



**- STATEMENT OF WORK -
Task Authorization (TA) - 36**

FOR SUBCONTRACT WITH CIMVHR

1. NUMBER – TITLE OF TASK AUTHORIZATION

TA 36 – Analysis of Royal Canadian Navy Sea Trial Actigraphy Data

2. VALIDATION OF SCOPE OF CONTRACT

2.1 The following task(s), as written in the SOW of the main contract (W7714-145967/001/SV) apply to this Task Authorization (TA): **Data Analysis** - Perform state of the art analysis of data from experimental studies, clinical trials, field studies or trials, and existing databases.

3. ACRONYMS

AMI	Ambulatory Monitoring Incorporated
DRDC	Defence Research and Development Canada
HMCS	Her Majesty's Canadian Ship
X-Ship	Experimental Ship
RCN	Royal Canadian Navy
SA	Scientific Authority
SCORE	Simulation for Crew Optimization and Risk Evaluation
S-DFM	DRDC Fatigue Model
TA	Task Authorization
UCSD	University of California San Diego
ZCM	Zero Crossing Mode

4. REQUIREMENT

4.1 To conduct analysis of up to 100 participant's worth of actigraph data collected during Royal Canadian Navy (RCN) Crewing and Human Factors sea trials aboard Experimental Ship (X-Ship) using Ambulatory Monitoring Incorporated (AMI) sourced software. Crewing sea trials are scheduled through to March 31st 2018.

5. BACKGROUND

5.1 The RCN designated the frigate Her Majesty's Canadian Ship (HMCS) Montreal as an X-Ship in 2016 for a period of five years. This program will advance innovative and leading edge naval concepts in all areas of warship deployment, crewing, and sustainment. Among the experiments being conducted aboard X-Ship will be trials on variations in crew size and impacts on crew work, rest, and performance.

5.2 Defence Research and Development Canada (DRDC) personnel will be collecting operational data on up to three separate trials aboard X-Ship between October 2016 and March 31st 2018. These data will be used to validate a DRDC constructed naval crewing analysis tool, Simulation for Crew Optimization and Risk Evaluation (SCORE) and a sleep prediction tool, DRDC Fatigue Model (S-DFM). SCORE is utilized to assist with the analysis of crew size and composition (Chow et al. 2013; Perlin et al., 2015) and S-DFM is utilized to predict when crew members will sleep based on work schedules entered in SCORE (Doubova, 2015). Predictions of sleep are utilized in turn to predict cognitive performance which can then be used by SCORE modellers to determine crew task readiness.

5.3 Wrist worn actigraphs are non-invasive watch-like devices which measure activity and rest cycles of an individual. Extremely sensitive accelerometers within the actigraph measure movement in three axes and algorithms within data analysis software compute activity and sleep levels. AMI produces one such device, the Micro Motionlogger. This actigraph is water resistant, has a one to four month battery life, off-wrist detection, and a light sensor which aids in analyzer derived sleep time determination. Utilizing AMI's ActionW software, actigraph data can be entered to determine numerous parameters of sleep. X-Ship participants of varying naval occupations will don Micro Motionloggers during X-Ship trials.



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6. OBJECTIVES

6.1 The objective of this work is to allow a validation of S-DFM by comparison of analyzed actigraph sleep parameters to those predicted by the model. This will allow optimization of both S-DFM and SCORE to be ultimately used by RCN mission planners. The analysis of actigraph sleep parameters may also inform the evaluation of different crew designs or crew schedules on operator sleep and fatigue.

7. SCOPE

7.1 The Sub Contractor will analyze up to 100 sets of actigraph data collected during X-Ship sea trials and provided by the Scientific Authority (SA) between May 2017 and January 2018.

8. APPLICABLE DOCUMENTS & REFERENCES

- a. Chow, R., Wang, W., Lamb, M., Coates, C., Perlin, M., & McKay, P. (2013). Simulation for Crew Optimization and Risk Analysis (SCORE), TTCP HUM TP-18 Workshop on Crewing Systems for Maritime Warfare.
- b. Doubova, N. (2015). Comparison of sleep models for SCORE-Fatigue model integration. Defence Research and Development Canada.
- c. Perlin, M., McKay, P., Coates, C., Lamb, M., Chow, R. (2015) SCORE 2.0 User's Guide: Crew generation and validation.

9. TASKS TO BE PERFORMED

The Sub Contractor must perform the following tasks:

9.1 **Data Analysis** – The Sub Contractor must analyze all sets of actigraph data provided by the SA using Action W-2 software in Zero Crossing Mode (ZCM) with the University of California San Diego (UCSD) sleep scoring algorithm. The work must be completed by only one analyst to prevent any subjectivity in the results.

9.2 **Data Reporting** – The Sub Contractor must generate a tabulated report of each participant's analyzed data set.

9.3 **Quality Assurance** – The Sub Contractor must initially provide 10 analyzed actigrams with tabulated reports for quality assurance purposes.

10. DELIVERABLES (DESCRIPTION AND SCHEDULES)

All deliverables must be completed and submitted by March 2018. The Sub Contractor must create and submit the following deliverables:

Deliverable Number	Task reference	Description (Quantity and Format) and Schedule
10.1	9.1	Individual participant actigrams (electronic, Action W-2 .AMI format) of analyzed data no later than 2 months after receiving data sets from the SA. Each actigram must show each day of data collection, ambient light levels, activity levels, sleep intervals, and manually set down times.
10.2	9.2	Individual participant tabulated reports (electronic, MS Excel format) of all analyzed data no later than 2 months after receiving data sets from the SA. Each report must include: participant ID, down start time, down end time, time of falling asleep,



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		time of awakening, sleep minutes, wake minutes, percent sleep, sleep efficiency, sleep latency, and wake after sleep onset for each day of data collection.
10.3	9.3	Actigrams (electronic, Action W-2 .AMI format) and tabulated reports (electronic, MS Excel format) of analyzed data from 10 data sets within 2 weeks after receiving the first data sets from the SA.

11. MANDATORY SELECTION CRITERIA

11.1 The successful Sub Contractor will have demonstrated expertise in the following:

- a. Collection of data utilizing wrist worn actigraphs;
- b. Analysis of actigraph data using AMI produced software; and
- c. Demonstrated subject matter expertise in sleep and circadian rhythm research (manifested by at least 5 peer-reviewed publications in the field).

12. LANGUAGE OF WORK

12.1 Documentation and deliverables must be submitted in the English language.

13. LOCATION OF WORK

13.1 Work will be conducted exclusively on the premises of the Sub Contractor.

14. TRAVEL

14.1 The Sub Contractor may be required to travel to meet the Scientific Authority. All travel must have the prior written authorization of the Technical Authority, and must be undertaken in accordance with the *National Joint Council Travel Directive* and with the other provisions of the directive referring to "travellers", rather than those referring to "employees".

15. MEETINGS

15.1 The Sub Contractor must attend the following meetings with the SA: an initial meeting shortly after each data collection for provision of data sets to Sub Contractor and a progress review meeting shortly after SA receives initial analyzed actigrams to discuss quality assurance as per task 9.3. All meetings will be scheduled by the SA and may be completed via teleconference or videoconference.

16. GOVERNMENT SUPPLIED MATERIAL (GSM)

16.1 The Scientific Authority will provide up to 100 raw data sets of individual participant actigraph files in Action W-2 .AMI format.

17. GOVERNMENT FURNISHED EQUIPMENT (GFE)

17.1 None

18. SPECIAL CONSIDERATIONS OR CONSTRAINTS

18.1 None.

19. SECURITY



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19.1 The Sub Contractor will not require access to PROTECTED and/or CLASSIFIED information or asset, nor to restricted access areas.

Not applicable RELIABILITY STATUS PROTECTED A PROTECTED B

20. INTELLECTUAL PROPERTY (IP) OWNERSHIP

20.1 No

21. CONTROLLED GOODS

Not applicable

22. BUDGET

The Sub Contractor will be paid by CIMVHR as per the terms of Contract # W7714-145967 between Defence Research and Development Canada and CIMVHR. The amount of funding available is allocated by fiscal year (April 1 - March 31st) and is approximately \$10,300.00 plus applicable overhead. Details TBD upon award.

A draft budget must be submitted with the proposal along with a budget justification. A detailed budget will be developed post award in consultation with CIMVHR. Interested parties should request budget documents and information on creating their budget from Jocelyne Halladay.