**Assignment #2 – Template**

*Software Requirements Specification*

# Revision History

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| **Date** | **Revision** | **Description** | **Author** |
| 02/06/2024 | 1.0 | Initial Version | Pravat Kiran Timsina |
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| **1.** | **Purpose** |

This document outlines the requirements for the Mine Pump Control System (MPC).

## 1.1. Scope

The MPC System monitors and manages the flood level and methane level in the mining chamber. The MPC System oversees flood levels using HWS (High Water Sensor) and LWS (Low Water Sensor) in mining chambers, triggering automatic water pumping at specified thresholds. Also, They MPC system increases safety by triggering an evacuation alarm when methane level reaches to certain levels. MPC system is within compliance with federal monitoring standard. It will also cover different MPC hardware and software such as sensors, pump control, logging system, data access and different user roles to access that software.

## 1.2. Definitions, Acronyms, Abbreviations

HWS - High Water Sensor

LWS - Low Water Sensor

MS - Methane Sensor

OM - Operator Module

SM - Supervisor Module  
  
PCM - Pump Control Mechanism

UDC - User Data Center

SEA - Security and Authentication

LMM - Logging and Monitoring Module

FMS - Federal Monitoring Standards

SRD - System Requirements Document

SCC - System Compliance Checker

DLM - Data Logging Module

TCS - Temperature Control System

HMI - Human-Machine Interface

## 1.3. References

Use Case Specification Document.docx

UML Use Case Diagrams Document.docx

UML Class Diagrams.docx

Sequence Diagrams – Step 6 in assignment description.

## 1.4. Overview

The Mine Pump Control System (MPC), is designed to monitor and pump flood water out of mine shafts. As underground mining operations take place far below the water table, flooding into mine galleries and shafts is an ever-present danger.

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| **2.** | **Overall Description** |

## 2.1. Product Perspective

**2.2. Product Architecture**

The system is composed of distinct hardware and software elements, including the Data Collection Module, Log Manager Module, and Override Module. It is imperative that the system architecture adheres to established Object-Oriented (OO) design principles, ensuring a standardized and effective design approach.

## 2.3. Product Functionality/Features

The high-level features of the system are as follows (see section 3 of this document for more detailed requirements that address these features):  
The main features of this particular system is to detect the water and methane level, and to send the useful information to the main controller whenever its necessary. Adding on this system itself can start or stop the water pump.

## 2.4. Constraints

2.4.1 The system's reaction time is contingent upon the proximity of the MPC system to the physical sensors, with geographical distance influencing system responsiveness.

2.4.2 The system ensures broad accessibility by users, allowing interaction through any web browser without incorporating browser-specific code.

2.4.3 The MPC system is constrained to operate within standard conditions for underground mines, encompassing acceptable ranges of temperature, humidity, and pressure to ensure reliable functionality.

2.4.4 The system is dependent on a consistent and reliable power supply for continuous operation, underscoring the importance of an uninterrupted power source.

2.4.5 Compliance with federal monitoring standards is a non-negotiable constraint, emphasizing adherence to regulations governing mine safety and environmental monitoring.

## 2.5. Assumptions and Dependencies

2.5.1 It is assumed that the operational environment for the Mine Pump Control (MPC) system will be within standard operating conditions for underground mines, including temperature, humidity, and pressure ranges.

2.5.2 The accuracy and reliability of the high and low water sensors, as well as the methane sensor, are assumed to meet industry standards. Any deviations may impact the effectiveness of the system.

2.5.3 The availability of a reliable power supply is assumed. The system relies on continuous power to operate the sensors, pump control mechanisms, and user authentication components   
2.5.4 It is assumed that users, including Operators and Supervisors, will undergo training on the proper use and interpretation of the MPC system. Adequate training is essential for accurate decision-making and system control.

2.5.5 The proper functioning of the user authentication system is dependent on successful integration with the MPC system. Any issues in the authentication system may impact user access and security.

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| **3.** | **Specific Requirements** |

## 3.1. Functional Requirements

**3.1.1. Common Requirements:**

3.1.1.1 The Mine Pump Control System should authenticate users through a secure login process, requiring a valid username and password. Usernames and passwords must be alphanumeric strings with a length between 6 and 20 characters.

3.1.1.2 The system should feature HTML-based help pages accessible on each screen, providing detailed information about the purpose and functionality of each component within the Mine Pump Control System.

**3.1.2. Operator Module Requirements:**

3.1.2.1 The Operator Module should allow users to log in using their issued ID and PIN. ID and PIN should be alphanumeric strings with a length between 6 and 20 characters.

3.1.2.2 Upon successful login, the Operator Module should grant access to pump control functionalities, enabling the operator to start or stop the pump based on water level conditions within the specified range.

**3.1.3. Supervisor Module Requirements:**

3.1.3.1 The Supervisor Module should provide secure login functionality, requiring supervisors to authenticate using their assigned credentials—username and password, both alphanumeric strings with a length between 6 and 20 characters.

3.1.3.2 After successful login, the Supervisor Module should allow supervisors to initiate pump control actions, including starting or stopping the pump at any time, overriding automatic behavior when necessary.

3.1.3.3 The Supervisor Module should enable supervisors to access the system logs for the last 30 days and add notes to specific log events within a 24-hour timeframe.

**3.1.4. Methane Sensor Module Requirements:**

3.1.4.1 The Methane Sensor Module should continuously monitor methane levels and trigger an evacuation alarm when dangerous levels are detected.

**3.1.5.** **Water Sensor Module Requirements:**

3.1.5.1 The Water Sensor Module should trigger the pump control actions, initiating pump startup when water levels exceed the maximum threshold and stopping the pump when levels fall below the minimum threshold.

**3.1.6.** **Main Controller Module Requirements:**

3.1.6.1 Main Controller Module should coordinate and integrate functionalities from various modules, including initiating pump actions, triggering the methane alarm, and collecting data from sensors.

3.1.6.2 The Main Controller Module should log operational times, events, and any system errors for future analysis and reference.

**3.1.7. Data Collection Module Requirements:**

3.1.7.1 The Data Collection Module should collect, store, and manage data from various sensors, including water level and methane sensors.

3.1.7.2 The Data Collection Module should support queries for historical sensor data, allowing users (Supervisors) to access readings for the last 30 days.

**3.1.8. Override Module Requirements:**

3.1.8.1 The Override Module should allow authorized users (Supervisors) to manually control pump actions, overriding automatic behaviors set by other modules.

## 3.2. External Interface Requirements

3.2.1 The Water Sensor Module must establish an interface with the water level sensors deployed in mine shafts. The interface should capture real-time water level data and transmit it securely to the Main Controller Module. The data format should include timestamped readings with the following fields: sensor ID, water level, and sensor status.

3.2.2 The Methane Sensor Module must integrate with methane sensors within the mining environment. The interface should continuously receive methane concentration data and communicate it securely to the Main Controller Module. The data format should include timestamped readings with the following fields: sensor ID, methane concentration, and sensor status.

3.2.3 The Main Controller Module must provide an interface for pump control actions triggered by water and methane sensors. This interface should allow seamless communication with the Pump Control Mechanism, ensuring timely startup and shutdown commands. The communication protocol should be secure, and the interface should include commands for starting the pump, stopping the pump, and activating the evacuation alarm.

## 3.3. Internal Interface Requirements

3.3.1 The Main Controller Module and Data Collection Module must have an internal interface to ensure seamless logging of operational times, events, and errors. The interface should enable the Main Controller to log pump control actions and trigger events, while the Data Collection Module logs sensor readings. The logging system should store logs in a secure and retrievable format for future analysis.

3.3.2 The Data Collection Module should establish an internal interface with the Water Sensor Module, Methane Sensor Module, and Pump Control Interface. This interface aims to collect, process, and store sensor data efficiently. The Data Collection Module should store data in a structured database, including timestamped sensor readings, sensor statuses, and pump control events.

3.3.3 The Supervisor Module must internally integrate with the Data Collection Module and Logging System. This interface allows supervisors to access historical sensor data, system logs, and add notes to specific log events within a 24-hour timeframe. The Supervisor Module should provide a user-friendly interface for efficient interaction with the system logs and data.

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| **4.** | **Non-Functional Requirements** |

## 4.1. Security and Privacy Requirements

4.1.1 The Mine Pump Control System must implement robust encryption protocols for securing data transmission across various electronic components, ensuring the confidentiality and integrity of sensitive information.  
  
4.1.2 The system should refrain from storing any personal information without explicit user consent, prioritizing user privacy and adhering to data protection regulations.  
  
4.1.3 User authentication is mandatory for accessing system logs and reports. This security measure ensures that only authorized personnel, such as operators and supervisors, can review critical system information.

## 4.2. Environmental Requirements

4.2.1 Operating Temperature range should be in between 40-80 degrees Fahrenheit.   
4.2.2 Humidity levels should be between 30-70%.

## 4.3. Performance Requirements

4.3.1 The system must render all user interface pages efficiently. Dynamic pages should load within 9 seconds, while static pages (HTML-only) must render in less than 3 seconds, ensuring a responsive and user-friendly experience for operators and supervisors.