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**Canada**  
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TEST PROJECT DAY 1 / PROJET D'ÉPREUVE JOUR 1

**INDUSTRIAL**  
**CONTROL**

**CONTRÔLE**  
**INDUSTRIEL**

POST - SECONDARY /  
NIVEAU POSTSECONDAIRE



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## **1. INTRODUCTION**

### **1.1 General**

With this challenge, we will assess your abilities in the following criteria:

- a) Ability to analyze technical data.
- b) Quality of wiring.
- c) Capacity to implement an automatic process.
- d) Troubleshooting techniques.
- e) Abilities for error detection.



### **1.2 Step A: Installation of Electrical Raceways and Components as per specifications**

Part of all process type projects is the installation of the raceways and components that function as inputs and outputs. We will assess the quality of your installation, interpretation of site drawings, and precision of equipment placement.

### **1.3 Step B: Wiring an automated process within a panel**

As a technician, you should have the ability to completely wire a system and make the necessary modifications. We will assess the quality of your manual work, the organization of components, and the use of materials provided.

### **1.4 Step C: Programming the automated process**

You are provided with a function, and you must program the automated process with your PLC and the provided VFD. The system must be functional, and adhere to the instructions.

### **1.5 Step D: Commissioning, Start-up and Troubleshooting**

Your ability to validate the safety of your installation prior to power up and/or detect and solve problems will be assessed.

## 2. Conductors

### 2.1 Size and use

1. Power connections must be 14 AWG gauge.
2. Control conductors must be 16 AWG gauge.
3. Ground conductors must be 14 or 16 AWG gauge (according to needs).
4. Any exceptions to paragraphs 1, 2 & 3 will be specifically mentioned on the drawings.

### 2.2 Colour Code

The following colour code must be used to distinguish circuits:

1. Single phase	Identified Conductor → White	
	Line	→ Red
2. Three phases	Line	→ Red, Black, Blue
3. DC Control		→ Blue
4. Bonding/Grounding		→ Green
5. Input/output	18/2 Cable	→ White
		→ Black
	18/3 Cable	→ Red
		→ Black
		→ White
6. Motor Connections	14/4 Cable	→ Red
		→ Black
		→ White
		→ Green



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### **3. General Description**

#### **3.1 Process Description**

The Canadian Government has recently decided to overhaul and upgrade its fleet of Naval Frigates. As part of this maintenance overhaul, the artillery firing system will be upgraded to improve overall reliability, maintainability and improve overall mission performance.

The Trade 19 project represents the portion of the automated process for loading and positioning of ammunitions for firing in the naval ship 5-inch MK 45 on board gun.

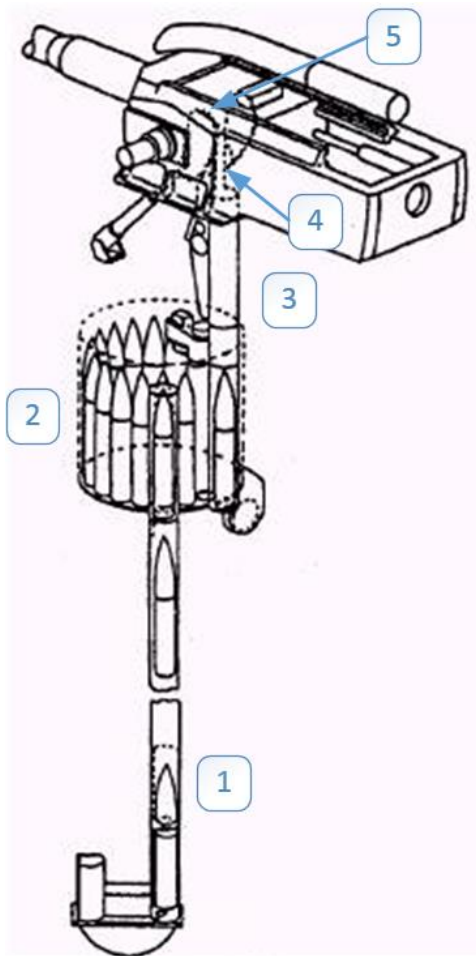
The auto-loading of ammunition is an integral part of the firing system and is critical for efficient mission success. The enhanced system upgrades to be introduced have been specifically tailored to allow the system to handle and fire high energy munitions, and to optimize performance and safety of new and existing ammunition types.

#### **3.2 Process Equipment Description**

The system consists of the following components:

- Control panel equipped with:
  - Green (L1), Amber (L2) & Red (L3) stack lights
  - Emergency Stop push-pull button (PB1A)
  - Green (PB2), Red (PB3) and Black (PB4A) momentary push buttons
  - Maintained 3 positions selector switch (SS1)
  - White (L4) pilot light
- Lower hoist (Driven by the FVD)
- Loader drum (Fed by Sol 1 and Driven by K1)
- Upper hoist (Driven by the K3F/K3R)
- Cradle (Fed by Sol 2)
- Breech (Fed by K2)
- 3 holes button station equipped with:
  - Buzzer (BZ)
  - Red illuminated (PLB5) momentary push button
  - Black (PB4B) momentary push button
- 1 hole button station equipped with:
  - Emergency Stop push-pull button (PB1B)

### 3.3 – Process Diagram



- 1) Lower hoist
- 2) Loader drum
- 3) Upper hoist
- 4) Cradle
- 5) Breech

## **4. Technical Details**

### **4.1 Emergency Stop Circuit**

The system is equipped with two general Emergency Stop push-pull buttons.

The Emergency Stop buttons mounted on the Control Panel Door and on the remote button station will be used in conjunction with a 24Vdc relay (non-PLC) to create a Master Control Relay (MCR)/Emergency Stop Circuit. The 24Vdc relay will be equipped with both normally-open and normally-closed contacts, as required.

When an Emergency Stop button is depressed, The Master Control Relay/Emergency Stop Circuit will de-energize all the PLC's outputs.

All the PLC's outputs shall remain de-energized, until all the Emergency Stop buttons are reset (pulled).

The following tables are a recommended assignment of the inputs and outputs for your programmable control. As controllers vary in how they are connected and function, you must check your particular PLC to see if these assignments are suitable.

## 4.2 - Inputs

Input Detail	Symbol	Contact Type	PLC inputs Assignment
Master Control Relay / Emergency Stop Circuit	MCR	NO	In0
Green push button	PB2	NO	In1
Red push button	PB3	NC	In2
Black push buttons	PB4A/B	NO	In3
3 positions Selector Switch 1 - Left Position	SS1_1	NO	In4
3 positions Selector Switch 1 - Right Position	SS1_3	NO	In5
Illuminated Red push button	PBL5	NO	In6
Contactor K1, K2, K3 Overloads	K_OL	NO	In7
VFD fault	VFD_FLT	NO	In8
Optical sensor 1	PE1	NO	In9
Optical sensor 2	PE2	NO	In10
Optical sensor 3	PE3	NO	In11
Limit switch 1	LS1	NC	In12
Limit switch 2	LS2	NC	In13
Limit switch 3	LS3	NC	In14
Limit switch 4	LS4	NC	In15



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### 4.3 Outputs

Output Detail	Symbol	PLC outputs Assignments
Green stack light	L1	Q0
Amber stack light	L2	Q1
Red stack light	L3	Q2
Illuminated Red push button	PBL5	Q3
Buzzer	BZ	Q4
Contactor K1	K1	Q5
Contactor K2	K2	Q6
Contactor K3 Forward	K3_F	Q7
Contactor K3 Reverse	K3_R	Q8
Solenoid 1	SOL1	Q9
Solenoid 2	SOL2	Q10
VFD Digital Input 02 (Forward command)	VFD02	Q11
VFD Digital Input 03 (Reverse command)	VFD03	Q12



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