out herein, referred to herein or attached hereto, the goods, services, and construction listed herein and on any attached sheets at the price(s) set out therefor.

Proposition aux: Travaux Publics et Services
Gouvernementaux Canada

Nous offrons par la présente de vendre à Sa Majesté la Reine du chef du Canada, aux conditions énoncées ou incluses par référence dans la présente et aux annexes ci-jointes, les biens, services et construction énumérés ici sur toute feuille ci-annexée, au(x) prix indiqué(s).

Comments - Commentaires

Vendor/Firm Name and Address
Raison sociale et adresse du
fournisseur/de l'entrepreneur

Issuing Office - Bureau de distribution

Atlantic Region Acquisitions/Région de l'Atlantique
Acquisitions
1713 Bedford Row
Halifax, N.S./Halifax, (N.É.)
B3J 3C9
Nova Scot

Title - Sujet PATS Software Modifications	
Solicitation No. - N° de l'invitation W7707-165840/A	Date 2015-12-16
Client Reference No. - N° de référence du client W7707-16-5840	
GETS Reference No. - N° de référence de SEAG PW-\$HAL-208-9713	
File No. - N° de dossier HAL-5-75106 (208)	CCC No./N° CCC - FMS No./N° VME
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2016-01-08	Time Zone Fuseau horaire Atlantic Standard Time AST
F.O.B. - F.A.B. Plant-Usine: <input type="checkbox"/> Destination: <input checked="" type="checkbox"/> Other-Autre: <input type="checkbox"/>	
Address Enquiries to: - Adresser toutes questions à: LeBlanc, JoAnne	Buyer Id - Id de l'acheteur hal208
Telephone No. - N° de téléphone (902) 496-5010 ()	FAX No. - N° de FAX (902) 496-5016
Destination - of Goods, Services, and Construction: Destination - des biens, services et construction: DEPARTMENT OF NATIONAL DEFENCE DRDC ATLANTIC 9 GROVE STREET DARTMOUTH NOVA SCOTIA B3A3C5 Canada	

Instructions: See Herein

Instructions: Voir aux présentes

Delivery Required - Livraison exigée See Herein	Delivery Offered - Livraison proposée
Vendor/Firm Name and Address Raison sociale et adresse du fournisseur/de l'entrepreneur	
Telephone No. - N° de téléphone Facsimile No. - N° de télécopieur	
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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TITLE: PERFORMANCE ASSESSMENT FOR TACTICAL SYSTEM (PATS) SOFTWARE MODIFICATIONS

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PART 1 - GENERAL INFORMATION

1.1 Introduction

The bid solicitation document is divided into six parts plus attachments and annexes as follows:

- Part 1 General Information: provides a general description of the requirement;
- Part 2 Bidder Instructions: provides the instructions, clauses and conditions applicable to the bid solicitation;
- Part 3 Bid Preparation Instructions: provides bidders with instructions on how to prepare their bid;
- Part 4 Evaluation Procedures and Basis of Selection: indicates how the evaluation will be conducted, the evaluation criteria that must be addressed in the bid, and the basis of selection;
- Part 5 Certifications: includes the certifications to be provided;
- Part 6 Resulting Contract Clauses: includes the clauses and conditions that will apply to any resulting contract.

The Annexes include the Statement of Requirement, the Basis of Payment, and other annexes.

1.2 Summary

Defence Research & Development Canada - Atlantic (DRDC) has a requirement for a service contract to restructure program directories and input files, improve existing calculations of sonar performance metrics, implement calculations of additional sonar performance metrics, and add a new acoustic propagation model, as well as to improve error handling and programming style where appropriate. Background: The Performance Assessment for Tactical Systems (PATS) software tool was developed to provide a means of assessing multistatic sonar performance. The tool allows a user to specify a model environment and sonar system configurations, and the potential performance of the multistatic sonar system is characterized by combining acoustic propagation model results with statistical analysis. The software is primarily written in Matlab. The output of a separate acoustic model is read into Matlab and the results are used in conjunction with the sonar equation to allow for calculation of sonar system performance based on the estimated signal excess at each model grid point.

The period for this contract will be from date of contract award to March 31, 2016, with an unfunded option for an additional year. See below for details.

There is a maximum of \$40,000.00 (taxes excluded) available for the work in the 2015-2016 fiscal year. The contractor will complete as much work as possible within the financial limitations during the 2015-2016 fiscal year. Tasks will be prioritized in consultation with the Technical Authority.

If there are unfinished tasks and additional funding is made available for the 2016-2017 fiscal year, the contract may be extended for a maximum of an additional \$40,000.00.

The requirement is subject to a preference for Canadian goods and/or services.

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1.3 Debriefs

Bidders may request a debriefing on the results of the bid solicitation process. Bidders should make the request to the Contracting Authority within 15 working days from receipt of the results of the bid solicitation process. The debriefing may be in writing, by telephone or in person.

PART 2 - BIDDER INSTRUCTIONS

2.1 Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the *Standard Acquisition Clauses and Conditions Manual* (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

Bidders who submit a bid agree to be bound by the instructions, clauses and conditions of the bid solicitation and accept the clauses and conditions of the resulting contract.

The 2003 (2015-07-03) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

Subsection 5.4 of [2003](#), Standard Instructions - Goods or Services - Competitive Requirements, is amended as follows:

Delete: 60 days
Insert: 90 days

2.2 Submission of Bids

Bids must be submitted only to Public Works and Government Services Canada (PWGSC) Bid Receiving Unit by the date, time and place indicated on page 1 of the bid solicitation.

2.3 Former Public Servant (to be completed by Supplier)

Contracts awarded to former public servants (FPS) in receipt of a pension or of a lump sum payment must bear the closest public scrutiny, and reflect fairness in the spending of public funds. In order to comply with Treasury Board policies and directives on contracts awarded to FPS, bidders must provide the information required below before contract award. If the answer to the questions and, as applicable the information required have not been received by the time the evaluation of bids is completed, Canada will inform the Bidder of a time frame within which to provide the information. Failure to comply with Canada's request and meet the requirement within the prescribed time frame will render the bid non-responsive.

Definitions

For the purposes of this clause,

"former public servant" is any former member of a department as defined in the *Financial Administration Act*, R.S., 1985, c.. F-11, a former member of the Canadian Armed Forces or a former member of the Royal Canadian Mounted Police. A former public servant may be:

- a. an individual;

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- b. an individual who has incorporated;
- c. a partnership made of former public servants; or
- d. a sole proprietorship or entity where the affected individual has a controlling or major interest in the entity.

"lump sum payment period" means the period measured in weeks of salary, for which payment has been made to facilitate the transition to retirement or to other employment as a result of the implementation of various programs to reduce the size of the Public Service. The lump sum payment period does not include the period of severance pay, which is measured in a like manner.

"pension" means a pension or annual allowance paid under the Public Service Superannuation Act (PSSA), R.S., 1985, c. P-36, and any increases paid pursuant to the Supplementary Retirement Benefits Act, R.S., 1985, c. S-24 as it affects the PSSA. It does not include pensions payable pursuant to the Canadian Forces Superannuation Act, R.S., 1985, c. C-17, the Defence Services Pension Continuation Act, 1970, c. D-3, the Royal Canadian Mounted Police Pension Continuation Act, 1970, c. R-10, and the Royal Canadian Mounted Police Superannuation Act, R.S., 1985, c. R-11, the Members of Parliament Retiring Allowances Act, R.S., 1985, c. M-5, and that portion of pension payable to the Canada Pension Plan Act, R.S., 1985, c. C-8.

Former Public Servant in Receipt of a Pension

As per the above definitions, is the Bidder a FPS in receipt of a pension? **Yes** () **No** ()

If so, the Bidder must provide the following information, for all FPS in receipt of a pension, as applicable:

- a. name of former public servant;
- b. date of termination of employment or retirement from the Public Service.

By providing this information, Bidders agree that the successful Bidder's status, with respect to being a former public servant in receipt of a pension, will be reported on departmental websites as part of the published proactive disclosure reports in accordance with Contracting Policy Notice: 2012-2 and the Guidelines on the Proactive Disclosure of Contracts.

Work Force Adjustment Directive

Is the Bidder a FPS who received a lump sum payment pursuant to the terms of the Work Force Adjustment Directive? **Yes** () **No** ()

If so, the Bidder must provide the following information:

- a. name of former public servant;
- b. conditions of the lump sum payment incentive;
- c. date of termination of employment;
- d. amount of lump sum payment;
- e. rate of pay on which lump sum payment is based;
- f. period of lump sum payment including start date, end date and number of weeks;
- g. number and amount (professional fees) of other contracts subject to the restrictions of a work force adjustment program.

For all contracts awarded during the lump sum payment period, the total amount of fees that may be paid to a FPS who received a lump sum payment is \$5,000, including Applicable Taxes.

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2.4 Communications - Solicitation Period

All enquiries must be submitted to the Contracting Authority no later than six (6) calendar days before the bid closing date. Enquiries received after that time may not be answered.

Bidders should reference as accurately as possible the numbered item of the bid solicitation to which the enquiry relates. Care should be taken by bidders to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a "proprietary" nature must be clearly marked "proprietary" at each relevant item. Items identified as proprietary will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the question(s) or may request that the Bidder do so, so that the proprietary nature of the question(s) is eliminated and the enquiry can be answered to all bidders. Enquiries not submitted in a form that can be distributed to all bidders may not be answered by Canada.

2.5 Applicable Laws

Any resulting contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in Nova Scotia.

Bidders may, at their discretion, substitute the applicable laws of a Canadian province or territory of their choice without affecting the validity of their bid, by deleting the name of the Canadian province or territory specified and inserting the name of the Canadian province or territory of their choice. If no change is made, it acknowledges that the applicable laws specified are acceptable to the bidders.

2.6 Basis for Canada's Ownership of Intellectual Property

The department of Defence Research & Development Canada – Atlantic has determined that any intellectual property rights arising from the performance of the Work under the resulting contract will belong to Canada, on the following grounds:

the main purpose of the contract, or of the deliverables contracted for, is to augment an existing body of Canada's background information as a prerequisite to the transfer of the augmented background to the private sector, through licensing or assignment of ownership (not necessarily to the original contractor), for the purposes of commercial exploitation.

2.7 Maximum Funding

The maximum funding available for the contract resulting from the bid solicitation is **\$80,000.00**, plus Applicable Taxes extra, as appropriate. This amount includes an "unfunded Option to extend" the contract in the amount of \$40,000.00 for an additional year (April 1, 2016 to March 31, 2017). *This maximum available funding noted above includes the unfunded option to extend the contract for one year.* Bids valued in excess of this amount will be considered non-responsive. This disclosure does not commit Canada to pay the maximum funding available.

PART 3 - BID PREPARATION INSTRUCTIONS

3.1 Bid Preparation Instructions

Canada requests that bidders provide their bid in separately bound sections as follows:

Section I: Technical Bid (2 copies)
Section II: Financial Bid (1 copy)

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Section III: Certifications (1 copy)

Prices must appear in the financial bid only. No prices must be indicated in any other section of the bid. Canada requests that bidders follow the format instructions described below in the preparation of their bid:

- (a) use 8.5 x 11 inch (216 mm x 279 mm) paper; and
- (b) use a numbering system that corresponds to the bid solicitation.

In April 2006, Canada issued a policy directing federal departments and agencies to take the necessary steps to incorporate environmental considerations into the procurement process Policy on Green Procurement (<http://www.tpsgc-pwgsc.gc.ca/ecologisation-greening/achats-procurement/politique-policy-eng.html>). To assist Canada in reaching its objectives, bidders should:

- (1) use paper containing fibre certified as originating from a sustainably-managed forest and containing minimum 30% recycled content; and
- (2) use an environmentally-preferable format including black and white printing instead of colour printing, print double sided/duplex, using staples or clips instead of cerlox, duotangs or binders.

Section I: Technical Bid

In their technical bid, bidders should demonstrate their understanding of the requirements contained in the bid solicitation and explain how they will meet these requirements. Bidders should demonstrate their capability and describe their approach in a thorough, concise and clear manner for carrying out the work.

The technical bid should clearly address and in sufficient depth the points that are subject to the evaluation criteria against which the bid will be evaluated. Simply repeating the statement contained in the bid solicitation is not sufficient. In order to facilitate the evaluation of the bid, Canada requests that bidders address and present topics in the order of the evaluation criteria under the same headings. To avoid duplication, bidders may refer to different sections of their bids by identifying the specific paragraph and page number where the subject topic has already been addressed.

Section II: Financial Bid

Bidders must submit their financial bid in accordance with the following:

Price Breakdown

- (a) Labour: For each individual and (or) labour category to be assigned to the Work, indicate: i) the hourly rate, inclusive of overhead and profit; and ii) the estimated number of hours.
- (b) Equipment: Specify each item required to complete the Work and provide the pricing basis of each one, Canadian customs duty and excise taxes included, as applicable. These items will be deliverable to Canada upon completion of the contract.
- (c) Materials and Supplies: Identify each category of materials and supplies required to complete the Work and provide the pricing basis.
- (d) Travel and Living Expenses (if applicable): Indicate the number of trips and the number of days for each trip, the cost, destination and purpose of each journey, together with the basis of these

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costs which must not exceed the limits of the Treasury Board (TB) Travel Directive. With respect to the TB Directive, only the meal, private vehicle and incidental allowances specified in Appendices B, C and D of the Directive <http://www.njc-cnm.gc.ca/directive/travel-voyage/index-eng.php>, and the other provisions of the Directive referring to "travellers", rather than those referring to "employees", are applicable. The Treasury Board Secretariat's Special Travel Authorities, http://www.tbs-sct.gc.ca/pubs_pol/hrpubs/tbm_113/statb-eng.asp, also apply.

- (e) Subcontracts: Identify any proposed subcontractor and provide for each one the same price breakdown information as contained in this article.
- (f) Other Direct Charges: Identify any other direct charges anticipated, such as long distance communications and rentals, and provide the pricing basis.
- (g) Applicable Taxes: Identify any Applicable Taxes separately.

Section III: Certifications

Bidders must submit the certifications required under Part 5.

PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

4.1 Evaluation Procedures

- (a) Bids will be assessed in accordance with the entire requirement of the bid solicitation including the technical evaluation criteria.
- (b) An evaluation team composed of representatives of Canada will evaluate the bids.
- (c) The evaluation team will determine first if there are two (2) or more bids with a valid Canadian Content certification. In that event, the evaluation process will be limited to the bids with the certification; otherwise, all bids will be evaluated. If some of the bids with a valid certification are declared non-responsive, or are withdrawn, and less than two (2) responsive bids with a valid certification remain, the evaluation will continue among those bids with a valid certification. If all bids with a valid certification are subsequently declared non-responsive, or are withdrawn, then all the other bids received will be evaluated.

4.1.1 Technical Evaluation

4.1.1.1 Mandatory and Point Rated Technical Evaluation

Refer to Annex D, Mandatory and Point Rated Technical Evaluation Criteria.

4.1.1.2 Evaluation of Price

The price of the bid will be evaluated in Canadian dollars, Applicable Taxes excluded, Canadian customs duties and excise taxes included.

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4.2 Basis of Selection

4.2.1 Basis of Selection - Highest Rated Within Budget

To be declared responsive, a bid must:

- (a) comply with all the requirements of the bid solicitation;
- (b) meet all mandatory technical evaluation criteria;
- (c) obtain the required minimum points for each criterion and each group of criteria with a pass mark;
and
- (d) obtain the required minimum points overall for the technical evaluation criteria which are subject to point rating.

Bids not meeting (a) or (b) or (c) or (d) will be declared non responsive. The responsive bid with the highest number of points will be recommended for award of a contract, provided that the total evaluated price does not exceed the budget available for this requirement (\$80,000.00 + applicable taxes extra). This amount represents a maximum of \$40,000.00 + taxes for the current fiscal year (ending March 31, 2016) and an additional currently unfunded maximum of \$40,000.00 + taxes for the new fiscal year (April 1st, 2016 to March 31st, 2017). In the event that the highest number of points is obtained by more than one responsive bid, the responsive bid with the lowest evaluated price will be recommended for award of a contract.

PART 5 – CERTIFICATIONS AND ADDITIONAL INFORMATION

Bidders must provide the required certifications and additional information to be awarded a contract.

The certifications provided by Bidders to Canada are subject to verification by Canada at all times. Canada will declare a bid non-responsive, or will declare a contractor in default, if any certification made by the Bidder is found to be untrue, whether made knowingly or unknowingly, during the bid evaluation period or during the contract period.

The Contracting Authority will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply and to cooperate with any request or requirement imposed by the Contracting Authority will render the bid non-responsive or constitute a default under the Contract.

5.1 Certifications Required with the Bid

Bidders must submit the following duly completed certifications as part of their bid.

5.1.1 Declaration of Convicted Offences

As applicable, pursuant to subsection Declaration of Convicted Offences of section 01 of the Standard Instructions, the Bidder must provide with its bid, a completed [Declaration Form](http://www.tpsgc-pwgsc.gc.ca/ci-if/formulaire-form-eng.html) (<http://www.tpsgc-pwgsc.gc.ca/ci-if/formulaire-form-eng.html>), to be given further consideration in the procurement process.

5.2 Certifications Precedent to Contract Award and Additional Information

The certifications and additional information listed below should be submitted with the bid but may be submitted afterwards. If any of these required certifications or additional information is not completed and submitted as requested, the Contracting Authority will inform the Bidder of a time frame within which to provide the information. Failure to provide the certifications or the additional information listed below within the time frame specified will render the bid non-responsive.

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5.2.1 Integrity Provisions – List of Names

Bidders who are incorporated, including those bidding as a joint venture, must provide a complete list of names of all individuals who are currently directors of the Bidder.

Bidders bidding as sole proprietorship, as well as those bidding as a joint venture, must provide the names of the owner(s).

Bidders bidding as societies, firms or partnerships do not need to provide lists of names.

5.2.2 Federal Contractors Program for Employment Equity - Bid Certification

By submitting a bid, the Bidder certifies that the Bidder, and any of the Bidder's members if the Bidder is a Joint Venture, is not named on the Federal Contractors Program (FCP) for employment equity "[FCP Limited Eligibility to Bid](http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml)" list (http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml) available from Employment and Social Development Canada (ESDC) - Labour's website.

Canada will have the right to declare a bid non-responsive if the Bidder, or any member of the Bidder if the Bidder is a Joint Venture, appears on the "[FCP Limited Eligibility to Bid](http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml)" list at the time of contract award.

5.2.3 Certifications Precedent to Contract Award and Additional Information

5.2.3.1 Canadian Content Certification

This procurement is limited to Canadian services

The Bidder certifies that (to be completed by bidder):

() the service(s) offered is(are) a Canadian service as defined in paragraph 2 of clause A3050T.

Signature

Date

5.2.3.2 SACC Manual clause A3050T (2010-01-11), Canadian Content Definition

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PART 6 - RESULTING CONTRACT CLAUSES

The following clauses and conditions apply to and form part of any contract resulting from the bid solicitation.

6.1 Statement of Work

The Contractor must perform the Work in accordance with the Statement of Work at Annex A.

6.2 Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the Standard Acquisition Clauses and Conditions Manual (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

6.2.1 General Conditions

2040 (2015-09-03), General Conditions - Research & Development, apply to and form part of the Contract.

6.2.2 Supplemental General Conditions

SACC Manual Clause K3410C (2015-02-25) Canada to Own Intellectual Property Rights in Foreground Information, apply and form part of the Contract.

SACC Manual Clause 4002 (2010-08-16) Software Development or Modification Services, apply and form part of the Contract.

6.3 Security Requirement

There are no security requirements associated with this document.

6.4 Term of Contract

6.4.1 Period of Contract

The period of the Contract is from date of Contract award to March 31, 2016, and an unfunded option to extend for an additional year.

6.5 Authorities

6.5.1 Contracting Authority

The Contracting Authority for the Contract is:

JoAnne LeBlanc
Supply Officer
Public Works and Government Services Canada
Acquisitions Branch
1713 Bedford Row
Halifax, Nova Scotia B3J 1T3

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Telephone: 902-496-5010

Facsimile: 902-496-5016

E-mail address: joanne.leblanc3@pwgsc.gc.ca

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

6.5.2 Technical Authority

The Technical Authority for the Contract is:

Will be completed upon Contract award.

The Technical Authority is the representative of the department or agency for whom the Work is being carried out under the Contract and is responsible for all matters concerning the technical content of the Work under the Contract. Technical matters may be discussed with the Technical Authority; however, the Technical Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of the Work can only be made through a contract amendment issued by the Contracting Authority.

6.5.3 Contractor's Representative (to be completed by Supplier)

Name: _____

Telephone: _____

Email address: _____

Procurement Business Number (PBN): _____

6.6 Proactive Disclosure of Contracts with Former Public Servants

By providing information on its status, with respect to being a former public servant in receipt of a [Public Service Superannuation Act](#) (PSSA) pension, the Contractor has agreed that this information will be reported on departmental websites as part of the published proactive disclosure reports, in accordance with [Contracting Policy Notice: 2012-2](#) of the Treasury Board Secretariat of Canada.

6.7 Payment

6.7.1 Basis of Payment

The Contractor will be reimbursed for the costs reasonably and properly incurred in the performance of the Work, and profit (if applicable), as determined in accordance with the Basis of Payment in [Annex B](#), to a limitation of expenditure of \$_____ (insert the amount at contract award). Customs duties are included, and Applicable Taxes are extra.

6.7.2 Limitation of Expenditure

1. Canada's total liability to the Contractor under the Contract must not exceed \$_____ (amount to be inserted at contract award). Customs duties are included, and Applicable Taxes are extra.

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2. No increase in the total liability of Canada or in the price of the Work resulting from any design changes, modifications or interpretations of the Work, will be authorized or paid to the Contractor unless these design changes, modifications or interpretations have been approved, in writing, by the Contracting Authority before their incorporation into the Work. The Contractor must not perform any work or provide any service that would result in Canada's total liability being exceeded before obtaining the written approval of the Contracting Authority. The Contractor must notify the Contracting Authority in writing as to the adequacy of this sum:
 - (a) when it is 75 percent committed, or
 - (b) four (4) months before the Contract expiry date, or
 - (c) as soon as the Contractor considers that the contract funds provided are inadequate for the completion of the Work,whichever comes first.
3. If the notification is for inadequate contract funds, the Contractor must provide to the Contracting Authority a written estimate for the additional funds required. Provision of such information by the Contractor does not increase Canada's liability.

6.7.3 Method of Payment

6.7.3.1 Progress Payments

1. Canada will make progress payments in accordance with the payment provisions of the Contract, no more than once a month, for cost incurred in the performance of the Work up to **90 percent** of the amount claimed and approved by Canada if:
 - (a) an accurate and complete claim for payment using form PWGSC-TPSGC 1111(<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf>), Claim for Progress Payment, and any other document required by the Contract have been submitted in accordance with the invoicing instructions provided in the Contract;
 - (b) the amount claimed is in accordance with the Basis of payment;
 - (c) the total amount for all progress payments paid by Canada does not exceed **90 percent** of the total amount to be paid under the Contract;
 - (d) all certificates appearing on form PWGSC-TPSGC 1111 have been signed by the respective authorized representatives.
2. The balance of the amount payable will be paid in accordance with the payment provisions of the Contract upon completion and delivery of all work required under the Contract if the Work has been accepted by Canada and a final claim for the payment is submitted.
3. Progress payments are interim payments only. Canada may conduct a government audit and interim time and cost verifications and reserves the right to make adjustments to the Contract from time to time during the performance of the Work. Any overpayment resulting from progress payments or otherwise must be refunded promptly to Canada.

6.7.4 SACC Manual Clauses

C0305C (2008-05-12), Cost Submission

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6.7.5 Time Verification

SACC Manual Clause C0711C (2008-05-12), Time Verification

6.8 Invoicing Instructions - Progress Claim

1. The Contractor must submit a claim for progress payment using form PWGSC-TPSGC 1111 (<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf>), Claim for Progress Payment.

Each claim must show:

- (a) all information required on form PWGSC-TPSGC 1111;
- (b) all applicable information detailed under the section entitled "Invoice Submission" of the general conditions;
- (c) a list of all expenses;
- (d) expenditures plus pro-rated profit or fee;
- (e) the description and value of the milestone claimed as detailed in the Contract.

Each claim must be supported by:

- (a) a copy of time sheets to support the time claimed;
- (b) a copy of the invoices, receipts, vouchers for all direct expenses, and all travel and living expenses;
- (c) a copy of the monthly progress report.

2. Applicable Taxes must be calculated on the total amount of the claim before the holdback is applied. At the time the holdback is claimed, there will be no Applicable Taxes payable as it was claimed and payable under the previous claims for progress payments.
3. The Contractor must prepare and certify one original and two (2) copies of the claim on form PWGSC-TPSGC 1111, and forward it to the Technical Authority for certification. The Technical Authority will then forward the original and two (2) copies of the claim to the Contracting Authority for appropriate certification after inspection and acceptance of the Work takes place, and onward submission to the Payment Office for the remaining certification and payment.
4. The Contractor must not submit claims until all work identified in the claim is completed.

6.9 Certifications

6.9.1 Compliance

The continuous compliance with the certifications provided by the Contractor in its bid and the ongoing cooperation in providing additional information are conditions of the Contract. Certifications are subject to verification by Canada during the entire period of the Contract. If the Contractor does not comply with any certification, provide the additional information, or if it is determined that any certification made by the Contractor in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

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6.9.2 SACC Manual Clauses

A3060C (2008-05-12), Canadian Content Certification

6.10 Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in _____ (to be inserted at contract award).

6.11 Priority of Documents

If there is a discrepancy between the wording of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

- (a) the Articles of Agreement;
- (b) the Supplemental General Conditions:
 - SACC Manual Clause K3410C (2015-02-25) Canada to Own Intellectual Property Rights in Foreground Information;
 - SACC Manual Clause 4002 (2010-08-16) Software Development or Modification Services;
- (c) the General Conditions 2040 (2015-09-03) General Conditions Research & Development;
- (d) Annex A, Statement of Requirement;
- (e) Annex B, Basis of Payment;
- (f) Annex C, Contractor Disclosure of Foreground Information;
- (g) the Contractor's bid dated _____.

6.12 Defence Contract

SACC Manual clause A9006C (2012-07-16), Defence Contract

6.13 Insurance

SACC Manual clause G1005C (2008-05-12), Insurance

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ANNEX A
STATEMENT OF REQUIREMENT

TITLE: PERFORMANCE ASSESSMENT FOR TACTICAL SYSTEMS (PATS) SOFTWARE MODIFICATIONS

1. BACKGROUND

The Performance Assessment for Tactical Systems (PATS) software tool was developed to provide a means of assessing multistatic sonar performance. The tool allows a user to specify a model environment and sonar system configurations, and the potential performance of the multistatic sonar system is characterized by combining acoustic propagation model results with statistical analysis. The software is primarily written in Matlab. The output of a separate acoustic model is read into Matlab and the results are used in conjunction with the sonar equation to allow for calculation of sonar system performance based on the estimated signal excess at each model grid point. There is a requirement to restructure the program directories and input files, improve existing calculations of sonar performance metrics, implement calculations of additional sonar performance metrics, and add a new acoustic propagation model, as well as to improve error handling and programming style where appropriate.

2. ACRONYMS

AD	Applicable Document
DRDC	Defence Research and Development Canada
PATS	Performance Assessment for Tactical Systems
SOW	Statement of Work
TA	Technical Authority

3. TASKS

The task numbers indicate the priority level, with Task 3.1.1 having the highest priority, followed by Task 3.1.2, followed by Task 3.2.1, etc. In the event that not all tasks can be completed, consultation with the Technical Authority will be required to prioritize the requirements. Additional details of each task will be provided by the Technical Authority following contract award.

3.1 Restructure program directories and configuration files

The PATS software uses a pre-defined, hierarchical directory "tree" to store information about modelled scenarios. The directory structure as it currently exists is not intuitive for the user. The PATS software also relies on several configuration files to specify various aspects of program operation including sonar system geometries and ping scheduling, desired performance metrics, displays, detection characteristics, and environmental properties. The settings assigned to each configuration files are not organized in the most intuitive manner for the user. To correct the situation, the Contractor must:

3.1.1 Modify the program source code to reflect the desired new directory structure.

3.1.2 Modify the program source code to reflect the desired groupings of sonar system and model settings.

The specific directory structure and new format for the configuration files will be provided by the Technical Authority at the time of contract award.

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3.2 Implement multi-static sonar metrics

The PATS software calculates the sonar signal excess that would result for a target found at any grid point in a model scenario. The signal excess is then used to calculate sonar performance metrics such as the cumulative probability of detection of a target proceeding along a track, or the "area coverage" metric (that is, the area over which a given level of signal excess is exceeded). However, other multi-static performance metrics exist that have not yet been implement in PATS. The Contractor must:

3.2.1 Modify the program source code to increase the efficiency (where possible) and accuracy of the calculation of the existing performance metrics.

3.2.2 Modify the program source code to calculate additional performance metrics as directed by the Technical Authority.

The specific performance metrics and order of priority will be specified by the Technical Authority at the time of contract award but may include, for example, a comparison of the signal excess for multi-static vs. mono-static fields ("Multistatic Gain"), or a measure of the risk of a target remaining undected after a specified length of time spent searching ("Anti-Submarine Warfare Residual Risk")

3.3 Add new propagation model

The PATS software currently has only one option for the underlying acoustic propagation model, which can be either executed before PATS is run, or called from within PATS. There is a requirement for the active sonar DRDC version of the Bellhop acoustic propagation model (called BellhopDRDC) to be added to the suite of available acoustic propagation models in PATS. The Contractor must:

3.3.1 Modify the program source code to enable PATS users to select and run the active version of BellhopDRDC, while still retaining the option of running the existing model.

3.3.2 Modify the program source code to generate input files for BellhopDRDC based on user-specified environmental data and program options.

3.3.3 Modify the program source code to ingest acoustic model results from BellhopDRDC into PATS for use in sonar signal excess calculations.

3.4 Improve error handling and programming style

The PATS software currently has very limited error-handling capabilities, i.e., when it fails it frequently "crashes" without providing the user with useful information to avoid future failures. Work has already been done to improve programming style by renaming many program variables with informative names according to a defined naming convention; however, some "legacy" variable names that are not very informative still exist within the PATS source code. On an "as-encountered" basis, the Contractor must:

3.4.1 Modify the source code to include testing for possible errors and the informative error statements for the portions of the code that will be modified or expanded during the contract.

3.4.2 Where "legacy" variables with unclear or uninformative names are encountered during the course of the work, modify the source code to conform to the naming convention provided by the Technical Authority. If the Contractor determines that significant changes to variable names or structures are required, the Contractor must consult with the Technical Authority for explicit approval before implementing the proposed changes.

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3.4.3 Add informative comments to the header of any Matlab routine created or substantially modified during the course of the contract.

4. Deliverables

Number	Task reference	Description of deliverable	Quantity and Format
4.1	3.1	Source files for PATS	1 copy on CD, DVD, or USB memory stick
4.2	3.2 3.3 3.4	Source files for PATS	1 copy on CD, DVD, or USB memory stick

5. DATE OF DELIVERY

Deliverable	Delivery date
5.1	The earlier of 1 month after contract award, or 31 Mar 2016.
5.2	31 Mar 2016

6. LOCATION OF WORK

The work must be performed on Contractor site.

7. MEETINGS

Meetings will be held by telephone conference call. If the Contractor site is located within 20 km by road of the DRDC Atlantic Research Centre at 9 Grove St., Dartmouth, NS, meetings may optionally be held at either DRDC Atlantic or the Contractor site.

A meeting will be held at the beginning of the work. This initial meeting must take place within 2 weeks after contract award. During or immediately following the initial meeting, DRDC will transfer the original PATS source code to the Contractor. Other progress meetings may be required to discuss progress of the work during the contract period, and will be agreed upon by the Technical Authority and the Contractor.

8. GOVERNMENT SUPPLIED MATERIAL (GSM)

GSM 1: PATS source code and working PATS configuration on a USB memory stick.

Quantity: 1

Part number: N/A

Serial number: N/A

Inventory number: N/A

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9. SPECIAL CONSIDERATIONS

There is a maximum of \$40,000.00 (taxes excluded) available for the work in the 2015-2016 fiscal year. The contractor will complete as much work as possible within the financial limitations during the 2015-2016 fiscal year. Tasks will be prioritized in consultation with the Technical Authority.

If there are unfinished tasks and additional funding is made available for the 2016-2017 fiscal year, the contract may be extended for a maximum of an additional \$40,000.00.

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ANNEX "B"
BASIS OF PAYMENT

1. **LABOUR:** at the following firm rates

CATEGORY (OR NAME)	FIRM HOURLY RATE	
_____	\$ _____	
_____	\$ _____	
etc.		Est.: \$ _____

2. **EQUIPMENT:** at laid down cost without markup
(Specify type of equipment, if applicable) Est.: \$ _____

3. **MATERIALS AND SUPPLIES:** at laid down cost without markup
(Specify what categories of materials and supplies, if applicable) Est.: \$ _____

4. **SUBCONTRACTS:** at actual cost without markup
(Identify subcontractors) Est.: \$ _____

5. **ANY OTHER DIRECT CHARGES:** at actual cost without markup
(Specify what categories of direct charges, if applicable) Est.: \$ _____

Estimated Cost to a Limitation of Expenditure: \$ _____
(Applicable Taxes extra)

With the exception of the firm rate(s) and price(s), the amounts shown in the various items specified above are estimates only. Minor changes to these estimates will be accepted for billing purposes as the Work proceeds, provided that these changes have the prior approval of the Project Authority and provided that the estimated cost does not exceed the aforementioned Limitation of Expenditure.

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ANNEX "C"
INTELLECTUAL PROPERTY DISCLOSURE CERTIFICATION

This form is to be completed and signed by the contractor upon completion of the contract and returned to:

Ce formulaire est à être complété et signé par le fournisseur dès l'attribution du contrat. Veuillez retourner à la personne indiquée ci-dessous.

JoAnne LeBlanc
Acquisitions Branch
Public Works and Government Services Canada
1713 Bedford Row, PO Box 2247
Halifax, Nova Scotia B3J 3C9
Tel: (902) 496-5010
Fax: (902) 496-5016

Contract Title: Performance Assessment for Tactical System (PATs) Software Modifications

PWGSC File number - W7707-165840/001/HAL

It is a term of the referenced contract that, regardless of its ownership, all Foreground Information¹ that could be Inventions¹ and all other Foreground Information, shall be promptly and fully disclosed to Canada.

¹ - defined in the General Conditions identified in the Contract

Consequently, the undersigned, being a duly authorized officer of the Contractor, certifies that during the tenure of the contract
(mark appropriate box):

- [] No Foreground Information was conceived, developed or produced as part of the Work and, therefore the Contractor has nothing to disclose.
- [] All Foreground Information which was conceived, developed or produced as part of the Work was fully disclosed and documented in the technical reports delivered by the Contractor to the Technical Authority designated in the Contract, and the Contractor has nothing further to disclose.
- [] All Foreground Information conceived, developed or produced as part of the Work by the Contractor is hereby fully disclosed in the attached document.

Tel que stipulé dans le contrat mentionné ci-dessus, et peu importe à qui sont dévolus les droits de propriété intellectuelle, tous les renseignements originaux * susceptibles de constituer des inventions*, de même que tous les autres renseignements originaux découlant de ce contrat, devront être divulgués pleinement et sans délai au Canada.

* - tels que définis dans les conditions générales identifiées dans le contrat.

Par conséquent, le soussigné, étant un agent dûment autorisé de l'Entrepreneur, certifie que durant la période du contrat
(cochez la case appropriée):

- Aucun renseignement original n'a été conçu, développé ou produit pendant l'exécution des travaux; l'entrepreneur n'a donc aucun renseignement original à divulguer.
- Tous les renseignements originaux conçus, développés ou produits pendant l'exécution des travaux ont été entièrement divulgués et documentés dans les rapports techniques livrés par l'Entrepreneur à l'autorité technique indiquée dans le contrat, et l'Entrepreneur certifie qu'il n'existe aucune information supplémentaire à divulguer.
- Tous les renseignements originaux conçus, développés ou produits pendant l'exécution des travaux par l'Entrepreneur sont entièrement divulgués dans le document ci-joint.

Signature - Signature: _____

Print Name - Nom en caractère imprimé: _____

Title - Titre: _____

Company Name - Entrepreneur: _____

Date - Date: _____

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ANNEX D **EVALUATION CRITERIA**

1. MANDATORY EVALUATION CRITERIA

In their proposals, bidders must demonstrate they meet the following mandatory criteria. Failure to meet any of the mandatory criteria will render the bid non-compliant and it will be given no further consideration.

	CRITERIA	MET	NOT MET
M1	The bidder's Firm must have a sufficient number of valid Matlab licenses (version R2013a or later) available.		
M2	The bidder's Firm must have a minimum of 12 months experience in scientific programming (defined as computer programming intended to solve a mathematics, physics, or engineering problem) within the last 60 months.		
M3	The bidder's Firm must have computer back-up capability and version control systems.		
M4	The project manager must have a minimum of 12 months of project management experience in the last 72 months.		
M5	The effort assigned to administrative and project management tasks must be less than or equal to 10% of the total effort. The resources not assigned to administrative or project management tasks will be considered "programming resources" in all the following mandatory and points-rated criteria.		
M6	The number of programming resources identified must be greater than or equal to 2 and less than or equal to 5.		
M7	All programming resources must have a minimum of a bachelor's degree in computer science, physics, engineering, engineering physics, acoustics, or a closely related field.		
M8	A minimum of 1 programming resource must be individually tasked with 25.0% or more of the total effort.		
M9	All programming resource(s) individually tasked with more than 25.0% of the total effort must have a minimum of 12 months of experience in scientific Matlab programming in the last 60 months.		
M10	All programming resource(s) individually tasked with more than 10.0% of the total effort must have a minimum of 6 months of experience in scientific Matlab programming in the last 36 months.		
M11	All programming resource(s) individually tasked with more than 10.0% of the total effort must have a minimum of 36 months of experience in scientific programming in the last 60 months.		
M12	There must be a minimum of 1 backup resource identified for the programming resource(s) identified in the project.		
M13	With reference to the Matlab programming test described under the point-rated criteria (P11), 6 specific items in the programming test must be corrected.		

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2. POINT-RATED EVALUATION CRITERIA

	POINT-RATED EVALUATION CRITERIA	Minimum	Maximum
P1	The bidder's Firm must have a minimum of 12 months of experience in scientific programming within the last 60 months. 12 to 23 months - 10 points 24 to 35 months - 15 points 36 months and above - 20 points	10	20
P2	The bidder should identify risks, estimate the likelihood of occurrence (e.g., low, medium, high) and potential impact (e.g., low, medium, high) and propose mitigation techniques for each risk identified. 2 points per risk to a maximum of 8 points	0	8
P3	The bidder's Firm should have off-site computer back-up capability. Off-site backup identified - 10 points	0	10
P4	The project manager must have a minimum of 12 months of project management experience in the last 72 months. 12 to 23 months - 5 points 24 to 35 months - 10 points 35 to 47 months - 15 points 48 months and above - 20 points	5	20
P5	There should be a backup project manager with a minimum of 24 months of project management experience in the last 60 months. no backup project manager specified - 0 points 0-11 months experience - 5 points 12-23 months experience - 10 points 24 months and above - 15 points	0	15
P5	All programming resources must have a minimum of a bachelor's degree in computer science, physics, engineering, engineering physics, acoustics, or a closely related field. All resources with bachelor's degrees - 8 points One or more resources with Master's or Ph. D. degrees - 10 points	8	10
P6	All programming resource(s) individually tasked with more than 25.0% of the total effort must have a minimum of 12 months of experience in scientific Matlab programming in the last 60 months. Score will be the average over all resource(s) individually tasked with more than 25.0% of the total effort. For each resource, 12-23 months - 5 points 24-35 months - 10 points 36 months and above - 15 points	5	15
P7	All programming resource(s) individually tasked with more than 10.0% of the total effort must have a minimum of 6 months of experience in scientific Matlab programming in the last 36 months. Score will be the average over all resource(s) individually tasked with more than 10.0% of the total effort that were not included in P6. For each resource, 6-11 months - 5 points 12-24 months - 10 points 24 months and above - 15 points	5	15
P8	All programming resource(s) individually tasked with more than 10.0% of the total effort must have a minimum of 36 months of experience in scientific programming in the last 60 months. Score will be the average over all resource(s) individually tasked with more than 10.0% of the total effort.	5	10

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	For each resource, 36-59 months - 5 points 59 months and above - 10 points		
P9	There must be a minimum of 1 backup resource identified for the programming resource(s) identified in the project. Ratio (backup to actual resources) less than 2:3 - 5 points Ratio greater than or equal to 2:3 - 10 points.	5	10
P10	One resource should have experience in underwater acoustics or acoustic propagation modelling. 0 months - 0 points 1 to 11 months - 5 points 12 months and above - 10 points	0	10
P11	<p>The bidder must submit a solution to the Matlab programming test found under <u>ANNEX D – 1</u>. The test purposely contains programming inefficiencies, stylistic problems, and naive calculations in order for the bidders to demonstrate their Matlab scientific programming knowledge. However, the test code does not contain any intentional mathematical or scientific errors.</p> <p>Points will be awarded based on a pre-determined list of items to be fixed, some which must be fixed and others which should be fixed. There are bonus points available if the bidder finds any mathematical or scientific errors in the program. Some of the items may fit into more than one category, but each one has been categorized primarily as an issue of efficiency, style, or knowledge of Matlab.</p> <p>The total number of points available for the programming test is 180. The intent of the exercise is to demonstrate the bidder's programming skill and ability to identify problems in the code. Therefore, the detailed scoring breakdown that includes which specific items must be addressed and which items should be addressed cannot be revealed because it would give away the answers.</p> <p>The test will be scored as follows:</p> <p>(a) Programming efficiency: Programming efficiency is demonstrated by the replacement of programming constructs that are inherently inefficient (and thus execute slowly) in Matlab with more efficient constructs. Scoring: 100 points for 4 items, of which 2 are mandatory</p> <p>(b) Programming style: A consistent programming style will allow other users to easily read, debug, and update code in the future. Good programming style includes but is not limited to variable naming conventions, parameterization of variables and constants, the use of comment lines and informative headers, and code layout and readability. Scoring: 50 points for 5 items, of which 3 are mandatory</p>	90	180

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CCC No./N° CCC - FMS No./N° VME

	<p>(c) Knowledge of the Matlab language: Matlab is very robust to ambiguous syntax but there are often "better" ways composing Matlab statements. An algorithm borrowed from another language may "work" in Matlab by providing the correct answer but there may be faster, Matlab-specific ways of implementing certain tasks. Scoring: 20 points for 2 items, of which 1 is mandatory</p> <p>(d) Scientific or mathematical mistakes: Despite the best of intentions, an unintentional mathematical or scientific mistake may exist in the test program. A maximum of 10 points will be awarded if any mathematical or scientific mistake is identified, explained, and corrected. Scoring: 10 points for any mistake identified, explained, and corrected</p>		
TOTAL		133	323

3. METHODE OF SELECTION

The basis of selection will be on the Highest Point Rated proposal within Maximum stated Budget.

To be declared responsive, a bid must:

- (a) comply with all the requirements of the bid solicitation;
- (b) meet all mandatory technical evaluation criteria;
- (c) obtain the required minimum points for each criterion and each group of criteria with a pass mark;
and
- (d) obtain the required minimum points overall for the technical evaluation criteria which are subject to point rating.

Bids not meeting (a) or (b) or (c) or (d) will be declared non responsive. The responsive bid with the highest number of points will be recommended for award of a contract, provided that the total evaluated price does not exceed the budget available for this requirement (\$80,000.00 + applicable taxes extra). This amount represents a maximum of \$40,000.00 + taxes for the current fiscal year (ending March 31, 2016) and an additional currently unfunded maximum of \$40,000.00 + taxes for the new fiscal year (April 1st, 2016 to March 31st, 2017). In the event that the highest number of points is obtained by more than one responsive bid, the responsive bid with the lowest evaluated price will be recommended for award of a contract.

ANNEX D-1

APPENDIX: Programming Test

```
%=====
% This is a greatly simplified problem based on a real example of work to
% be done as part of this contract. It assumes MATLAB with no additional
% toolboxes is available. It runs on R2013a but would also likely run on
% older or newer versions.
%
% For this demonstration, we are calculating the beam pattern for a line
% array in which the individual array elements are directional (DIFAR)
% elements with cardioid beam patterns. The beam pattern varies with
% steering angle and we require the beam pattern at several different
% steering angles. The array is "shaded"; that is, the voltage from the
% elements is a weighted sum that (in this case) reduces the contribution
% from the elements on the ends of the array.
%
% The output voltage for an individual element in a line array with n
% omnidirectional array elements, each of weight Wn, is a function
% of azimuth (theta), elevation (phi), and steering angles (theta_0). The
% weighted output voltage from each element is Vn:
%
%  $V_n = W_n \exp(-i * (n-1) * (2 * \pi * d / \lambda) * (\cos(\theta) * \cos(\phi) - \cos(\theta_0)))$ 
%
% Here, d is the element spacing and lambda is the wavelength of the sound
% being detected. Note that theta = 90 corresponds to broadside incidence
% in this notation (i.e., if the array elements lie along the x-axis,
% symmetrically arranged about the line y=0, theta = 90 corresponds to
% sound arriving from a point anywhere along the y-axis, and thus no phase
% difference between adjacent elements).
%
% The total voltage output by the array (V_line) is the sum of Vn over all
% the array elements.
%
% The voltage output from a DIFAR element (V_difar), steered in the
% direction theta_0, is
%
%  $V_{difar} = (1/2) * (1 + \cos(\theta - \theta_0) * \cos(\phi))$ 
%
% And the beam pattern is the squared product of the two voltages, the line
% array voltage and the difar voltage:
%
%  $BeamPattern = (V_{difar} * V_{line})^2$ 
%
% normalized so that for theta = theta_0 and phi = 0,
% BeamPattern = 1 (in linear units). Of course in acoustics we do
% everything in decibels (dB) so BeamPattern_dB = 10*log10(BeamPattern).
%
% The output of this program is used as input to another program, so, for
% each steering angle, part of the beam pattern is output to a text file
% with a strictly specified format. There is no need to keep all the beam
% patterns for all the steering angles in memory. Consider also that we may
% want to repeat the calculations for a different number of steering angles
% but display them on a similar plot with more (or fewer) subplots.
%
% Exercise:
%
% Using the following program as a start point, rewrite the program where
% necessary to increase its efficiency, improve its style, and demonstrate
% knowledge of the Matlab programming language. The evaluation will take
% into account specific programming constructs that are inherently
% inefficient in Matlab and award points for their replacement with faster
% constructs. Pay attention as well to programming style, including
% parameterization of variables to allow for future changes to be
% implemented more easily.
%
% As an example, after implementing all the changes required by the answer
% key to obtain a perfect score on the test, the runtime decreased from 32s
% to 3.2s: about a tenfold improvement in speed. This number is provided
% as a guideline only; the results may vary on your platform.
%
% The variable that must be calculated correctly is BeamPattern_dB at each
```

```

% value of steering angle. Note that some types of changes may
% results in "small" differences in the value of BeamPattern_dB (on the
% order of 10^-15 or less), which is acceptable.
%
% The variables section are for the user's and evaluator's information
% only. There is no need to worry about efficiency in those three sections.
%=====

% =====
% Variables
% No need to alter this section
% =====

tic;

clear;
close all;

% some array parameters
nElements = 128; % number of line array elements
fCut = 3500; % (Hz) the design frequency of the array (used to determine d)
c = 1500; % (m/s) nominal sound speed in water
f = 3500; % (Hz) frequency of sound being detected
floor_dB = -40; % (dB) lowest value we would like for the beam pattern

% We are going to calculate the beam pattern at all available
% azimuth and elevation angles in increments of 1 degree.
azimuthDeg = -180:180;
azimuth = azimuthDeg/180*pi;
elevationDeg = -90:90;
elevation = elevationDeg/180*pi;

% convert some of the physical parameters
lambda = c/f;
lambdaCut = c/fCut;
d = lambdaCut/2;
floor_linear = 10^(floor_dB/10);

% calculate the Hamming (shading) window, assuming that you don't have the
% Signal Processing Toolbox (if you did, you could use
% shadingWindow = hamming(nElements));
shadingWindow = 0.54-0.46*cos(2*pi*(0:nElements-1)/(nElements-1));

% set up a slightly larger figure than the default
screenSize = get(0,'ScreenSize');
newFigWidth = 800;
newFigHeight = 800;
cornerX = floor((screenSize(3)-newFigWidth)/2);
cornerY = floor((screenSize(4)-newFigHeight)/2);
figure(1);
set(1,'Position',[cornerX cornerY newFigWidth newFigHeight]);

% =====
% End variables section
% =====

% =====
% Begin section in need of repairs
% =====

for iSteeringAngle = 1:8 % want the beam pattern at 8 steering angles

    % Write to the screen so the user knows the program hasn't died
    fprintf('Steering angle %d of %d\n',iSteeringAngle,8);

    % figure out the steering angle (starting at zero, equally spaced)
    steeringAngleDeg = (iSteeringAngle-1)*(360/8);
    steeringAngle = steeringAngleDeg/180*pi;

    BeamPattern = zeros(361,181);

```



```

for iAzimuth = 1:361
    for iElevation = 1:181
        % we include the square in the difarFactor here
        difarFactor = 0.25*(1+cos(azimuth(iAzimuth)-steeringAngle)).*...
            cos(elevation(iElevation)).^2;
        % now calculate the sum of voltage over all the (omni) elements
        Vsum = 0;
        Vnorm = 0;
        for iElement = 1:nElements
            Vsum = Vsum + shadingWindow(iElement)*exp(-i*...
                (iElement-1)*(2*pi*d/lambda)*...
                (cos(elevation(iElevation))*cos(azimuth(iAzimuth))...
                - cos(steeringAngle)));
            Vnorm = Vnorm + shadingWindow(iElement);
        end
        Vout = difarFactor*abs(Vsum/Vnorm)^2;

        % we don't want any part of the beam pattern to be less than
        % floor_dB ... so if the voltage is any smaller we set it to
        % equal floor_dB

        if Vout > floor_linear
            BeamPattern(iAzimuth,iElevation) = Vout;
        else
            BeamPattern(iAzimuth,iElevation) = floor_linear;
        end
    end
end
BeamPattern_dB = 10*log10(BeamPattern);

% plotting at elevation = 0 degrees (91st column)

subplot(3,3,iSteeringAngle);
polar(azimuth',BeamPattern_dB(:,91)-floor_dB);
title([num2str(steeringAngleDeg),' deg steering angle']);

% write the elevation = 0 column to a text file
fidl=fopen(['BP' num2str(steeringAngleDeg) '.DAT'],'wt');
fprintf(fidl,'Azimuthal pattern at 0 deg Elevation\n');
fprintf(fidl,'=====\n');

for iAzimuth = 1:361
    fprintf(fidl,'%f %f \n',azimuthDeg(iAzimuth),...
        BeamPattern_dB(iAzimuth,91));
end
fclose(fidl);

end

% =====
% End section in need of repairs
% =====

toc;

```