# Assignment #2

Software Requirements Specification

Revision History

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| **Date** | **Revision** | **Description** | **Author** |
| 09/10/2023 | 1.0 | Initial Version | Kat Webb |
| 09/19/2023 | 1.1 | Modules and Use Cases Edited | Kat Webb |
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# Purpose

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

## Scope

This document will catalog the user, system, and hardware requirements for the MPC system. It will not, however, document how these requirements will be implemented.

## Definitions, Acronyms, Abbreviations

Water table – the point which divides the area of the soil which is saturated with water and the area of the soil that consists of topsoil.

PPM – parts per million (unit of measurement), used in this document when referring to the amount of methane in the air.

N – usually and abbreviation for number, meaning the number of methane particles found in the air. When combined with the PPM abbreviation, these become N PPM, or the number of methane particles found per million particles of anything in the air.

## References

Use Case Specification Document

UML Use Case Diagrams Document

Class Diagrams

Sequence Diagrams

## 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.

# Overall Description

## Product Perspective

## Product Architecture

This system will be organized into five modules – the pump module, the high-water sensor module, the low water sensor module, the evacuation alarm module, and the methane sensor module.

## 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):

## Constraints

SR7 Because the pump is affected by both the methane sensor and the water sensors, the methane alarm, water level high and low sensors, and methane sensor must all be on the same system.

## Assumptions and Dependencies

It is assumed that there will be constant access to power via the mine’s electrical system or a generator.

# Specific Requirements

## Functional Requirements

### Common Requirements:

3.1.1.1 SR9 Supervisors should be able to log into the methane and water level sensor systems and view logs within 24 hours of an event.

3.1.1.2 Supervisors and Operators should be able to view logs of water pump start and stop, methane sensor readings from every 30 minutes, and evacuation alarm triggers. Furthermore, the date, time, and actor will be recorded as well.

### Pump Module Requirements:SR10

3.1.2.1 The system should pump water out of the cave when the sensor detects that the water level is too high.

3.1.2.2. The system should stop pumping when the water has reached a safe level which is specified by the sensor.

3.1.2.3 The system should stop pumping when the methane sensor determines there is an unsafe amount of methane in the air.

3.1.2.4 The system should be able to stop or start pumping upon supervisor request.

### High Water Sensor Module Requirements:SR10

3.1.3.1 The sensor should activate the water pump if it detects water.SR9 The syThe

3.1.3.2 The sensor should deactivate upon the water level lowering below the sensor.SR9 The syThe

3.1.3.3 The sensor should not activate if the water level is not at the sensor’s height.SR9 The syThe

3.1.3.4 The sensor should be constantly checking for water in case it needs to activate the pump. SR9 The syThe

3.1.3.5 The sensor should notify the water sensor log that it has been activated so that the log can record the activation.SR9 The syThe

### Low Water Sensor Module Requirements:SR10

3.1.4.1 The sensor should deactivate the water pump if it detects air.SR9 The syThe

3.1.4.2 The sensor should deactivate upon the water level rising above the sensor.SR9 The syThe

3.1.4.3 The sensor should not activate if the water level is above the sensor’s height.SR9 The syThe

3.1.4.4 The sensor should be constantly checking for air in case it needs to deactivate the pump. SR9 The syThe

3.1.4.5 The sensor should notify the water sensor log that it has been activated so that the log can record the activation.

### Methane Sensor Module Requirements:SR10

3.1.4.1 The sensor should constantly be reading the current level of methane gas.SR9 The syThe

3.1.4.2 Upon detection of N PPM methane gas, the system should send a message to the water pump telling it to cease pumping if it is doing so.SR9 The syThe

3.1.4.3 Upon detection of N PPM methane gas, the system should ping the evacuation alarm and tell it to begin ringing.SR9 The syThe

3.1.4.4 After activation, the methane sensor should continuously check for gas levels having fallen below the N PPM threshold.SR9 The syThe

3.1.4.5 The sensor should notify the log that it has been activated so that the log can record the activation.SR9 The syThe

3.1.4.6 Supervisors should be able to add notes to the methane sensor log up to 24 hours after an event.

3.1.4.7 Operators and supervisors should be able to access and view a log of the sensor trips that took place in the methane sensor.

3.1.4.8 Once methane level has fallen below the N PPM threshold, the system should send another message to the alarm telling it to turn off.SR9 The syThe

## External Interface Requirements

3.2.1 The system must provide an external user interface that allows operators and supervisors access to logs recorded by the system. This user interface must also allow supervisors to add notes to the methane sensor log up to 24 hours after an incident and must allow supervisors and operators to view all methane sensor logs. This external user interface must also allow supervisors to override the current pump state and allow the operator to change the current pump state if the water is within the safe water level range.

SR9 SR1 The SR9 SR1 The

## Internal Interface RequirementsSR10

3.3.1 SR17 The system must process a data-feed from the methane sensor such that methane readings are recorded every thirty minutes, and methane sensor trigger events are processed as well. All events must be stored in a file with the date and time of incident, as well as any notes a supervisor has left for future operators and supervisors. Data feed will be stored with the water level pump trigger data in the form of a comma separated value file and be exported every 24 hours from initial system startup.

3.3.2 SR24 The system must process a data-feed from the pump such that water pump trigger events (on and off) are processed and stored in a file with the date and time of incident, as well as whether the pump was triggered by a water level sensor detection or a manual override from an operator or a supervisor. Data feed will be stored with the methane sensor data in the form of a comma separated value file and be exported every 24 hours from initial system startup.

# Non-Functional Requirements

## Security and Privacy Requirements

4.1.1 The SR8 system must encrypt log file information if the information is being transmitted over the internet.

4.1.2 The system must not allow unauthorized users to log into the user interface and alter or view any pump states or information.

4.1.3 The system must not let anyone but the supervisors with authorization have the ability to alter the pump state or methane logs.

4.1.4 The system must require a username and password for authorization before allowing users to interact with the system.

## Environmental Requirements

4.2.1 SR20 System must have two energy supplies to the methane sensor.

SR25 SR26

## Performance Requirements

4.3.1 System must respond to sensors being activated in 5 seconds or less.SR27 Syus

Use Case ID: 0001

Use Case Name: High Water Sensor Set Off   
Relevant Requirements: 3.1.1, 3.1.2, 3.1.3

Primary Actor: High Water Pump Sensor

Pre-conditions: The high-water level sensor detects excess water, a supervisor has not interrupted the pump flow, and the water pump is not already active.

Post-conditions: The high-water level sensor is turned off. The pump system pumps water out of the mining area.

Basic Flow or Main Scenario:

1. The water level rises to a dangerous level.
2. The water level sensor is activated by the water and activates the water pump.
3. The sensor deactivates and the pump stays active.
4. The log creates a record of the date, time, actor, and event and stores it in the log file.

Extensions or Alternate Flows: Manual override by supervisor   
Exceptions: The sensor fails to trigger if the water reaches the sensor level, the sensor triggers continuously so the pump will never stop reinitializing, the sensor triggers inconsistently causing the pump to activate at incorrect times, the log does not record the event and event attributes properly.   
Related Use Cases:0002, 0006, 0007

Use Case ID: 0002   
Use Case Name: Low Water Sensor Set Off   
Relevant Requirements: 3.1.1, 3.1.2, 3.1.4

Primary Actor: Low Water Sensor

Pre-conditions: The low water level sensor detects air, a supervisor has not interrupted the pump flow, and the water pump is already active.

Post-conditions: The low-water level sensor is turned off. The pump system is not pumping water out of the mining area.

Basic Flow or Main Scenario:

1. The low water level sensor detects air.
2. The low water level sensor is activated by the air and in turn deactivates the water pump.
3. The sensor deactivates when not exposed to air and the pump stays inactive until the water hits the high sensor level.
4. The log generates a record of the time, date, actor, and event.

Extensions or Alternate Flows: Manual override by supervisor   
Exceptions: The sensor fails to trigger when the air reaches the sensor level, the sensor triggers continuously and the pump will not stay active, the sensor triggers inconsistently causing the pump to deactivate at incorrect times, the log does not record the event and event attributes properly.

Related Use Cases: 0001, 0006, 0007

Use Case ID: 0003   
Use Case Name: Methane Sensor Set Off   
Relevant Requirements: 3.1.1, 3.1.5, 3.2, 3.3

Primary Actor: Methane Sensor

Pre-conditions: The methane sensor detects methane above N PPM

Post-conditions: The evacuation alarm is activated. The methane sensor continues to detect the amount of methane gas in the air. The log has created a date, time, and event record.

Basic Flow or Main Scenario:

1. The methane sensor detects methane gas above the N PPM threshold.
2. The evacuation alarm is set off by the methane sensor.
3. The sensor continues to read methane levels. The evacuation alarm remains on until methane levels fall to a safe range.
4. The log generates a record of the date, time, and sensor tripped, and sends this information to the log file.

Exceptions: The sensor fails to trigger when methane surpasses threshold, the sensor triggers continuously without methane above the threshold and the evacuation alarm goes off permanently, the sensor triggers inconsistently causing the evacuation alarm to ring at incorrect times, the log does not record the event and event attributes properly.

Use Case ID: 0004   
Use Case Name: Supervisor Starts water pump   
Relevant Requirements: 3.1.1, 3.1.2, 3.2, 3.3

Primary Actor: Supervisor

Pre-conditions: The supervisor logs into the system and turns the pump on

Post-conditions: The pump has turned on. The log has generated a record of the date, time, actor, and event.

Basic Flow or Main Scenario:

1. The supervisor logs into the system.
2. The supervisor overrides the pump state and starts the pump.
3. The log generates a record of the date, time, event, and actor, which is sent to the log file.

Exceptions: The pump breaks or is damaged because it is run at an inappropriate time, the supervisor cannot gain access to the system to start the pump or cannot gain access to the pump to start or stop it directly, the log doesn’t record the event properly.

Related Use Cases: 0005

Use Case ID: 0005   
Use Case Name: Supervisor Stops Water Pump   
Relevant Requirements: 3.1.1, 3.1.2, 3.2, 3.3

Primary Actor: Supervisor

Pre-conditions: The supervisor logs into the system and turns the pump off.

Post-conditions: The pump has turned off. The log has generated a record of the date, time, actor, and event.

Basic Flow or Main Scenario:

1. The supervisor logs into the system.
2. The supervisor overrides the pump state and stops the pump.
3. The log generates a record of the date, time, event, and actor, which is sent to the log file.

Exceptions: The supervisor cannot gain access to the system to start the pump or cannot gain access to the pump to start or stop it directly, the log doesn’t record the event properly, the pump is unresponsive to the override and continues to pump regardless of override.

Related Use Cases: 0004

Use Case ID: 0006   
Use Case Name: Operator Starts water pump   
Relevant Requirements: 3.1.1, 3.1.2, 3.2, 3.3

Primary Actor: Operator

Pre-conditions: The operator logs into the system and attempts to turn the pump on

Post-conditions: If the water is between the two water sensors, the pump has turned on. The log has generated a record of the date, time, actor, and event.

Basic Flow or Main Scenario:

1. The operator logs into the system.
2. The operator checks the water sensor readings and, if appropriate, starts the pump.
3. The log generates a record of the date, time, event, and actor, which is sent to the log file.

Exceptions: The pump breaks or is damaged, the operator cannot gain access to the system to start the pump, the log doesn’t record the event properly.

Related Use Cases: Pump is stopped by operator.

Use Case ID: 0007   
Use Case Name: Operator Stops water pump   
Relevant Requirements: 3.1.1, 3.1.2, 3.2, 3.3

Primary Actor: Operator

Pre-conditions: The operator logs into the system and attempts to turn the pump off.

Post-conditions: If the water is between the two water sensors, the pump has turned off. The log has generated a record of the date, time, actor, and event.

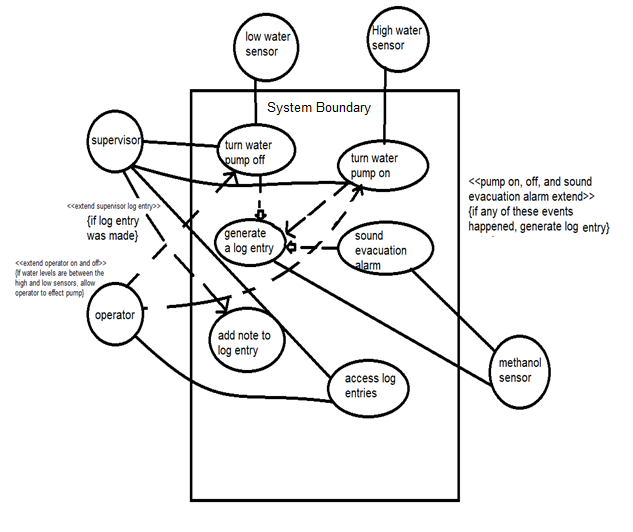
Basic Flow or Main Scenario:

1. The operator logs into the system.
2. The operator checks the water sensor readings and, if appropriate, stops the pump.
3. The log generates a record of the date, time, event, and actor, which is sent to the log file.

Exceptions: The pump breaks or is damaged and refuses to stop pumping, the operator cannot gain access to the system to stop the pump, the log doesn’t record the event properly.

Related Use Cases: Pump is stopped by operator

UML Case Diagram



A group of white rectangular boxes with black text

Description automatically generated Class Diagram

Sequence Diagrams

A diagram of a process

Description automatically generated

