



**ANNEX B**  
**Appendix 3**

**Technical Statement of Requirements**  
**Naval Remote Weapon Station System**

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# 1. INTRODUCTION

## 1.1 Scope

1.1.1 This Technical Statement of Requirements (TSOR) contains the performance and technical requirements for the Naval Remote Weapon Station (NRWS) System, which will consist of multiple remotely operated weapon mounts, sensor suites, and Operator Consoles to be designed, manufactured, supported, initially spared and installed for operation in the Royal Canadian Navy.

## 1.2 Terminology

1.2.1 The following definitions shall apply throughout this TSOR:

- a. Availability: The probability that the NRWS is in an operable state at any time, based on a combination of Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR). This relationship is given by  $\text{Availability (as \%)} = \text{MTBF} / (\text{MTBF} + \text{MTTR}) \times 100$ ;
- b. Local: Operations conducted at the physical location of the NRWS Mount by the Operator;
- c. NRWS System: The NRWS System consists of four remotely operated NRWS mounts, sensor suites, and NRWS Operator Consoles integrated together;
- d. NRWS: One NRWS Mount and an NRWS Operator Console and all the auxiliary components;
- e. NRWS Mount: The above deck component that secures, aims, and fires the mounted weapon, and secures the electro-optical sensor suite;
- f. NRWS Operator Console: The component that provides the primary point for Operator monitoring and control of NRWS Mounts;
- g. Operator: The individual member of ship's staff who is operating the NRWS; and
- h. Remote: Controlling the NRWS Mount at a distance away using the NRWS Operator Console.

1.2.2 The following acronyms shall apply to this TSOR:

Acronyms	
CEP	Circular Error Probable
FN	Fabrique National

HMG	Heavy Machine Gun
LRF	Laser Range Finder
LRU	Line Replaceable Unit
NRWS	Naval Remote Weapon Station
TIC	Thermal Imaging Camera
TSOR	Technical Statement of Requirements
WMO	World Meteorological Organization

### **1.3 Intended Application**

- 1.3.1 The NRWS System will provide a short range, point defence, and limited area defence capability within the layered defence concept employed in Canada’s twelve Halifax Class vessels and two Joint Support Ship Vessels when they are commissioned.
- 1.3.2 The NRWS System will be employed to engage small sea-surface and low-slow air threats while underway, alongside, moored, and at anchor, as well as engage land vehicles when alongside. Within this role, the NRWS System will provide surveillance, threat detection, tracking, warning shots, non-disabling fire, disabling fire, and threat battle damage assessment. Additionally, the NRWS System will be used to conduct surface surveillance in support of Search and Rescue, and to acquire information regarding neutral and threat forces during domestic and international operations.
- 1.3.3 NRWS Systems will be supplied to Canada in order to be later fitted on the Joint Support Ship Class vessels. Canada is separately responsible for NRWS System installation on these vessels which will include procurement of cables.

### **1.4 System Overview**

- 1.4.1 The NRWS will enable Canada to singly mount the Fabrique National (FN) M2 0.50 Calibre Heavy Machine Gun (HMG) or the 7.62 millimetre C6 machine gun. The NRWS will provide full remote operation of these weapons.
- 1.4.2 The design of the NRWS System will provide the automated weapon mounts and associated equipment in each vessel necessary to provide a 360 degree threat engagement, while significantly enhancing the lethality currently achievable with locally operated pintle mounted HMGs. The design will allow for optimum coverage, lethality (two mount coverage per threat), and ensure redundancy of the NRWS Mounts and NRWS Operator Consoles.

- 1.4.3 There will be one NRWS Operator Console per NRWS Mount. However, two Operator Consoles will be able to operate either of the port NRWS mounts and two Operator Consoles will be able to operate either of the starboard NRWS mounts.
- 1.4.4 The NRWS System will support the use of the HMG in the zone between the maximum effective range of small arms teams and the minimum range of the Halifax Class vessel's main gun.
- 1.4.5 The NRWS System will consist of non-developmental military off-the-shelf hardware and software that is customized to meet the requirements of Canada.
- 1.4.6 The NRWS System will provide the required capabilities within all of the environments necessary to support world-wide Canadian naval operations.

## **2. APPLICABLE DOCUMENTS**

- 2.1 The following documents listed are applicable to and shall form part of this TSOR:
  - a. MIL-STD-1472G, Department of Defense Design Criteria Standard, Human Engineering;
  - b. MIL-DTL-24643C, General Specification for Shipboard Use of Low Smoke Electric Cable and Cords;
  - c. C-03-010-000/MM-001, Technical Manual, Canadian Naval Shipboard Techniques for Electromagnetic Compatibility;
  - d. D-03-003-005/SF-000, General Electrical Specification for Canadian Forces Ships;
  - e. MIL-STD-1310H (Navy), Shipboard Bonding, Grounding, and Other Techniques For Electromagnetic Compatibility, Electromagnetic Pulse (EMP) Mitigation, and Safety;
  - f. Technical Readiness Assessment Guidance, Department of Defense (DOD);
  - g. D-02-002-001/SG-001, Identification Marking of Canadian Military Property;
  - h. MIL-STD-461F, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment;
  - i. STANAG 2895, MMS Edition 1, Extreme Climate Conditions and Derived Conditions for Use in Defining Design/Test Criteria for NATO Forces Material;
  - j. MIL-STD-108E, Definitions and Basic Requirements for Enclosures for Electric and Electronic Equipment;

- k. D-03-003-007/SF-000, Specification for Design and Test Criteria for Shock Resistant Equipment in Naval Ships;
  - l. C-03-007-181/ME-001, Cable and Cable Termination Data for Shipboard Installation;
  - m. MIL-STD-810G, Environmental Engineering Considerations and Laboratory Tests;
  - n. C-03-010-000/AG-001, EMSEC Control Plan and Procedures for Naval Vessels.
  - o. STANAG 4347, Definition of Nominal Static Range Performance for Thermal Imaging Systems; and
  - p. STANAG 4512, Dismounted Personnel Target.
- 2.2 In the event of a conflict between this TSOR and an applicable document, this TSOR at the time of bid closing shall take precedence to the extent necessary to resolve such conflict.
- 2.3 The latest approved revision of the documents listed in paragraph 2.1 shall apply unless otherwise specified.

### 3. PERFORMANCE REQUIREMENTS

#### 3.1 Threats

3.1.1 The NRWS System shall defend against the threats listed in Table 1.

<u>Table 1 – Threats</u>				
<u>Threat Type</u>	<u>Threat Size</u>	<u>Threat Construction</u>	<u>Threat Speed</u>	<u>Threat Manoeuvres</u>
Boats	2 square metres or greater	Standard civilian Standard military	0 to 25 metres/second	A continuous narrow weave consisting of a threat that manoeuvres in a random pattern up to 45 degrees either side of its course.
Aircraft	2 square metres or greater	Light fixed wing Light rotary	0 to 64 metres/second	Closing, not evasive

Land Vehicles	2 square metres or greater	Standard civilian such as trucks, cars, motorcycles		Continuous, weave
Personnel		Armed or IED laden		

## 3.2 Surveillance

- 3.2.1 Each NRWS mount shall be provided with an Electro-Optical (EO) sensor suite that allows the Operator to detect, in both day and night conditions the threats listed in Table 1 to this Appendix at a range of 2,000 metres.
- 3.2.2 The NRWS EO sensor suite shall allow the Operator to identify, in both day and night conditions, the threats listed in Table 1 to this Appendix at a range of 1,800 metres, with the exception of the Personnel threat.
- 3.2.3 The NRWS EO sensor suite shall allow the Operator to conduct fall of shot observation at a range of 1,000 metres while using 0.50 Calibre tracer ammunition.
- 3.2.4 The NRWS EO sensor suite shall include a Thermal Imaging Camera (TIC).
- 3.2.4.1 The NRWS TIC shall be located on the NRWS Mount.
- 3.2.4.2 The NRWS TIC shall have a variable field of view.
- 3.2.4.3 The NRWS TIC shall have a Wide Horizontal Field of View (FOV) of at least 9.0 degrees.
- 3.2.4.4 The NRWS TIC shall have a Narrow Horizontal FOV in the range of 2.0 degrees to 4.0 degrees.
- 3.2.4.5 The NRWS TIC shall allow the Operator a 50 percent probability of identifying a unprotected man standing erect as described in STANAG 4512, characterized by a temperature difference, target to background, of 2K with a background temperature of 288K at a range of 1,600 metres and a visibility level characterized by an atmospheric IR attenuation factor of 0.2/kilometre in accordance with STANAG 4347.
- 3.2.5 The NRWS EO sensor suite shall include a day camera.
- 3.2.5.1 The NRWS day camera shall be located on NRWS Mount.
- 3.2.5.2 The NRWS day camera shall have a variable continuous zoom.
- 3.2.5.3 The NRWS day camera zoom shall perform at a minimum in all the ranges of horizontal FOV from 3.0 degrees to 40.0 degrees.



- 3.2.5.4 The NRWS day camera shall have a colour mode.
- 3.2.5.5 The NRWS day camera shall allow the Operator a 50 percent probability of identifying an unprotected man standing erect as described in STANAG 4512 at a range of 1,800 metres under the following conditions:
  - a. A clear day with atmospheric transmittance of 23.5 kilometres at sea level, in the visible wavelengths, 1E04 lux illuminance and line of sight;
  - b. A target contrast of 19%; and
  - c. Low turbulence conditions:  $C_n^2=1E-14$  (m<sup>-2/3</sup>).
- 3.2.6 The NRWS EO sensor suite shall include a Class 1 laser range finder (LRF) in accordance with American Standards Institute (ANSI) Z136.1, 2014.
  - 3.2.6.1 The NRWS LRF shall measure range of the threats listed in Table 1 at 2,000 metres.
  - 3.2.6.2 The NRWS LRF shall measure range with an accuracy of +/-5 metres against the threats listed in Table 1 when the threats are in the range of 200 metres to 1,000 metres.
- 3.2.7 The NRWS shall have a surveillance mode whereby the weapon shall be de-coupled from the EO sensor suite and elevated to a minimum of 15 degrees relative to the line of site of the EO sensor suite.

### **3.3 Acquisition and Tracking**

- 3.3.1 The NRWS shall be a real-time system such that the response to a selected function must be at such a rate that there is no delay discernible by the Operator.
- 3.3.2 The NRWS shall have mount velocities and accelerations, in order to track the threats listed in Table 1 on closing, crossing, and manoeuvring courses at ranges of 200 metres and above.
- 3.3.3 The NRWS shall enable the Operator to select a threat for automatic tracking.
- 3.3.4 The NRWS shall automatically acquire the threats listed in Table 1 to this Appendix in day conditions.
- 3.3.5 The NRWS shall automatically track the acquired threats in day conditions once selected by the Operator.
- 3.3.6 The NRWS shall automatically acquire the threats listed in Table 1 to this Appendix in night conditions.
- 3.3.7 The NRWS shall automatically track the acquired threats in night conditions once selected by the Operator.

- 3.3.8 The NRWS shall enable the Operator to remotely acquire and track threats.
- 3.3.9 The NRWS shall be a stabilized platform that maintains the EO sensor suite and weapon within 1.0 milliradian standard deviation pointing accuracy, while in Sea State 3 as defined in the World Meteorological Organization (WMO) code tables and as described in Table 4.
- 3.3.10 The NRWS shall acquire and track the threats listed in Table 1 to this Appendix at all ranges from 50 metres to 1,000 metres.
- 3.3.11 The NRWS shall automatically acquire the targets listed in Table 2 to this Appendix in day conditions.
- 3.3.12 The NRWS shall automatically track the acquired targets in day conditions once selected by the Operator.
- 3.3.13 The NRWS shall automatically acquire the targets listed in Table 2 to this Appendix in night conditions.
- 3.3.14 The NRWS shall automatically track the acquired targets in night conditions once selected by the Operator.

<u>Table 2 – Targets</u>			
<u>Type of Target</u>	<u>Example of Target</u>	<u>Size of Target</u>	<u>Range of Target</u>
Super structures of ships	Funnels and masts	2 square metre area	No less than 1,000 metres
Sub-structures of commercial vessels	Funnels, steering gear, doors, windows	2 square metre area	Up to and including 1,000 metres
Optically/Thermally discernible features	Doors, windows, hatches, exhaust plumes, markings (lettering/numbering/crests/stripes)	2 square metre area	No less than 1,000 metres

- 3.3.15 The NRWS shall automatically re-acquire and track stationary threats, in the event that the threat has been obstructed for up to and including 2 seconds.
- 3.3.16 The NRWS shall automatically re-acquire and track dynamic threats, in the event that the threat has been obstructed for up to and including 2 seconds.
- 3.3.17 The NRWS shall have an automatic re-acquisition probability of at least 90%.

3.3.18 The NRWS EO sensor suite shall be independently stabilized from the weapon cradle.

### **3.4 Fire Control and Engagement**

3.4.1 The NRWS shall produce a fire control solution on the threats listed in Table 1 to this Appendix while the threats are stationary at all ranges from 200 metres to 1,000 metres.

3.4.2 The NRWS shall produce a fire control solution on the threats listed in Table 1 to this Appendix while the threats are manoeuvring at all ranges from 200 metres to 1,000 metres.

3.4.3 The NRWS shall produce a fire control solution on the targets listed in Table 2 to this Appendix while the targets are stationary at all ranges from 200 metres to 1,000 metres.

3.4.4 The NRWS shall produce a fire control solution on the targets listed in Table 2 to this Appendix while the targets are manoeuvring at all ranges from 200 metres to 1,000 metres.

3.4.5 The NRWS shall produce a fire control solution within 16 seconds or less on threats listed in Table 1, when a verbal designation is given to the Operator of the surface threat range and surface threat bearing anywhere within the NRWS's weapon arc.

3.4.6 The NRWS shall automatically adjust the position of the weapon in accordance with the fire control solution.

3.4.7 The NRWS shall maintain the threat at the centre of the Operator Display when the fire control solution is applied.

3.4.8 This paragraph has been intentionally left blank.

3.4.9 This paragraph has been intentionally left blank.

3.4.10 The NRWS shall remotely charge (cock) the installed weapon when selected by the Operator.

3.4.11 The NRWS shall have remote selectable salvo sizes including 1 round, 3 rounds, and continuous firing.

3.4.12 The NRWS Operator Console shall enable the Operator to remotely train and elevate the weapon without stabilization.

3.4.13 The NRWS Operator Console shall enable the Operator to remotely train and elevate the weapon with stabilization.

3.4.14 The NRWS Operator Console shall enable the Operator to remotely fire the weapon.

- 3.4.15 The NRWS Mount shall be capable of being aimed locally, by physically removing or disengaging any drive system, disabling remote functions, and locally firing the weapon.
- 3.4.16 The NRWS Operator Console shall enable the Operator to offset the firing aim point when tracking threats and targets.
- 3.4.17 The NRWS Operator Console shall enable the Operator to engage the threats listed in Table 1 from 50 metres to at least 600 metres..
- 3.4.18 The NRWS shall maintain the threat at the centre of the Operator Display while engaging the threat.

### **3.5 Weapon Effectiveness**

- 3.5.1 The NRWS shall achieve at least 7 hits against a surface target within 16 seconds or less of obtaining a fire control solution where:
  - a. the FN M2 0.50 Calibre HMG is mounted;
  - b. the target has an aspect ratio of 2 by 1 and presents a vulnerable area of 2 square metres;
  - c. the surface target is closing the NRWS Mount at a speed through the water of 25 metres per second while conducting a continuous narrow weave;
  - d. not more than 50 rounds are expended; and
  - e. the engagement starts at 600 metres.
- 3.5.2 The NRWS shall achieve at least 7 hits against an air target within 16 seconds or less of obtaining a fire control solution where:
  - a. the FN M2 0.50 Calibre HMG is mounted;
  - b. the target has an aspect ratio of 2 by 1 and presents a vulnerable area of 2 square metres;
  - c. the target is closing the NRWS Mount at an airspeed of 64 metres per second, without evasive manoeuvres;
  - d. not more than 100 rounds are expended; and
  - e. the engagement starts at 600 metres.
- 3.5.3 The NRWS shall achieve a Circular Error Probable (CEP) of 2.5 milliradians or less where:
  - a. the target is a vertical panel with a centred, high contrast aim point;

- b. the target is towed on a steady course and at a speed of 8 to 10 knots;
- c. the firing ship is stationed such that a constant target bearing perpendicular to the target course +/- 2 degrees and a constant target range of 500 metres +/- 50 metres are maintained;
- d. the sea state is not less than Sea State 1 and not more than Sea State 3 as defined in the WMO code tables and as described in Table 4;
- e. the salvo size is 1;
- f. the sample size is not less than 100 rounds;
- g. CEP of 2.5 milliradians shall be interpreted to mean that not less than 50% of the rounds fired shall land on or within a circle of a radius equivalent to 2.5 milliradians for the range at the time of firing; and
- h. rounds fired for alignment/calibration are not scored or counted in the sample.

### **3.6 Power**

- 3.6.1 The NRWS shall be compliant with the electrical system requirements as specified in D-03-003-005/SF-000.
- 3.6.2 The NRWS shall utilize existing ships power infrastructure to provide power for the NRWS.
- 3.6.3 The NRWS shall operate in full compliance with this TSOR for not less than 10 minutes without ships power.

### **3.7 Weapon Aiming and Firing Limitation**

- 3.7.1 The NRWS System shall incorporate firing circuit interrupts.
  - 3.7.1.1 The NRWS System shall be configured with one firing circuit interrupt for port NRWS mounts and one firing circuit interrupt for starboard NRWS mounts.
  - 3.7.1.2 When the firing circuit interrupt is activated, the firing circuit interrupt shall interrupt the physical firing circuit and inhibit firing of the two NRWS controlled weapons.
  - 3.7.1.3 When the NRWS firing circuit interrupt is activated, the NRWS shall permit the Operator to remotely move the mount and utilize the NRWS EO sensor suite.
  - 3.7.1.4 When the NRWS firing circuit interrupt is activated, the NRWS shall permit the automatic tracking process.
- 3.7.2 The NRWS System shall have a firing enable key.

- 3.7.2.1 When inserted, the NRWS firing enable key shall enable all NRWS mount firing functions.
- 3.7.2.2 The NRWS firing enable key shall be installed in close proximity to each NRWS Operator Console.
- 3.7.3 The NRWS shall have a readily accessible override function located at the NRWS mount.
  - 3.7.3.1 When activated, the NRWS mount override function shall disable all functions controlled from the NRWS Operator Console.
  - 3.7.3.2 When activated, the NRWS mount override function shall have a two step disengagement process to prevent accidental disengagement of the override function.
- 3.7.4 The NRWS shall have safety interlocks that will prevent NRWS mount movement and firing functions in the event that the NRWS mount is not safe to operate.
- 3.7.5 If the NRWS has an onboard trainer, the onboard trainer shall incorporate software and hardware inhibits to prevent operation of the NRWS mounted weapon.
- 3.7.6 The NRWS shall have adjustable mechanical firing cut-outs for training, elevation and depression.
- 3.7.7 The NRWS shall have adjustable firing cut-outs in software to ensure the weapon cannot be fired within a distance of the ships silhouette (2.5 calibres (32 millimetres) from ship's hard obstructions and more for antennas).
- 3.7.8 The NRWS shall have an electronic means of aligning the EO sensor suite to the boresight of the weapon gun barrel.

### **3.8 Ammunition Handling**

- 3.8.1 The NRWS mount ammunition box shall accommodate not less than 200 rounds of linked 12.7 millimetre ammunition when the FN M2 0.50 Calibre HMG is mounted and not less than 400 rounds of linked 7.62 millimetre ammunition when the C6 machine gun is mounted.
- 3.8.2 The NRWS mount shall collect casings, rounds and links ejected from the weapon.
- 3.8.3 The NRWS mount ammunition box shall be located on the NRWS mount, without requiring access below deck.

### **3.9 Operator Console**

- 3.9.1 The NRWS System shall incorporate one NRWS Operator Console for each NRWS mount.

- 3.9.2 The NRWS Operator Console shall control the NRWS mount.
- 3.9.3 The NRWS Operator Console shall provide proportional control for laying the weapon in training and elevation.
- 3.9.4 The NRWS Operator Console shall provide positive and safe control for cocking, firing, and ceasing fire.
- 3.9.5 The NRWS Operator Console shall require two Operator actions to fire the NRWS mounted weapon.
- 3.9.6 The NRWS Operator Console shall incorporate a selector switch to allow operation of one of two NRWS mounts as selected by the Operator.
- 3.9.7 The NRWS Operator Console shall only control the NRWS mount that has been selected by the selector switch.
- 3.9.8 The NRWS Operator Console shall comply with MIL-STD-1472G section 5.10.3.2, section 5.10.3.4.4, section 5.10.3.7 and section 5.10.4.
- 3.9.9 The NRWS Operator Console selector switch shall allow operation of the selected NRWS mount only if the NRWS mount is not currently selected for operation.
- 3.9.10 The NRWS Operator Console shall have an Operator display.
  - 3.9.10.1 The NRWS Operator display shall have a display size of not less than 10 inches and resolution of not less than 800 x 600 pixels.
  - 3.9.10.2 The NRWS Operator display shall display all imaging information from the NRWS EO sensor suite.
  - 3.9.10.3 The NRWS Operator display shall display the range finding measurements.
  - 3.9.10.4 The NRWS Operator display shall display all NRWS operating modes.
  - 3.9.10.5 The NRWS Operator display shall display all Operator selectable screen functions.
  - 3.9.10.6 The NRWS Operator display shall display the current training and elevation status of the NRWS mount in:
    - a. true bearing; and
    - b. relative bearing to the ships head.
  - 3.9.10.7 The NRWS Operator display shall display a reticule graduated in degrees and milliradians.
  - 3.9.10.8 This paragraph has been intentionally left blank.

- 3.9.10.9 The NRWS Operator display shall display the number of rounds which have been fired.
- 3.9.10.10 The NRWS Operator display shall display the current NRWS status and any associated fault messages.
- 3.9.10.11 The NRWS Operator display shall display a safe to fire indicator.
- 3.9.10.12 The NRWS Operator display shall display a visual reference indicating the amount of time remaining for system operation once the NRWS is functioning on backup power.
- 3.9.10.13 The NRWS Operator display shall be dimmable by the Operator from complete luminosity to complete shutdown of luminosity.
- 3.9.10.14 The NRWS Operator display shall provide an exact replication of what is being displayed on the Operator display to an output source for viewing from a remote monitor.
- 3.9.10.15 The NRWS Operator display shall be in accordance with MIL-STD-1472G section 5.2.3.
- 3.9.11 The NRWS Operator Console shall incorporate Operator controls.
  - 3.9.11.1 The NRWS Operator controls shall incorporate a means to power each NRWS on and off.
  - 3.9.11.2 The NRWS Operator controls shall incorporate all controls required to maintain safe control over the NRWS mount.
  - 3.9.11.3 The NRWS Operator controls shall incorporate a means to wash the EO sensor suite optics.
  - 3.9.11.4 The NRWS Operator controls shall incorporate a means to de-ice EO sensor suite.
  - 3.9.11.5 The NRWS Operator controls shall incorporate all functions required to support surveillance and associated detection, recognition, and identification of threats.
  - 3.9.11.6 The NRWS Operator controls shall incorporate all functions required to select threats for tracking.
  - 3.9.11.7 The NRWS Operator controls shall incorporate all functions required for stabilization control for remotely tracking of threats.
  - 3.9.11.8 The NRWS Operator controls shall incorporate all functions required for stabilization control for remotely training and elevating the weapon.
  - 3.9.11.9 The NRWS Operator controls shall incorporate all functions required for selection of salvo sizes.



- 3.9.11.10 The NRWS Operator controls shall incorporate all functions required to position the weapon in accordance with the fire control solution.
- 3.9.11.11 The NRWS Operator controls shall incorporate all functions required for full operation of the weapon that is fitted to the mount.
- 3.9.11.12 The NRWS Operator controls required to fire the NRWS mount in an immediate and urgent operational situation shall be immediately accessible at all times.
- 3.9.11.13 The NRWS Operator controls shall incorporate all functions required for stabilization control.
- 3.9.11.14 The NRWS Operator controls shall incorporate all functions required to offset the firing aim point when tracking threats and targets.
- 3.9.11.15 The NRWS Operator controls shall incorporate all functions required for monitoring fall of shot.
- 3.9.11.16 This paragraph has intentionally been left blank.
- 3.9.11.17 The NRWS Operator controls shall incorporate all functions required for selection of NRWS operating modes.
- 3.9.11.18 The NRWS Operator controls shall incorporate on the screen only the Operator selectable settings for the mode the NRWS is functioning in.
- 3.9.11.19 The NRWS Operator controls shall be co-located with the NRWS Operator display.
- 3.9.11.20 The NRWS Operator controls shall be readable in all lighting conditions between direct sunlight and complete darkness.
- 3.9.11.21 The NRWS Operator controls shall be readable under red lighting conditions.
- 3.9.11.22 The NRWS Operator controls which emit light shall be dimmable by the Operator from complete luminosity to complete shutdown of luminosity.
- 3.9.11.23 The NRWS Operator controls markings shall be white on a dark background.
- 3.9.11.24 The NRWS Operator controls shall be suitable for an Operator subject to a dynamic marine environment.
- 3.9.11.25 The NRWS Operator controls shall respond to the Operator's input while the Operator is wearing full flash gear including gloves.
- 3.9.12 The NRWS shall have a video recorder.
  - 3.9.12.1 The NRWS video recorder shall record all that is displayed on the NRWS operator display.

- 3.9.12.2 The NRWS video recorder shall record for not less than 24 hours.
- 3.9.12.3 The NRWS video recorder shall record video with a date/time stamp.
- 3.9.12.4 The NRWS video recorder shall record video to common commercially available portable media.

### **3.10 Initialization and Built-In Test**

- 3.10.1 The NRWS shall initialise from a shutdown state to full functionality in accordance with this TSOR in:
  - a. less than 2 minutes, with the exception of the TIC, when selected by the Operator; and
  - b. less than 7 minutes, including the TIC, when selected by the Operator.
- 3.10.2 The NRWS shall automatically re-initialise from an abnormal shutdown to full functionality in accordance with this TSOR in:
  - a. less than 4 minutes, with the exception of the TIC; and
  - b. less than 10 minutes, including the TIC.
- 3.10.3 The NRWS shall enable the Operator to perform a controlled shut down.
- 3.10.4 The NRWS shall operate at a reduced level of performance in the event of a critical failure.
- 3.10.5 The NRWS Built-In Test (BIT) shall automatically detect faults.
- 3.10.6 The NRWS BIT shall monitor for faults on the TIC.
- 3.10.7 The NRWS BIT shall monitor for faults on the day camera.
- 3.10.8 The NRWS BIT shall monitor for faults on the LRF.
- 3.10.9 The NRWS BIT shall monitor for faults on the training/elevation system.
- 3.10.10 The NRWS BIT shall monitor for faults on the weapon control system.
- 3.10.11 The NRWS BIT shall monitor for faults on the power availability.
- 3.10.12 The NRWS BIT shall monitor for faults on the processing systems.
- 3.10.13 The NRWS BIT shall monitor for electrical faults on each Line Replaceable Unit (LRU).

3.10.14 The NRWS BIT shall display corresponding fault alarms to the Operator indicating the nature of the faults.

### **3.11 Onboard Trainer**

3.11.1 If the NRWS has an onboard trainer, the onboard trainer shall be either appended or embedded to the NRWS.

3.11.2 If the NRWS has an onboard trainer, when the onboard trainer is active, the NRWS shall display this mode on the NRWS Operator display.

3.11.3 If the NRWS has an onboard trainer, when the onboard trainer is active, the NRWS shall simulate the firing of the mounted weapon.

3.11.4 If the NRWS has an onboard trainer, the onboard trainer shall simulate the firing of NRWS without ammunition being present on the mount.

3.11.5 If the NRWS has an onboard trainer, the onboard trainer shall simulate the firing of NRWS without a weapon being present on the mount.

3.11.6 If the NRWS has an onboard trainer, the onboard trainer shall include not less than 5 pre-programmed naval combat scenarios.

3.11.7 If the NRWS has an onboard trainer, the onboard trainer combat scenarios shall vary in level of complexity.

3.11.8 If the NRWS has an onboard trainer, the onboard trainer shall include a control to exit the onboard trainer in not more than two Operator actions.

## **4. PHYSICAL REQUIREMENTS**

### **4.1 Equipment**

4.1.1 The NRWS components internal to the ship shall be capable of being installed in existing ship compartments.

4.1.2 The NRWS shall provide a means to singly mount each of the following weapons in one weapon cradle:

- a. FN M2 0.50 Calibre HMG; and
- b. 7.62 millimetre C6 machine gun.

4.1.3 The NRWS shall provide a means to mount the FN M2 0.50 Calibre HMG and 7.62 millimetre C6 machine gun without modification to the current configuration of these weapons held by Canada.

- 4.1.4 The NRWS shall have a cover to protect functional components of the mounted weapon.
- 4.1.5 The NRWS cover shall allow weapon firing at any time without cover removal.
- 4.1.6 The NRWS shall have a means to align the EO sensor suite and the mounted weapon to a common reference point on the ship.
- 4.1.7 The NRWS shall have a means to align the EO sensor suite and the mounted weapon to a common reference point at the maximum effective range of the NRWS.
- 4.1.8 The NRWS EO sensor suite shall incorporate an Operator controlled jet wash system to clean any debris impeding functionality of the EO sensor suite optics.
- 4.1.9 The NRWS EO sensor suite shall incorporate an Operator controlled de-icing system to melt any ice accumulation impeding functionality of the EO sensor suite.
- 4.1.10 This paragraph has been intentionally left blank.
- 4.1.11 The NRWS above deck components shall be painted in accordance with MIL-T-704 using topcoat in accordance with MIL-C-22750 and primer in accordance with MIL-P-53022.
- 4.1.12 The NRWS above deck components exterior painted surfaces shall be painted grey in colour in accordance with FED-STD-595C colour chip 26480.
- 4.1.13 The NRWS above deck components interior painted surfaces shall be painted white in colour in accordance with FED-STD-595C colour chip 17925.
- 4.1.14 The NRWS equipment handling shall be in accordance with MIL-STD-1472G sections 5.8.6 & 5.9.11.
- 4.1.15 The NRWS shall not employ existing shipboard hardware to meet the requirements of this TSOR with the exception of true heading information.
- 4.1.16 This paragraph has been intentionally left blank.
- 4.1.17 The NRWS shall be at a technology readiness level of at least 8 as defined in Technical Readiness Assessment Guidance, Department of Defense.

## **4.2 Range of Motion**

- 4.2.1 Each NRWS mount shall traverse continuously clockwise and counter-clockwise for 360 degrees in azimuth.
- 4.2.2 Each NRWS mount shall elevate the weapon to a minimum of 55 degrees above the horizontal plane.

4.2.3 Each NRWS mount shall depress the weapon to a minimum of 20 degrees below the horizontal plane.

### **4.3 Cables**

4.3.1 The NRWS cables shall have low smoke and halogen-free properties as specified in MIL-DTL-24643C.

4.3.2 The NRWS cabling shall be terminated as specified in C-03-007-181/ME-001.

4.3.3 The NRWS cabling shall be marked and labelled as specified in D-02-002-001/SG-001.

4.3.4 The NRWS cabling shall be shielded as specified in C-03-010-000/MM-001, section 6, paragraphs 118-168.

4.3.5 The NRWS cabling shall adhere to C-03-010-000/AG-001.

4.3.6 The NRWS cabling shall adhere to MIL-STD-1310H (Navy).

## **5. INTERFACE REQUIREMENTS**

### **5.1 Mechanical Interface Requirements**

5.1.1 The NRWS equipment shall incorporate the Contractor supplied seats, retention devices, and fasteners in order to mount them to corresponding seats on ship's structure.

5.1.2 The NRWS shall provide all required mechanical interfaces to existing shipboard systems such as cooling water, conditioned air, compressed air, and condensate drains that may be necessary for full operational capability.

5.1.3 The NRWS shall provide all mechanical interfaces to existing shipboard systems that may be necessary for full operational capability without degrading the performance of any existing shipboard system.

5.1.4 The NRWS shall provide all mechanical interfaces to existing shipboard systems that may be necessary for full operational capability without interfering with the use of these systems for their existing primary functions.

### **5.2 Electrical Interface Requirements**

5.2.1 The NRWS shall provide all required electrical interfaces to existing electrical shipboard systems that may be necessary for full operational capability.

5.2.2 The NRWS shall provide all electrical interfaces to existing shipboard systems that may be necessary for full operational capability without degrading the performance of any existing shipboard system.

5.2.3 The NRWS shall provide all electrical interfaces to existing shipboard systems that may be necessary for full operational capability without interfering with the use of these systems for their existing primary functions.

### **5.3 Signal Interface Requirements**

5.3.1 The NRWS shall provide all signal interfaces to existing shipboard systems that may be necessary for full operational capability without degrading the performance of any existing shipboard system.

5.3.2 The NRWS shall provide all signal interfaces to existing shipboard systems that may be necessary for full operational capability without interfering with the use of these systems for their existing primary functions.

5.3.3 The NRWS shall provide all signal interfaces to existing shipboard systems that may be necessary for full operational capability without jeopardizing existing certifications of these systems.

## **6. SPECIALTY ENGINEERING REQUIREMENTS**

### **6.1 Health and Safety**

6.1.1 The NRWS shall out-gas in a manner that does not pose a health hazard to humans.

6.1.2 The NRWS shall be flame resistant, non-combustible and fire retardant.

6.1.3 The NRWS shall preclude electrical hazards in accordance with MIL-STD-1472G section 5.7.9.1 and D-03-003-005/SF-000 section 1.3.3.

6.1.4 The NRWS shall preclude mechanical hazards in accordance with MIL-STD-1472G section 5.7 and D-03-003-005/SF-000 section 1.3.3.

6.1.5 The NRWS shall generate noise levels that are in accordance with MIL-STD-1472G section 5.5.4.

6.1.6 The NRWS shall be designed for maintenance as described in MIL-STD-1472F section 5.9 and D-03-003-005/SF-000 section 1.3.7, to ensure that all required preventative and corrective maintenance functions may be completed.

6.1.7 The NRWS shall be grounded in accordance with the requirements of D-03-003-005/SF-000 part 4 and MIL-STD-1310H (Navy) section 3.20.

### **6.2 Availability**

6.2.1 The NRWS shall have no less than 98% availability, 24 hours a day, seven days a week, throughout a deployed period of no less than 90 days considering the typical usage patterns as outlined Table 3.

Table 3 – Typical NRWS Usage During a Deployed Period of 90 days	
NRWS	90% turned on
NRWS TIC	30% TIC usage
NRWS day camera	45% usage for surveillance
NRWS rounds fired	600 rounds per NRWS mount

6.2.2 The NRWS shall be available for not less than 250 days per calendar year.

6.2.3 Any NRWS electrical single point of failure shall permit the local operation of the NRWS mounted weapon.

### **6.3 Survivability**

6.3.1 The NRWS shall withstand exposure to conditions up to and including Sea State 6 as defined in the WMO code tables and as described in Table 4.

Table 4 - Halifax Class Motions and Accelerations at Mount Locations

These results are the maximum expected ship motions and accelerations at the proposed installation locations at the respective sea state and speed with a 99% confidence level. The results provided are predictions and appropriate safety factors shall be applied. These results do not take into account any shock and/or blast requirements.

	Speed [knots]	Displacement			Velocity	Acceleration		
		Vertical [m]	Lateral [m]	Longitudinal [m]	Vertical [m/s]	Vertical [m/s <sup>2</sup> ]	Lateral [m/s <sup>2</sup> ]	Longitudinal [m/s <sup>2</sup> ]
Sea State 2	0	0.03	0.02	0.01	0.04	0.01	0.01	0.00
	5	0.15	0.10	0.00	0.20	0.03	0.03	0.01
	10	0.15	0.10	0.19	0.25	0.04	0.04	0.01
	15	0.29	0.34	0.19	0.25	0.04	0.04	0.01
	20	0.20	1.25	0.29	0.25	0.04	0.04	0.01
	25	0.33	0.52	0.14	0.25	0.04	0.05	0.01
	30	0.39	0.55	0.15	0.25	0.04	0.05	0.01
Sea State 3	0	0.39	0.16	0.06	0.48	0.06	0.03	0.01
	5	1.8	0.8	0.25	2.35	0.32	0.13	0.05
	10	1.6	0.85	0.29	2.2	0.32	0.14	0.06
	15	1.54	1.06	1.38	2.01	0.31	0.14	0.06
	20	1.54	2.02	1.44	1.94	0.29	0.15	0.06
	25	1.54	4.21	1.56	1.94	0.28	0.15	0.06
	30	1.85	11.11	2.52	1.89	0.26	0.15	0.06
Sea State 4	0	0.9	0.42	0.1	0.98	0.11	0.05	0.01
	5	4.62	2.13	0.55	5.26	0.64	0.26	0.08
	10	4.68	2.18	0.64	5.57	0.7	0.26	0.09
	15	4.59	2.35	2.9	5.73	0.75	0.27	0.11
	20	4.43	5.53	4.55	5.65	0.77	0.27	0.11
	25	5.24	14.92	8.64	5.51	0.78	0.28	0.13
	30	5.43	27.13	8.11	5.27	0.78	0.28	0.14
Sea State 5	0	1.41	0.96	0.18	1.24	0.12	0.07	0.02
	5	7.38	4.78	1.52	6.62	0.69	0.34	0.08
	10	7.85	4.73	2.61	7.61	0.80	0.35	0.09
	15	8.18	4.64	5.84	8.58	0.96	0.35	0.12
	20	8.41	10.11	17.43	9.36	1.11	0.34	0.16
	25	9.39	21.86	24.88	9.94	1.24	0.35	0.19
	30	9.19	25.95	19.87	10.27	1.33	0.37	0.21
Sea State 6	0	2.17	1.70	0.44	1.58	0.15	0.09	0.02
	5	10.92	8.20	3.54	8.67	0.80	0.44	0.10
	10	11.35	7.91	5.95	9.83	0.94	0.44	0.12
	15	11.82	7.57	11.40	11.17	1.14	0.44	0.14
	20	12.35	11.69	27.93	12.60	1.39	0.45	0.17
	25	12.92	24.70	42.98	13.93	1.67	0.46	0.22
	30	13.34	33.97	32.17	14.93	1.90	0.47	0.27



## **6.4 Maintainability**

- 6.4.1 The NRWS daily preventive maintenance shall be less than 30 minutes in total in a 24 hour period.
- 6.4.2 This paragraph has been intentionally left blank.
- 6.4.3 The NRWS MTTR shall be less than 1 hour for corrective maintenance repair functions which includes combined diagnostic and LRU replacement time but does not include time associated with provisioning the LRU.
- 6.4.4 The NRWS shall enable an Operator to install the NRWS mountable weapons while standing on the deck beside the NRWS mount.
- 6.4.5 The NRWS shall enable an Operator to load the NRWS mounted weapon with ammunition while standing on the deck beside the NRWS mount.
- 6.4.6 The NRWS shall enable an Operator to empty the spent cartridges/casings/links container(s) while standing on the deck beside the NRWS mount.
- 6.4.7 The NRWS shall enable an Operator to clear ammunition jams while standing on the deck beside the NRWS mount or on inboard platforms that are provided with the NRWS.
- 6.4.8 The NRWS shall enable an Operator to change gun barrels while standing on the deck beside the NRWS mount or on inboard platforms that are provided with the NRWS.

## **6.5 This section has been intentionally left blank**

## **6.6 Nameplates and Product Marking**

- 6.6.1 The NRWS shall be marked and labelled in accordance with D-02-002-001/SG-001.
- 6.6.2 The NRWS equipment weighing more than 15 kilograms shall be marked to identify its weight.
- 6.6.3 The NRWS equipment that presents a hazard to personnel shall be labelled in accordance with the requirements of MIL-STD-1472G Section 5.7.2.1.

## **7. ENVIRONMENTAL REQUIREMENTS**

### **7.1 Ship's Motion and Sea State**

- 7.1.1 The NRWS shall operate while the ship has a permanent list within the range of -20 to +20 degrees.
- 7.1.2 The NRWS shall operate while the ship has a permanent trim of 5 degrees.

- 7.1.3 The NRWS shall operate while the ship is rolling within the range of -40 to +40 degrees.
- 7.1.4 The NRWS above deck equipment shall operate in accordance with this TSOR after immersion in a mean green water load of 42 kilopascals.
- 7.1.5 The NRWS shall operate in conditions up to and including Sea State 5 as defined in the WMO code tables and as described in Table 4.

## **7.2 Mechanical Shock**

- 7.2.1 The NRWS equipment enclosures, mounts, and retention devices shall prevent equipment deflection that could be hazardous to personnel or other shipboard equipment under exposure to shock conditions specified in D-03-003-007/SF-000 Grade 1 Type A, Section 6.
- 7.2.2 The NRWS equipment shall have restraints fitted that preclude equipment from becoming projectiles; remain fully intact, and in their normal operational positions, under exposure to shock conditions specified in D-03-003-007/SF-000 Grade 1 Type A, Section 6.
- 7.2.3 The NRWS equipment shall operate in accordance with this TSOR following exposure to shock conditions specified in D-03-003-007/SF-000 Grade 1 Type A, Section 6.

## **7.3 Vibration**

- 7.3.1 The NRWS equipment enclosures, mounts, and retention devices shall remain fully intact, and in their normal operational positions, when excited by Type 1 environmental vibration levels up to and including 33Hz as specified in MIL-STD-810G, method 528.1.
- 7.3.2 The NRWS equipment shall operate in accordance with this TSOR when excited by Type 1 environmental vibration levels up to and including 33Hz as specified in MIL-STD-810G, method 528.1.

## **7.4 Electromagnetic Effects**

- 7.4.1 The NRWS shall operate in accordance with this TSOR when subjected to the shipboard electromagnetic environments specified by MIL-STD-461F, Section 5, requirements CE101, CE102, RE101, and RE102.
- 7.4.2 The NRWS shall not generate an electromagnetic environment that exceeds the standards described in MIL-STD-461F, Section 5, requirements CS101, CS114, CS116, RS101, and RS103.
- 7.4.3 The NRWS shall not generate radiated electromagnetic interference emissions into other nearby systems as specified in C-03-010-000/MM-001, Part 4.

## **7.5 Temperature, Humidity, and Solar Radiation**

- 7.5.1 The NRWS equipment not exposed to the weather shall operate in accordance with this TSOR in temperatures ranging from 0 to 40 degrees Celsius.
- 7.5.2 The NRWS equipment exposed to the weather shall operate in accordance with this TSOR in temperatures ranging from -32 to 40 degrees Celsius.
- 7.5.3 The NRWS equipment shall withstand the storage and transit conditions specified for Categories M1, M2, and M3 of STANAG 2895.
- 7.5.4 The NRWS equipment shall operate in accordance with this TSOR in 95% humidity condensing environment.
- 7.5.5 The NRWS equipment exposed to the weather shall operate in accordance with this TSOR when exposed to the solar environment described in MIL-STD-810G, method 505.6 Procedure II.

## **7.6 Wind**

- 7.6.1 The NRWS equipment exposed to the weather shall operate in accordance with this TSOR under the sustained winds, plus gusts as described in STANAG 2895 Table 26.
- 7.6.2 The NRWS equipment exposed to the weather shall not sustain damage when subjected to sustained winds of 50 metres/second.

## **7.7 Rainfall, Dust, and Spray**

- 7.7.1 The NRWS equipment exposed to the weather shall operate in accordance with this TSOR under rainfall conditions of 0.8 millimetres per minute.
- 7.7.2 The NRWS equipment exposed to the weather shall operate in accordance with this TSOR under dust concentrations of 1gram per cubic metre.
- 7.7.3 The NRWS equipment located in a sheltered environment shall operate in accordance with this TSOR when in a drip environment as identified in MIL-STD-810G, method 506.6, Procedure III.
- 7.7.4 The NRWS electrical equipment exposed to the weather shall be watertight, spray tight, and dust proof in accordance with MIL-STD-108E.

## **7.8 Ice**

- 7.8.1 The NRWS equipment exposed to the weather shall operate in accordance with this TSOR when subjected to conditions which produce icing loads of up to and including 20 kilograms per square metre.
- 7.8.2 The NRWS equipment exposed to the weather shall not be damaged by an icing load of up to and including 37 kilograms per square metre except as otherwise specified in TSOR requirement 7.8.3.
- 7.8.3 The NRWS equipment exposed to the weather shall not be damaged by an icing load of up to and including 180 kilograms per square metre if located in the forward one-third of the ship and below a line parallel to and 12.2 metres above the Halifax Class vessels design waterline.

## **7.9 Corrosion and Salt Fog**

- 7.9.1 The NRWS above deck components shall be constructed from galvanic compatible materials.
- 7.9.2 The NRWS above deck components exposed to the weather shall be constructed from materials with surface treatments in order to preclude failure due to oxidation and corrosion.
- 7.9.3 The NRWS above deck components exposed to the weather shall not corrode when subjected to the tests as described in ASTM G7, ASTM G31, ASTM G50, and ASTM G52.
- 7.9.4 The NRWS shall be resistant to the effects of salt deposits on the physical aspects of materiel when subjected to the test described in method 509.6 of MIL-STD-810G.
- 7.9.5 The NRWS shall be resistant to the effects of salt deposits on the electrical aspects of materiel when subjected to the test described in method 509.6 of MIL-STD-810G.

## **8. SUPPORTABILITY**

- 8.1 The NRWS shall have an operational life expectancy of not less than 15 years.
- 8.2 The NRWS shall accommodate the facilitation of new technologies, including, but not limited to, the upgrade of individual sensors, without having to replace other components.
- 8.3 The NRWS hardware architecture shall be an open architecture format.