Real-Time Ship Health And Maintenance System Requirements Document

CyOasis
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Revision History

Name	Date	Reason for Changes	Version
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Ian Chen/Sheldon	2023-11-04	View Ship Status	2.0
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1 Introduction

1.1 Purpose

Product: "Real-Time Ship Health And Maintenance System (RTSHMS)"

RD Revision/Release Number: CY RD-1.0

CY RD-1.0 outlines the software requirements for the development of an advanced maintenance system catering to large-scale ships encompassing naval warships. This document specifically focuses on the initial release (CY RD-1.0) and aims to provide a comprehensive understanding of the system's purpose and scope.

1.2 Project Scope

The software's core purpose is to develop an advanced maintenance system tailored for servicing large-scale ships, including naval warships. This comprehensive solution will encompass various essential functions, including real-time monitoring of ship structure and engine health, intelligent maintenance scheduling, efficient spare parts inventory management, and in-depth ship performance analysis. The overarching goal is to ensure the reliability, safety, and optimal performance of these substantial vessels. The software's scope involves continuous monitoring of ship health, early anomaly detection, and automated response mechanisms, all of which align with corporate objectives focused on enhancing safety, reducing operational downtime, and achieving high client satisfaction.

1.3 Glossary of Terms

1. **Software Requirements -** Specifications that describe the desired functionality, behavior, and constraints of the software to be developed.
2. **Advanced Maintenance System -** The software system being developed, which provides maintenance capabilities for large-scale ships.
3. **Naval Warships -** Military vessels designed for warfare and defense purposes.
4. **Functionality -** The capabilities or features that the software is expected to provide.
5. **Maintenance Scheduling -** The process of planning and organizing maintenance activities to ensure the proper functioning of equipment.
6. **Spare Parts Inventory Management -** The management of the inventory of spare parts and components needed for maintenance and repairs.
7. **Ship Performance Analysis -** The evaluation of a ship's operational performance, including factors like fuel efficiency and reliability.
8. **Reliability -** The ability of a system to perform consistently and predictably without failures.
9. **Safety -** The condition of being free from harm, danger, or risk, particularly in the context of ship operations.
10. **Efficiency -** The ability to accomplish a task with minimal wasted resources, such as time, money, or materials.
11. **Resource Management -** The efficient allocation and utilization of resources, such as spare parts, personnel, and equipment.

13 **Downtime -** The period during which a system or equipment is not operational or available for use.

14 **Environmental Impact -** The effect of ship operations on the natural environment, including factors like emissions and pollution.

15 **Compliance -** Adherence to relevant laws, regulations, and industry standards.

16 **Operational Efficiency -** The ability to use resources and perform tasks in a cost-effective and productive manner.

1.4 References

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1.5 Overview

In the glossary provided, key terms related to the "Real-Time Ship Health and Maintenance System (RTSHMS)" project are outlined. The primary objective of this project is to develop an advanced maintenance system for large-scale ships, encompassing both military naval warships and commercial vessels. The core functionalities of this system include real-time monitoring of ship structure and engine health, intelligent maintenance scheduling, efficient spare parts inventory management, and in-depth ship performance analysis. The ultimate goal is to ensure the reliability, safety, and optimal performance of these substantial vessels.

The project's scope involves continuous real-time monitoring of ship health, early anomaly detection, and automated response mechanisms. These align with the corporate objectives focused on enhancing safety, reducing operational downtime, and achieving high client satisfaction. Furthermore, the project emphasizes the importance of resource management, environmental impact, compliance with regulations, and operational efficiency.

In summary, this project aims to develop a maintenance system that ensures the reliability, safety, and efficiency of large-scale ships. This will be achieved through real-time monitoring, intelligent scheduling, and resource management, all while adhering to environmental regulations and industry standards. The project seeks to minimize downtime, enhance safety, and improve operational efficiency, ultimately meeting the needs and expectations of clients.

2 Overall Description

2.1 Product Perspective

The Real-Time Ship Health and Maintenance System (RTSHMS), as specified in this Requirements Document (RD), is a new, self-contained product developed to meet the growing demands of modern ship maintenance and management. It is not a follow-on member of a product family or a replacement for existing systems; instead, it is designed to provide a cutting-edge solution that addresses the unique needs of large-scale naval warships.

In the context of a larger system, RTSHMS can be considered a critical component of the ship's overall operational framework. It plays a pivotal role in ensuring the health, safety, and efficiency of the vessel. This system is closely integrated with the ship's existing infrastructure, including monitoring sensors, maintenance equipment, and ship control systems. The diagram below provides a simplified representation of how RTSHMS interfaces with other key components in the ship's system:

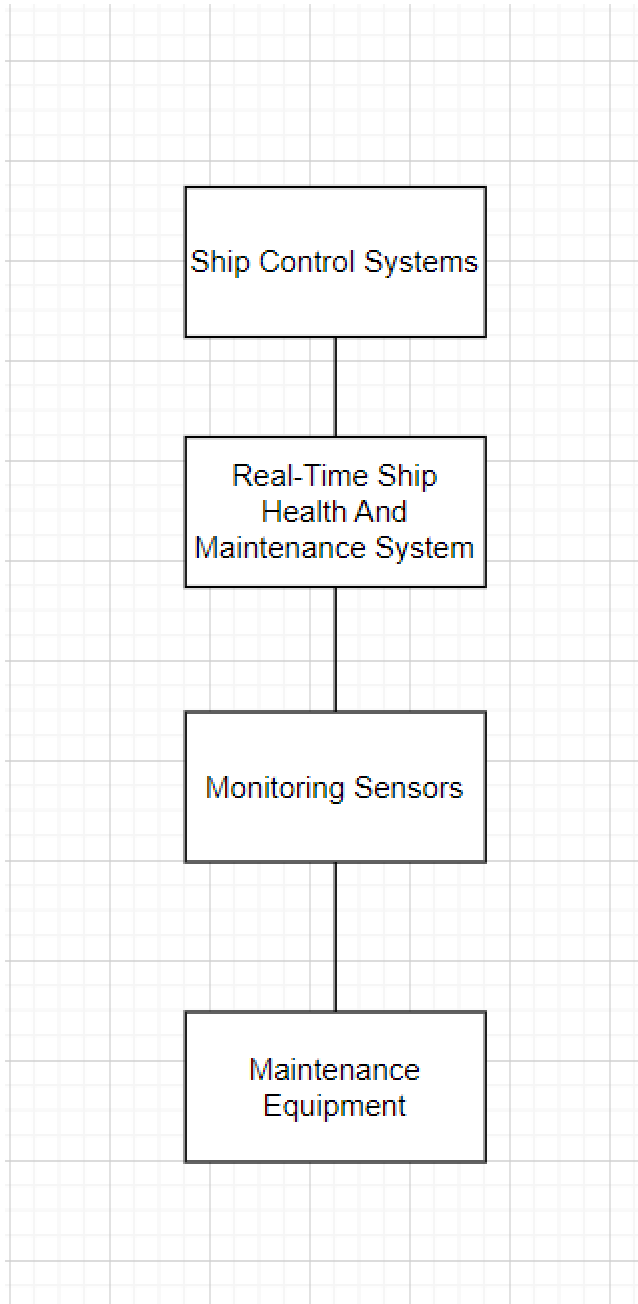

Figure 2.1 Simplified representation of how RTSHMS interfaces with other components on the ship.

RTSHMS interfaces with ship control systems to receive data and control ship functions based on maintenance requirements and safety protocols. It integrates with monitoring sensors to collect real-time data on the ship's structural and engine health. Additionally, it interfaces with maintenance equipment to automate and schedule maintenance tasks, ensuring the ship's optimal performance.

While not explicitly shown in the diagram, RTSHMS may also have external interfaces, such as communication systems for remote monitoring and data exchange with onshore maintenance and command centers.

In summary, the RTSHMS is a standalone product designed to enhance ship maintenance and management. It integrates with the larger ship system, sharing data and control interfaces, and plays a central role in ensuring the health, safety, and efficiency of the ship. External interfaces may also exist to facilitate communication with onshore support and monitoring facilities.

2.2 Product Features

The Real-Time Ship Health and Maintenance System (RTSHMS) consists of three major components:

Retrofitted Sensor Array:

- This feature involves the installation of advanced sensor arrays throughout the ship.
- These sensors continuously monitor the ship's structure and engine health in real-time.
- Data collected from these sensors enable the system to detect anomalies and potential issues immediately.

Unified Diagnostic Response System (UDRS):

- UDRS provides a centralized dashboard that displays real-time data from the sensor array.
- The UDRS includes a relational database to hold ship health information.
- Users can access and visualize critical ship health information from a single, user-friendly interface.
- The dashboard supports data-driven decision-making, facilitating proactive maintenance and ensuring safety.

Maintenance AI:

- This feature automates the maintenance scheduling process.
- It creates maintenance tickets based on real-time sensor data and analysis.
- Maintenance tasks are assigned, prioritized, and optimized to minimize operational downtime and enhance the ship's reliability and safety.

These three components work together to provide a holistic solution for ship maintenance and management, offering real-time monitoring, data visualization, and automated maintenance scheduling to ensure the ship's optimal performance and safety. Further details about these components can be found in Section 3 of the Requirements Document.

2.3 User Classes and Characteristics

The Real-Time Ship Health and Maintenance System (RTSHMS) is anticipated to be used by several distinct user classes, each with their unique characteristics and roles:

Engineering Officers:

Characteristics: Engineering officers are the primary users who interact with RTSHMS daily. Engineering officers include the Chief Engineer, Second Engineer, Third Engineer and so on. They require real-time data monitoring, maintenance task assignment, and decision-making capabilities.

Role: They use RTSHMS for day-to-day ship operation, ensuring safety and reliability.

Administrators:

Organizations will likely also have administrators that require the same privileges as the engineering officers to implement the RTSHMS.

Role: They use RTSHMS during initial implementation of the RTSHMS and onboarding of new system users.

Maintenance Crew:

Characteristics: Maintenance crews are technically skilled and often involved in hands-on tasks. They need clear task assignments and maintenance data to perform their duties effectively.

Role: They use RTSHMS for executing maintenance tasks based on repair plans they also use the system for reporting task progress.

Ship Managers:

Characteristics: Ship managers have a broad overview of ship operations and maintenance. They need access to performance analysis and compliance reports for decision-making.

Role: They rely on RTSHMS for strategic planning and resource allocation.

Technical Support:

Characteristics: Technical support personnel possess expertise in system troubleshooting and maintenance. They may require elevated privileges to access detailed system diagnostics and troubleshooting features.

Role: They use RTSHMS to provide remote assistance and resolve technical issues.

Executive Leadership:

Characteristics: Executives have a high-level view of the ship's performance, safety, and compliance. They require summarized reports for decision-making.

Role: They use RTSHMS for strategic decisions and resource allocation at an organizational level.

External Auditors:

Characteristics: Auditors may have specialized knowledge in ship maintenance and compliance standards. They may request specific compliance records and data from organizations implementing RTSHMS.

Role: They request compliance records and data from officials within the organizations implementing RTSHMS.

2.4 Operating Environment

The Real-Time Ship Health and Maintenance System (RTSHMS) operates within a complex maritime environment that necessitates seamless integration into the existing infrastructure of the ship. Crucially, the system is designed to interface with various onboard components, including sensors, monitoring equipment, and control systems. This integration allows RTSHMS to gather real-time data, which is essential for its monitoring and analysis functions. Additionally, the software's compatibility with the ship's communication protocols and interfaces ensures the efficient transmission of data while at sea.

As part of its operations, RTSHMS relies on a robust sensor array that is strategically retrofitted throughout the ship's structure and engine compartments. These sensors are engineered to withstand the harsh marine conditions, including exposure to saltwater, extreme weather, and potential physical stresses associated with maritime navigation. Moreover, the system's centralized dashboard provides a user-friendly interface that is accessible on shipboard computers. This accessibility enables the crew members responsible for maintenance and operations to make informed, real-time decisions based on the data provided by the system.

Furthermore, the software platform on which RTSHMS operates should be compatible with the ship's existing hardware and operating systems. This compatibility ensures smooth operations and facilitates seamless data exchange between the various ship components and the RTSHMS. Given the nature of maritime operations, the system is designed to comply with stringent safety and environmental regulations, emphasizing the importance of adherence to industry standards and legal requirements. Additionally, the system's remote connectivity allows for secure data transmission to onshore support and monitoring centers, thus enabling comprehensive oversight and support for the ship's maintenance and operational needs.

2.5 Design and Implementation Constraints

The design and implementation of the Real-Time Ship Health and Maintenance System (RTSHMS) are subject to various constraints that shape the development process.

Regulatory Compliance:

RTSHMS must adhere to stringent international and maritime-specific regulations governing ship operations, safety, and environmental impact. Compliance with safety standards and emissions regulations is paramount.

Hardware Restrictions:

RTSHMS must operate within the often limited hardware constraints of ships, accounting for factors such as onboard computing resources, power limitations, and the need for ruggedized components suitable for marine environments. Compatibility with existing ship systems, including ship control systems and monitoring equipment, is essential, as the software must integrate seamlessly with these systems, potentially across various hardware and software platforms. The RTSHMS must be compatible with the existing health monitoring sensor arrays on the vessel.

Security Protocols:

RTSHMS deals with critical ship operations, requiring robust measures to protect data integrity, ensure confidentiality, and prevent unauthorized access.

These constraints, along with considerations for multilingual support, resource allocation, parallel operations, design standards, and potential maintenance responsibility, all contribute to the complexities of the RTSHMS project, demanding careful attention during the design and implementation phases.

2.6 Assumptions and dependencies

Availability of Third-Party Components:

Assumption: The availability and functionality of third-party components or software libraries for specific functionalities, such as data analysis or sensor integration.

Impact: If these components are unavailable or do not meet requirements, it could affect the project's development and capabilities.

Data Connectivity and Communication:

Assumption: Reliable data connectivity and communication channels, including satellite or internet connections, are assumed for transmitting data between the ship and onshore support centers.

Impact: Connectivity issues or disruptions could impact real-time monitoring and data transmission, potentially affecting the system's performance.

Environmental Conditions:

Assumption: The system is designed to operate in harsh maritime environments, assuming the expected levels of exposure to saltwater, weather conditions, and vibrations.

Impact: If environmental conditions exceed design parameters, it could lead to premature component failure or data accuracy issues.

Regulatory Compliance:

Assumption: Assumption that the system's design and functionalities comply with existing and future maritime safety and environmental regulations.

Impact: Changes in regulations or misunderstanding of compliance requirements could result in project delays or legal issues.

Availability of External Data Sources:

Assumption: The availability and accuracy of external data sources, such as weather forecasts or maritime traffic data, are assumed for various system functions.

Impact: Inaccurate or unavailable data sources could affect the reliability of certain RTSHMS features.

Interoperability with Ship's Existing Infrastructure:

Assumption: The successful integration of RTSHMS with the ship's existing hardware, operating systems, and communication protocols is assumed.

Impact: Compatibility issues or unanticipated integration challenges could disrupt the system's operation.

Availability of Onboard Support Personnel:

Assumption: The availability of trained crew members to respond to maintenance tasks generated by the system.

Impact: A lack of qualified personnel could affect the system's ability to address maintenance issues promptly.

Software Component Reuse:

Assumption: The reusability and compatibility of certain software components from other projects to expedite development.

Impact: Incompatibility or unforeseen issues with reused components could impact development timelines.

Vendor or Supplier Performance:

Assumption: Dependence on external vendors or suppliers for critical hardware or software components.

Impact: Delays or failures by vendors could affect the project's schedule and functionality.

Regulatory Changes:

Assumption: Regulatory requirements and standards remain consistent during the project's development.

Impact: Changes in regulations may necessitate revisions to the system's features and functionalities.

3 System Features

For the Real-Time Ship Health and Maintenance System to be a successful project, several features are required in the design. In this section, features and functional requirements will be described in detail. Below is a use-case diagram outlining the features available to the users of the system.

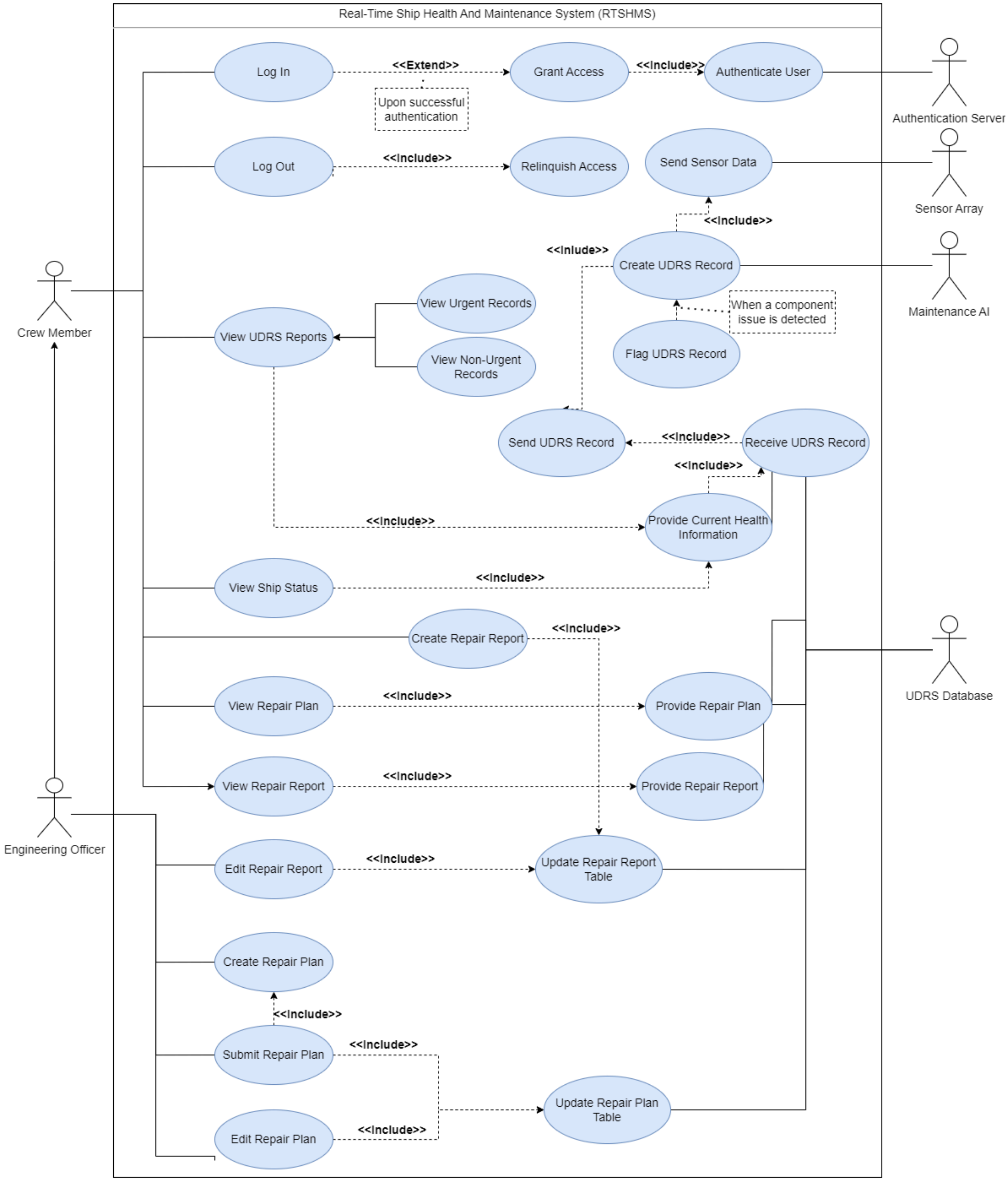

Figure 3.1 RTSHMS Use-Case Diagram

3.1 User Authentication

3.1.1 Description and Priority

Before a user can be granted access into the system, it is important that the system is able to determine the user's identity. User's will have credentials, a unique user id and password, which they can input into the system's login form. Upon successful authentication, the user will be granted access to features appropriate to their role. Given the level of security required by the Canadian navy, this feature has high priority.

3.1.2 Functional Requirements

REQ1-1: Each user's login user id must be unique.
Rationale: The system must know who is currently using the terminal in order to determine access based on the user's role as well as log the user's activity when creating reports within the system.

REQ-1-2: The user must "sign-in" by submitting their credentials before being granted access.
Rationale: The user must be able to initiate authentication with their provided credentials, no functionality other than authentication shall be granted until successful authentication.

REQ-1-3: Upon authentication, the user shall be directed to the system dashboard.
Rationale: The dashboard is the main interface from which the user can navigate to other system features.

REQ-1-4: Users shall be able to contact their Engineering Officer for issues regarding their credentials.
Rationale: If a user has forgotten their password, they need a method to change or retrieve it.

REQ-1-5: The Engineering Officers shall be notified upon five consecutive failed login attempts on a terminal.
Rationale: Potential unauthorized access attempts must be known and dealt with by the Engineering Officers.

REQ-1-6: The terminal must "lock-out" user access for five minutes upon 20 consecutive failed login attempts.
Rationale: To protect the authentication process from brute-force attacks.

REQ-1-7: When the user logs out, they are relinquished access to the system.
Rationale: To ensure the unauthorized personnel do not access the system.

Logging In
ID: UC-1-1
Description: A user attempts to log into the system.
Actors: Maintenance Crew Member, UDRS, Authentication Server, Engineering Officer
Secondary Use Cases: N/A
Preconditions: The user has login credentials and is situated at a terminal.
Main Flow: 1. The maintenance crew member enters their user id and password into the login form. 2. The login form sends these credentials to the authentication server. 3. The authentication server attempts to authenticate the user id and password. 4. Upon successful authentication the maintenance crew member is granted access privileges based on their role. 5. The maintenance crew member is directed to the system dashboard.
Postconditions: 1. The maintenance crew member has been granted access appropriate for their role and has access to the features displayed on the dashboard.

Alternative Flow(s): 2a. If the user selects the forgotten password feature, a notification is sent to their Engineering Officer. 4a. If the credentials are incorrect the user is notified and returns to step 1. 4b. If the authentication has failed five times, the Engineering Officer is notified. 4c. If the authentication has failed 20 times, the terminal locks users out for five minutes.

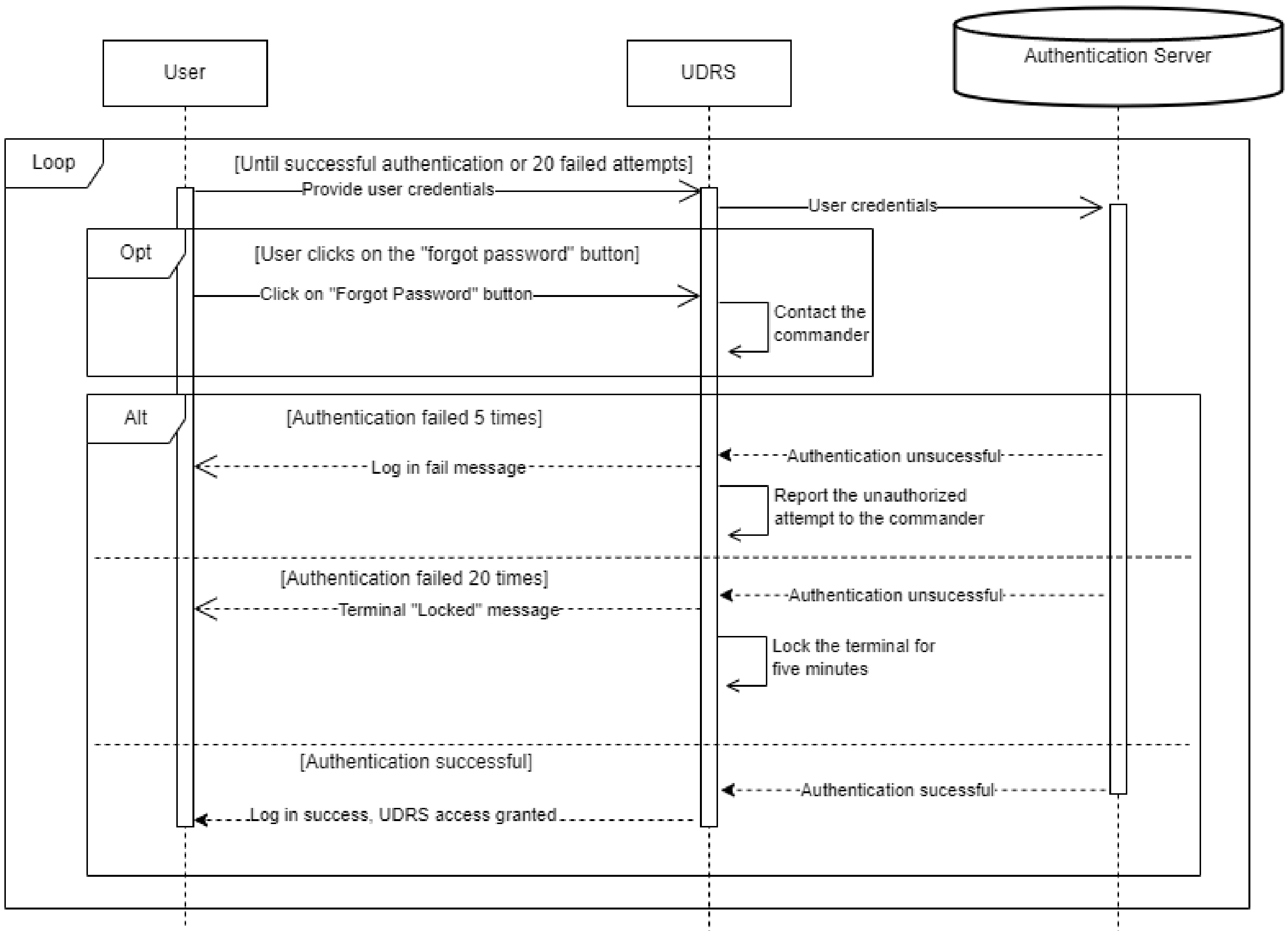

Figure 3.2 Logging In Sequence Diagram

Logging Out
ID: UC-1-2
Description: A user logs out of the system.
Actors: Maintenance Crew Member, UDRS
Secondary Use Cases: Logging in
Preconditions: The user has already logged into the terminal.
Main Flow: 1. The maintenance crew member navigates back to the main dashboard. 2. The maintenance crew member clicks on the “Log Out” button. 3. The terminal relinquishes access privileges for that session and returns to the login page.

Postconditions: 1. The terminal relinquishes access and returns to the login page.
Alternative Flow(s): N/A

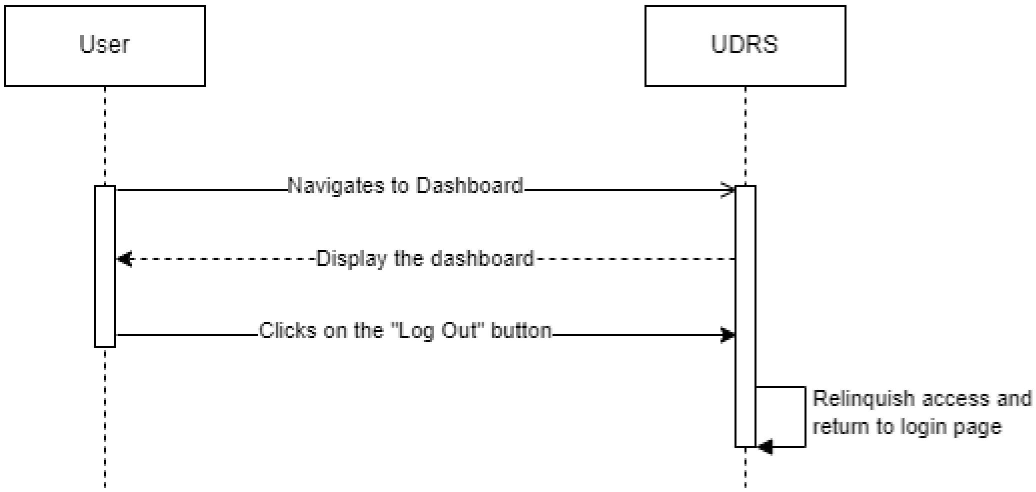

Figure 3.3 Logging Out Sequence Diagram

3.2 View Ship Health

3.2.1 Description and Priority

The maintenance team requires access to real-time information on the status of each ship component in order to conduct repairs. The UDRS improves the team's efficiency by ranking identified repair requirements, UDRS records, by urgency as well as flagging these records as either “urgent” or “non-urgent.” The maintenance team cannot conduct repairs on the ship’s components without access to these UDRS records and therefore viewing ship health is the project’s highest priority.

3.2.2 Functional Requirements

REQ2-1: The UDRS shall provide health information based on data streams from all ship health sensors.
Rationale: In order for the system to monitor the entire health of the ship, it needs to process real-time data from all critical ship components.

REQ2-2: The UDRS shall determine less urgent maintenance requirements via predictive models.
Rationale: To reduce the occurrence of preventable ship component failures.

REQ2-3: The UDRS shall order and prioritize information based on context, importance and urgency.
Rationale: To ensure the maintenance crew can allocate resources and services effectively and efficiently.

REQ2-4: The UDRS shall process the ship’s condition and maintenance priorities, providing UDRS records identifying urgent and non-urgent repair tasks.
Rationale: Determining the maintenance priorities on the ship allows the maintenance crew to react quickly and efficiently to critical events as well as conduct preventive maintenance when time permits.

REQ2-5: The maintenance crew shall have access to UDRS records from every maintenance terminal.
Rationale: To ensure the maintenance department is aware of the complete status of the ship regardless of their current position on board.

3.2.3 Use Cases

View Current Issues

ID: UC-2-1
Description: Maintenance Crew member views the UDRS records from the system
Actors: Maintenance Crew, UDRS
Secondary Use Cases: Logging In
Preconditions: N/A
Main Flow: 1. The maintenance crew member requests current issues from UDRS. 2. UDRS system pull the records form the UDRS Database 3. The UDRS system will display the record to the maintenance crew member.
Postconditions: 1. Engineering Officers can review the information and communicate it with the rest of the maintenance crew.
Alternative Flow(s): 2. a. If there are no issues it will display "No active issues"

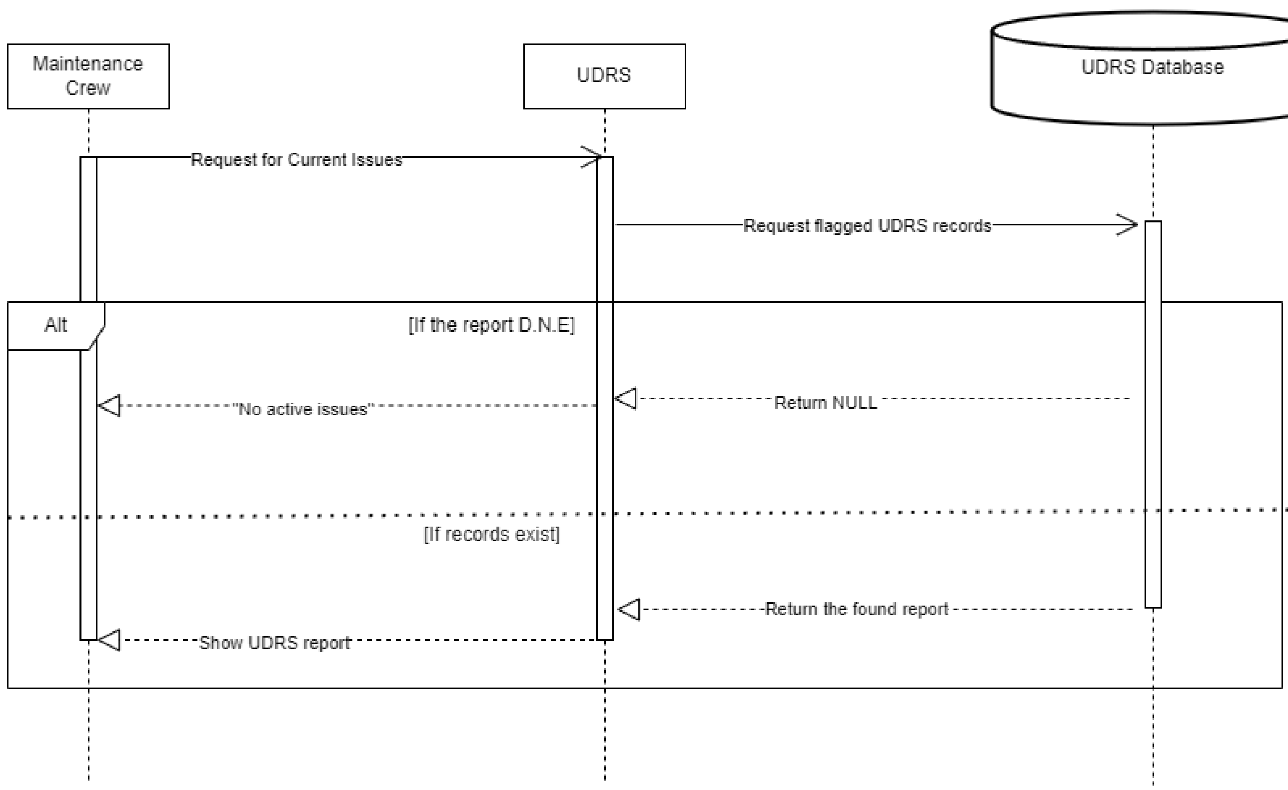

Figure 3.4 View Current Issues Sequence Diagram

Figure 3.1.2 View Current Issues Sequence Diagram

View Ship Status
ID: UC-2-2
Description: The Engineering Officers view the health status of the ship and its monitored components.
Actors: Maintenance Crew, UDRS, UDRS Database

Secondary Use Cases: Logging In
Preconditions: The crew member is logged in.
Main Flow: 1. User is able to search the ship status from the UDRS dashboard 2. UDRS system pulls the UDRS records from the UDRS Database 3. Users select from a menu to view the ship status, urgent issues, non-urgent issues or repair plans. 4. The maintenance crew selects “Ship Status” 5. The UDRS system updates the UI to reflect the ship’s current health status.
Postconditions: 1. Users can review the information and communicate it with the rest of the maintenance crew.
Alternative Flow(s): 2. a. If there are no records it will return an error message, UDRS system will keep updating every minute.

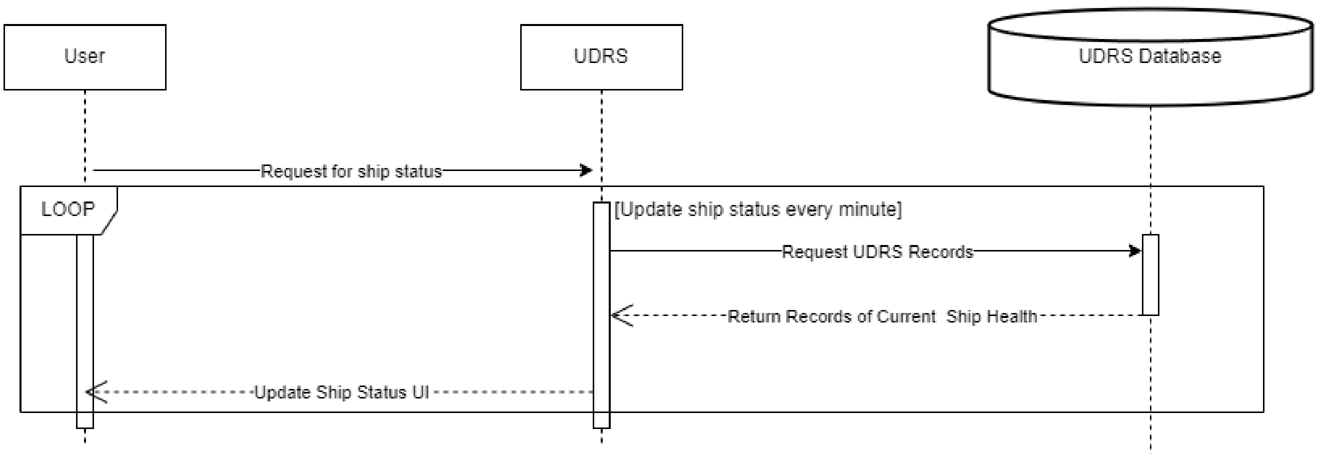

Figure 3.5 View Ship Status Sequence Diagram

Figure 3.1.3 View Ship Status Sequence Diagram

3.3 Repair Plans

3.3.1 Description and Priority

While the system is able to prioritize and display the current health of the ship through its UDRS records, the responsibility to designate tasks is still left to the Engineering Officers. In order for the officers to communicate with their subordinates, the system allows engineering officers to produce “repair plans” for the maintenance crew to act upon. Since there are currently other forms of communication available to the engineering officers, this feature is medium-high priority.

3.3.2 Functional Requirements

REQ3-1: The engineering officers shall be able to create repair plans.
Rationale: The maintenance crew needs to be communicated specific tasks to complete by their engineering officers.

REQ3-2: The engineering officers will be able to view and edit repair plans.
Rationale: Changes to the way something needs to be repaired could happen on the fly, and so these changes in plan need to be communicated effectively, while updating the original repair plan for record keeping purposes. Centralizing this process and communicating the changes through the repair plan itself is important.

REQ3-3: The maintenance crew will be able to view repair plans, and will be notified of any edits made by the engineering officer in real time.
Rationale: The maintenance crew need to be able to view the repair plan in order to make repairs and be notified of any changes to their repair process via real-time updates of the repair plan.

3.3.3 Use Cases

Create Repair Plan
ID: UC-3-1
Description: Engineering Officers can create a repair plan for the maintenance crew to follow.
Actors: Engineering Officer, Maintenance Crew
Secondary Use Cases: Logging In
Preconditions: Usually following a flagged record from the UDRS.
Main Flow: 1. Engineering Officer logs into the dashboard. 3. Engineering Officer selects a flagged UDRS record that needs to be acted on. 4. Engineering Officer selects “Create Repair Plan” from the menu. 5. Engineering Officer writes out the plan and submits it into the system.
Postconditions: 1. The maintenance crew has a repair plan in their interface to act upon.
Alternative Flow(s): N/A

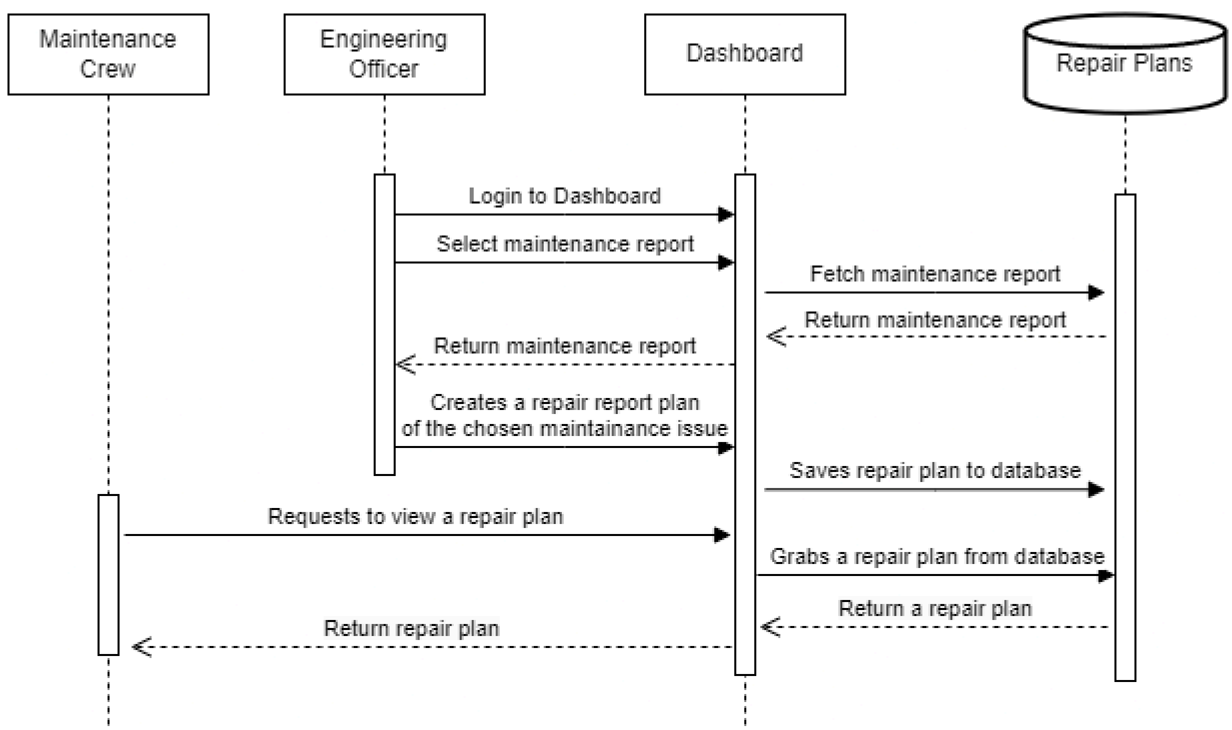

Figure 3.6 Create Repair Plan Sequence Diagram

View/Edit Repair Plan
ID: UC-3-2
Description: Engineering Officers can view and edit a repair plan for the maintenance crew to follow. Maintenance crew members have view only access to the repair plan

Actors: Engineering Officer, Maintenance Crew
Secondary Use Cases: N/A
Preconditions: 1. A repair plan has been previously made. 2. Engineering Officer is already logged in.
Main Flow: 1. Engineering Officer selects a repair plan to view. 2. Engineering selects "Edit Repair Plan" from the menu. 3. Engineering makes changes to the plan and submits it into the system.
Postconditions: 1. The maintenance crew has the edited repair plan in their interface to act upon.
Alternative Flow(s): N/A

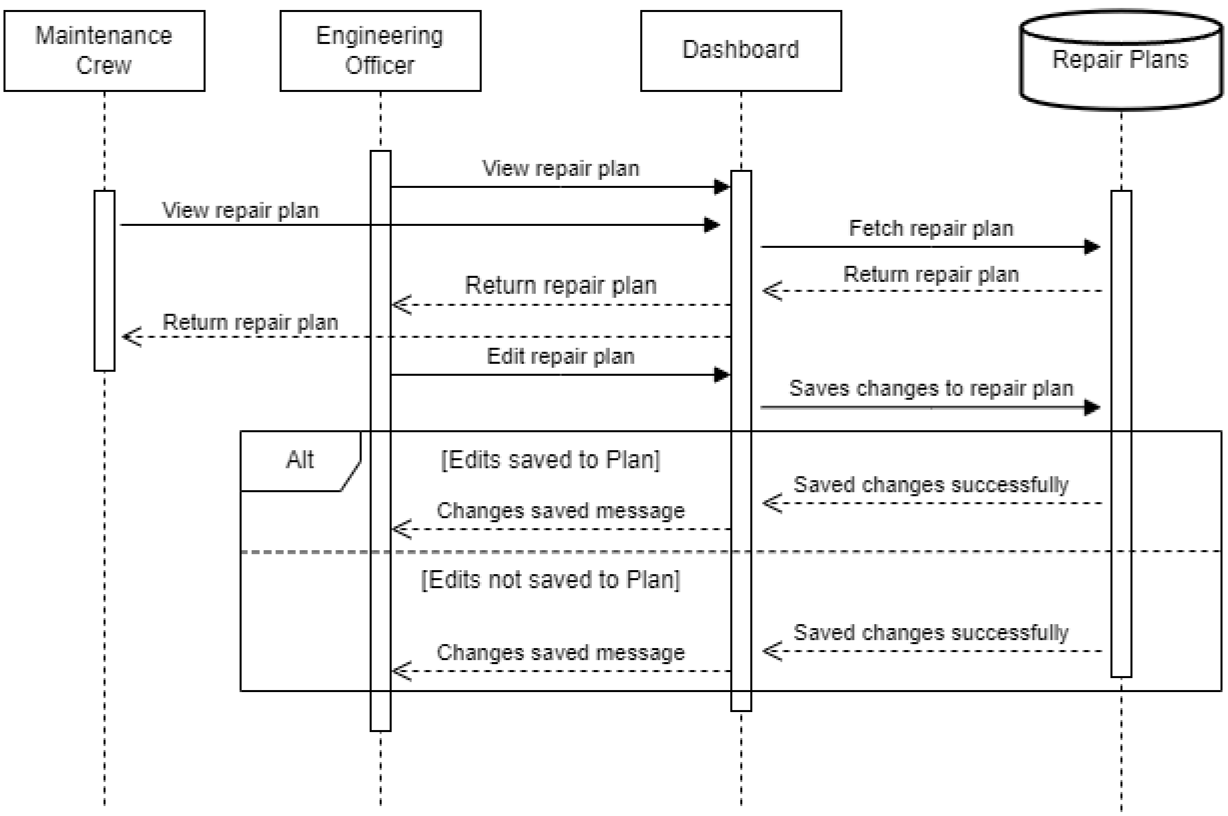

Figure 3.7 View/Edit Repair Plan Sequence Diagram

3.4 Post-Maintenance Repair Reports

3.4.1 Description and Priority

Post-maintenance repair reports are created by maintenance crew members after work has been done towards completing a repair plan. The purpose of the repair report is to communicate to the engineering officers and other crew members details including: what was accomplished, parts used, obstacles/ potential threats, work that still needs to be done, etc. If there are no repair reports for a given repair plan, this indicates that no work has been done towards the repair plan, however a repair plan may have multiple reports associated with it. The repair report supports the repair plan and therefore is medium priority.

3.4.2 Functional Requirements

REQ4-1: Maintenance crew members shall be able to create post-maintenance repair reports for a repair plan.
Rationale: To communicate to the rest of the maintenance team progress towards the repair plan.

REQ4-2: Maintenance crew members shall be able to view past repair reports.
Rationale: To obtain crucial details involving the repair plans and the associated components and environments.

REQ4-3: Engineering officers shall be able to edit past repair reports.
Rationale: To fix errors or make necessary adjustments that improve the clarity of the report.

REQ4-4: Post-maintenance repair reports are organized by datetime and repair plan.
Rationale: Maintenance crew members will be navigating to repair reports via their associated repair plans with the latest repair reports providing the most up-to-date information.

3.4.3 Use Cases

Create Repair Report
ID: UC-4-1
Description: The maintenance crew can create a repair report for a given repair plan. This information can communicate details on the outcome of the repair attempt and further requirements if needed.
Actors: Maintenance Crew, Admin
Secondary Use Cases: UC-2-2: Submitting Repair Plan.
Preconditions: Repair plan exists and has been worked on by the maintenance crew.
Main Flow: 1. Include UC-2-2. 2. Maintenance crew member logs into the dashboard on a local terminal. 3. Maintenance crew member selects the target repair plan to write a repair report on. 4. Maintenance crew member creates and submits the repair report.
Postconditions: 1. The engineering officers or admins can then view the reports from their interfaces.
Alternative Flow(s): N/A

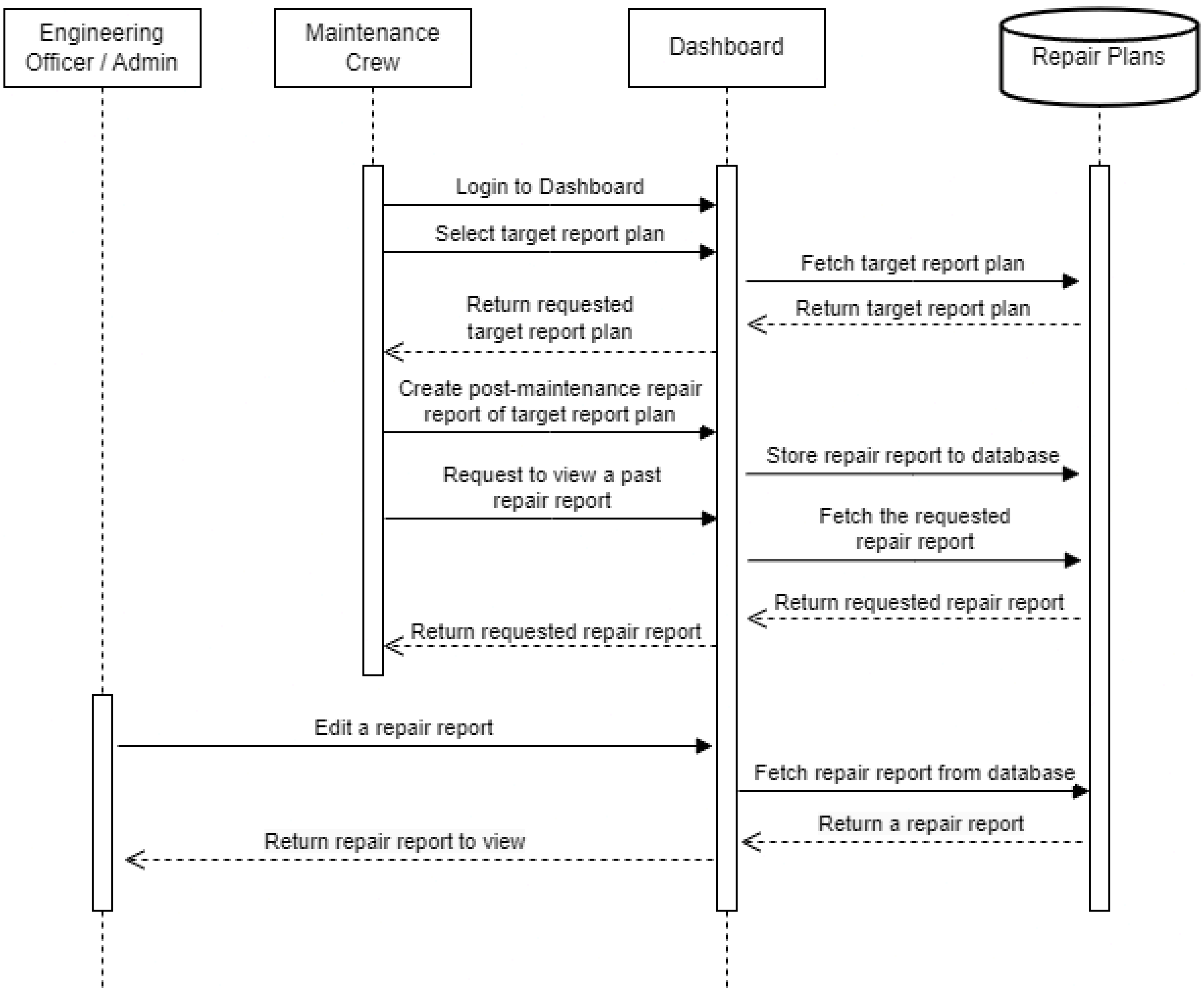

Figure 3.8 Create Repair Report Sequence Diagram

View/Edit Repair Report
ID: UC-4-2
Description: Maintenance crew members can view past repair reports, engineering officers have the extended capability of editing them.
Actors: Maintenance Crew, Engineering Officer
Secondary Use Cases: Maintenance Report Database
Preconditions: N/A
Main Flow: 1. Maintenance crew member logs into the dashboard on a local terminal. 2. UDRS returns a login message if login is successful, if not, it returns a fail message and reports to the Admin. 3. User is able to search the ship status from the UDRS system 4. The UDRS system pulls the required report from the Maintenance Report/Record Database, if the report doesn't exist it will return an error message. 5. Maintenance crew members select from a menu to view the shipping status, maintenance reports, predictive

maintenance reports, or repair plans. 6. The UDRS system will show the report to the maintenance crew member. 7. If the maintenance crew member tries to edit the report, the system will ask for permission, if the maintenance crew member is an engineering officer and has permission, the system will update the report in the database after the officer is finished editing. Otherwise, if the maintenance crew member does not have permission, the maintenance crew member can view only.
Postconditions: 1. Users can review the information and communicate it with the rest of the maintenance crew.
Alternative Flow(s): N/A

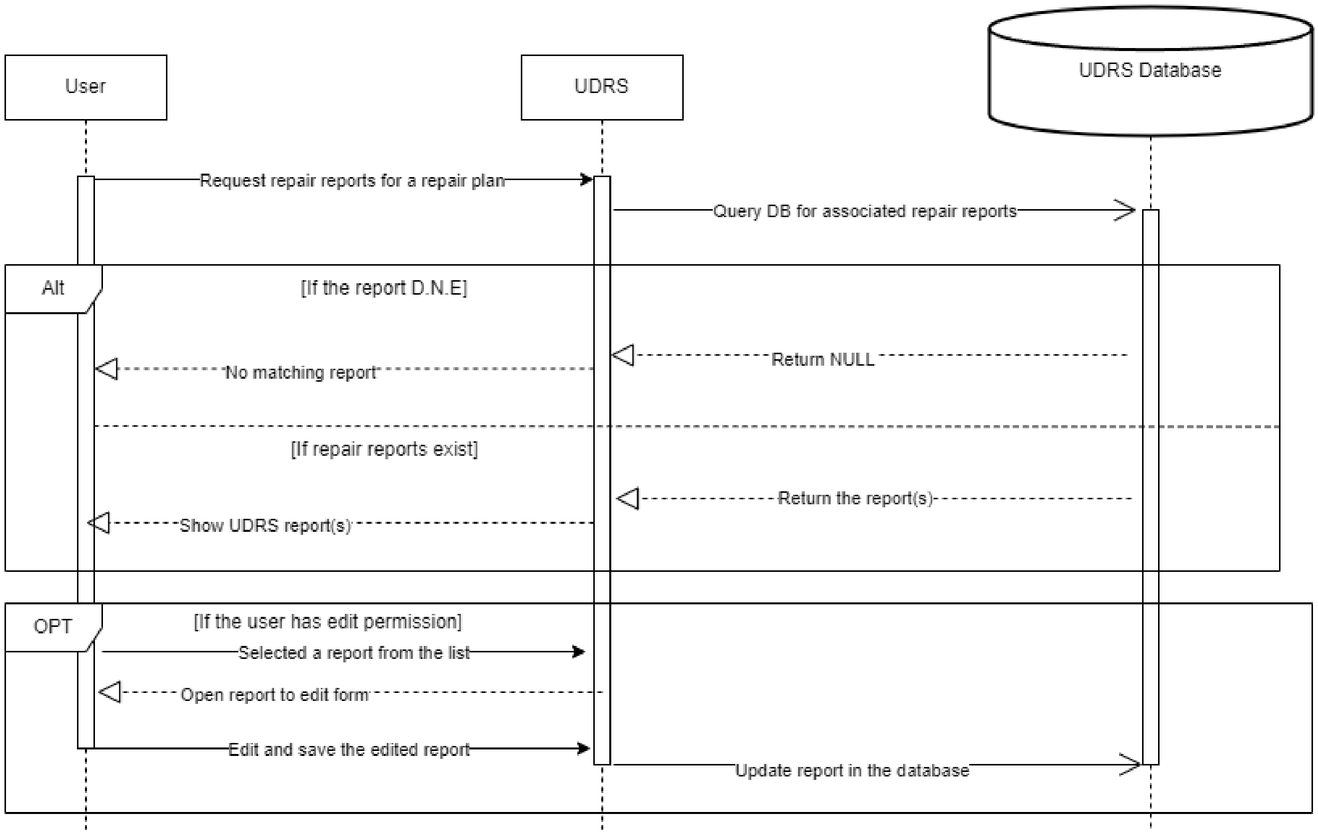

Figure 3.9 View/Edit Repair Report

3.5 Maintenance AI

3.5.1 Description and Priority

The maintenance AI processes sensor data sent by the ship's sensor array, generating UDRS records. These records are used by the UDRS to display the ship's health status. Using this data, the AI also identifies "urgent" issues like component failures as well as "non-urgent" issues which consist of predictive or preventive measures. The non-urgent issues are identified using "predictive maintenance" which involves a continuous analysis of connected assets and equipment using various data types to create detailed models of equipment condition and usage to provide accurate and component-specific recommendations. Note: A UDRS record does not need to be flagged with an issue. Since this feature separates the client's product from the competition, it is a high priority.

3.5.2 Functional Requirements

REQ5-1: The maintenance AI shall continuously analyze asset and equipment conditions.
Rationale: To create a detailed model of equipment status and provide highly accurate maintenance recommendations.

REQ5-2: The maintenance AI generates UDRS records from the incoming sensor data.

Rationale: The raw data needs to be aggregated in such a way that the UDRS is able to display it to the maintenance crew.

REQ5-3: The maintenance AI continuously sends UDRS records to the UDRS database.
Rationale: The UDRS records notify the engineering officers with the ship's current health and maintenance that needs to be conducted.

REQ5-4: The maintenance AI shall flag UDRS records as either "urgent" or "non-urgent" when maintenance is required.
Rationale: To assist the UDRS and engineering officers prioritize maintenance tasks.

REQ5-5: The maintenance AI shall rank flagged UDRS records based on priority.
Rationale: To assist the UDRS and engineering officers prioritize maintenance tasks.

3.5.3 Use Cases

Create UDRS Record
ID: UC-5-1
Description: The maintenance AI processes raw data received from the ship's sensors and packages that information into "UDRS records" to be held by the UDRS database.
Actors: Maintenance AI, Sensor Array
Secondary Use Cases: N/A
Preconditions: The sensor array is operational and sending data to the maintenance AI.
Main Flow: 1. Sensors stream raw data to the maintenance AI asynchronously. 2. Maintenance AI generates a UDRS record 3. Maintenance AI flags the UDRS record as "urgent" if there is a component failure or "non-urgent" if there is predictive maintenance to be done. 4. Flagged UDRS records are assigned a priority by the maintenance AI.
Postconditions: 1. The maintenance AI has a UDRS record that can be sent to the UDRS Database or further prioritized if flagged.
Alternative Flow(s): N/A

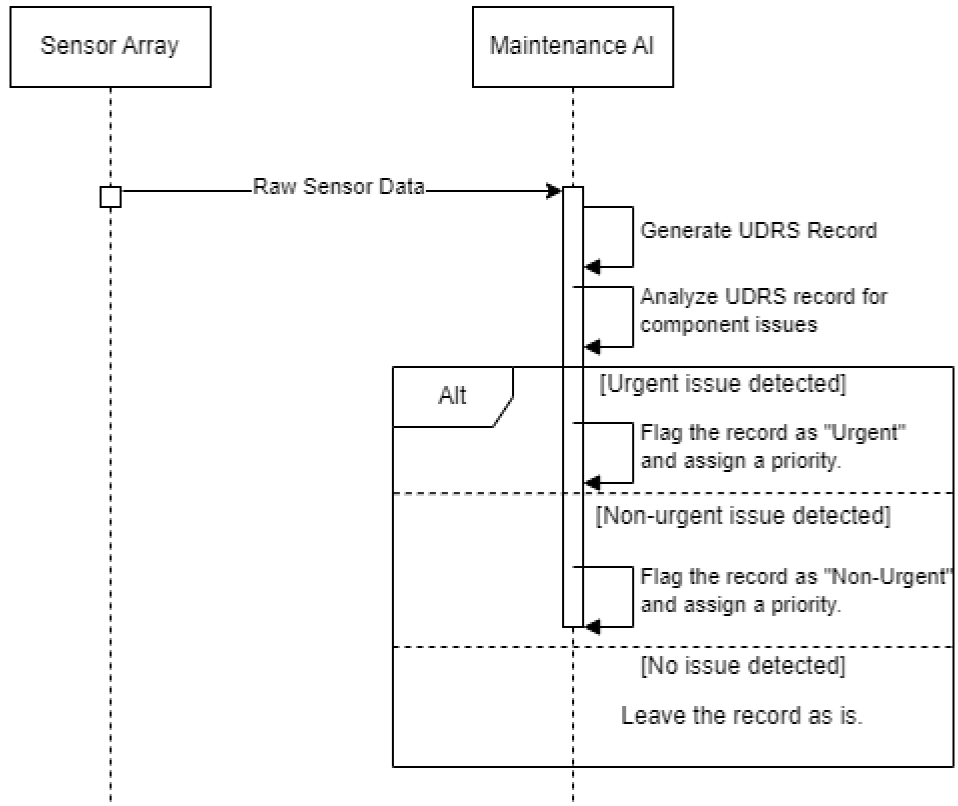

Figure 3.10 Create UDRS Record Sequence Diagram

Send UDRS Record
ID: UC-5-2
Description: After creating a UDRS record, the maintenance AI sends the record to be stored in the UDRS database.
Actors: Maintenance AI, UDRS Database
Secondary Use Cases: Create UDRS Record.
Preconditions: A UDRS record has been created.
Main Flow: 1. Maintenance AI sends the recently created UDRS record to the UDRS database. 2. The UDRS database receives the record. 3. The UDRS database updates the UDRS records table with the current health information provided in the record.
Postconditions: 1. The UDRS database is up-to-date with the current health information of the ship.
Alternative Flow(s): N/A

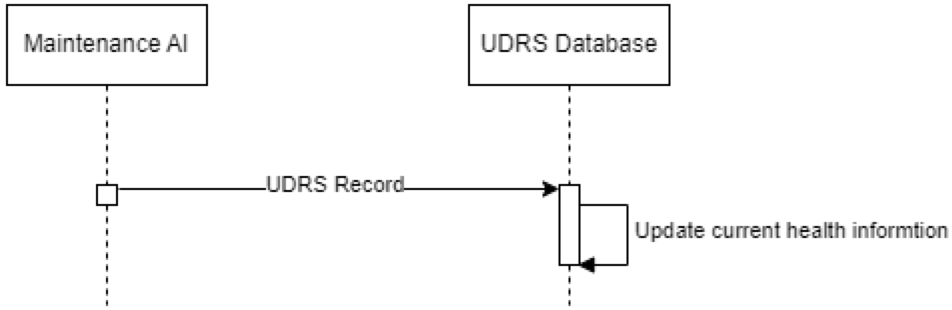

Figure 3.11 Send UDRS Record Sequence Diagram

4 External Interface Requirements

Note: Choose those that are applicable to your project

4.1 User Interfaces

Operator Interface:

User Type: Ship operators responsible for day-to-day vessel operation.

Sample Screen: The operator interface may include a dashboard displaying real-time ship health metrics, including structural integrity, engine status, and performance indicators.

GUI Standards: Follow intuitive and user-friendly graphical user interface (GUI) standards with a clear layout.

Screen Layout: Emphasize a clean, uncluttered and customizable layout with easily readable data.

Standard Buttons/Functions: Include navigation menus, alerts, and notifications.

Keyboard Shortcuts: Incorporate keyboard shortcuts for efficient access to different health status views.

Error Messages: Clear and user-friendly error messages that help operators take appropriate actions in case of system issues.

Maintenance Personnel Interface:

User Type: Maintenance and repair professionals responsible for implementing scheduled maintenance and addressing anomalies.

Sample Screen: The interface must provide a maintenance calendar, task lists, and real-time diagnostics.

GUI Standards: A well-organized, task-centric GUI with efficient navigation.

Screen Layout: Prioritize task lists, maintenance instructions, and diagnostics tools.

Standard Buttons/Functions: Include task creation and tracking, access to equipment manuals, and alerts.

Keyboard Shortcuts: Incorporate keyboard shortcuts for efficient task management and data entry.

Error Messages: Detailed error messages that guide maintenance personnel in diagnosing and resolving issues.

Administrator Interface:

User Type: System administrators and engineering officers responsible for configuring and maintaining RTSHMS.

Sample Screen: The interface may include configuration settings, user management, and system health monitoring.

GUI Standards: A robust, versatile, and secure GUI for system setup and maintenance.

Screen Layout: Organize settings and monitoring tools logically.

Standard Buttons/Functions: Include user management, system configuration, and system status monitoring.

Keyboard Shortcuts: Advanced options for efficient administration tasks.

Error Messages: Detailed error messages and logs for troubleshooting and system maintenance.

Common Characteristics:

Help Function: All interfaces should provide access to a help function or documentation to assist users.

Consistent Design: Maintain Poseidon Marine Systems's consistent look and feel, color scheme, and navigation structure across interfaces to create a unified user experience.

Security: Ensure strong security features, including user authentication, access control, and data encryption, to protect sensitive ship data.

4.2 Hardware Interfaces

Sensor Arrays:

Logical Characteristics: These arrays consist of a variety of sensors for monitoring ship structure and engine health. They generate real-time data.

Physical Characteristics: Sensors are distributed throughout the ship, including temperature sensors, pressure sensors, vibration sensors, and engine performance monitors.

Data and Control Interaction: RTSHMS receives data from these sensors, which is essential for real-time monitoring. The software may also send control signals to calibrate or adjust certain sensors.

Communication Protocols: The software interfaces with sensors using industry-standard communication protocols such as CAN (Controller Area Network), MODBUS, or proprietary ship-specific protocols.

Ship Control Systems:

Logical Characteristics: These systems manage ship operations, including propulsion, navigation, and communication.

Physical Characteristics: Control systems are a combination of hardware and software components that control engines, rudders, and other ship functions.

Data and Control Interaction: RTSHMS may send control commands to ship control systems based on maintenance requirements and sensor data. It also receives operational data from these systems.

Communication Protocols: These systems typically use maritime-specific communication protocols, such as NMEA 0183 or NMEA 2000, and potentially ship-specific proprietary protocols.

Monitoring Equipment:

Logical Characteristics: Monitoring equipment includes various devices for measuring ship performance parameters.

Physical Characteristics: This equipment encompasses a range of instruments, from fuel flow meters to engine monitoring systems.

Data and Control Interaction: RTSHMS collects data from these instruments to perform ship performance analysis.

Communication Protocols: It interfaces with these instruments using standard communication protocols such as RS-232, RS-485, or Ethernet.

Onboard Computers:

Logical Characteristics: Onboard computers are essential for processing and storing data.

Physical Characteristics: They include ruggedized computers suitable for the marine environment.

Data and Control Interaction: These computers host the RTSHMS software and facilitate data processing and storage.

Communication Protocols: The software communicates with these computers via standard operating system interfaces and hardware drivers.

4.3 Software Interfaces

Operating System:

Name and Version: RTSHMS is compatible with Windows 10+ and Linux 5.0+ systems.

Purpose: The operating system provides the platform on which RTSHMS runs, handling low-level system tasks, resource management, and hardware interaction.

Database Management System (DBMS):

Name and Version: Examples include MySQL, PostgreSQL, or Microsoft SQL Server.

Purpose: RTSHMS relies on a DBMS to store and manage data related to ship health, maintenance schedules, and historical records.

Data Interfaces:

Data Items: Sensor data, maintenance records, ship performance metrics.

Purpose: Data from various sensors and ship systems are input to RTSHMS for real-time monitoring and analysis. Maintenance records are stored and managed in the database. Ship performance metrics are used for analysis and decision-making.

External Communication Systems:

Tools and Protocols: Internet protocols (e.g., HTTP, HTTPS), email servers, and communication protocols.

Purpose: RTSHMS may need to communicate with external systems for remote monitoring, alert notifications, and data exchange with onshore maintenance and command centers.

Hardware Sensors and Controllers:

Data Items: Sensor data from ship components and controllers.

Purpose: RTSHMS interfaces with onboard sensors and controllers to collect real-time data on ship health, engine status, and other critical parameters.

Analysis and Reporting Tools:

Tools and Libraries: Statistical analysis software, reporting libraries.

Purpose: RTSHMS may employ external tools and libraries for in-depth ship performance analysis and generating reports for maintenance and operational insights.

User Interfaces:

Software Components: These include the operator interface, maintenance personnel interface, and administrator interface within RTSHMS.

Purpose: These interfaces allow different users to interact with RTSHMS for monitoring, maintenance, and system configuration.

Integration Middleware:

Tools and Protocols: Middleware solutions like message brokers (e.g., Apache Kafka) for data integration**.**

Purpose: Middleware facilitates the real-time flow of data between RTSHMS and other connected systems.

Shared Data:

Data Items: Critical ship health data, maintenance schedules, and diagnostic results.

Purpose: Shared data items enable seamless collaboration between the software components, ensuring that maintenance schedules and critical ship health information are consistently up-to-date and accessible to all relevant components.

4.4 Communications Interfaces

Data Acquisition and Sensor Communication:

RTSHMS communicates with a network of onboard sensors using various communication protocols such as CAN (Controller Area Network), MODBUS, or proprietary maritime-specific protocols. It collects real-time data from these sensors, including temperature, pressure, and engine performance metrics.

Ship Control Systems Integration:

The software interacts with ship control systems to receive operational data and, when necessary, send control commands. It uses maritime-specific communication protocols such as NMEA 0183 or NMEA 2000 and potentially ship-specific proprietary protocols.

Monitoring Equipment Data Retrieval:

RTSHMS communicates with monitoring equipment such as fuel flow meters and engine monitoring systems to collect performance data. It utilizes standard communication protocols like RS-232, RS-485, or Ethernet to access and retrieve this data.

Centralized Dashboard Access:

Users access RTSHMS through a web-based interface. The system requires support for modern web browsers and should be compatible with common web technologies, including HTML, JavaScript, and CSS.

Maintenance Ticket Generation and Reporting:

The system generates maintenance tickets and reports, which can be transmitted to relevant personnel or authorities through email or other electronic forms.

System Alerts and Notifications:

RTSHMS sends real-time alerts and notifications to ship operators and maintenance crews through various communication channels within the vessel.

Secure Data Exchange:

RTSHMS adheres to security best practices to protect data integrity and confidentiality. It may utilize encryption protocols like SSL/TLS for secure data transmission.

API and Data Exchange with External Systems:

The system provides APIs (Application Programming Interfaces) to facilitate data exchange with external systems, such as enterprise resource planning (ERP) systems, allowing for the integration of maintenance data with broader organizational processes.

5 Other Non Functional Requirements

5.1 Performance Requirements

1. Monitoring has to be in real-time, with a maximum delay of 1 second. This will help to ensure immediate data availability for every one on board.
2. It is crucial for the system to have a minimum uptime of 99.99%, to maintain the continuity of data for the crew.
3. Given the clients need of having multiple user groups work with it with their own needs highlighted in the system, the system needs to have multi-user support.
4. The system will need to make maintenance predictions and recommendations, therefore the data processing must be efficient.

5.2 Safety Requirements

1. The system needs to be able to have an emergency alert to inform the crew if any problem has occurred, which will prevent the problem from getting worse and potentially harming the crew.
2. In case the primary system fails, a redundancy mechanism must be in use to prevent the stoppage of monitoring.
3. In case of a serious malfunction, the system should have a fail-safe mechanism that will ensure the basic functionalities are still working.

5.3 Security Requirements

1. Strive to achieve and maintain ISO/IEC 27001 certification to validate that the system adheres to recognized standards and best practices for information security management, illustrating CyOasis Co.'s commitment to data protection and security.
2. Implement RBAC to regulate access and permissions within the system, ensuring that different stakeholders such as Deck Workers, The Engineering Department, and The Purchasing Department have appropriate access tailored to their specific roles and needs.
3. Employ comprehensive audit trails that meticulously log all user interactions within the system. This will facilitate accountability and provide essential data for investigations in the event of unusual activities or security breaches.
4. Implement regular data backups as the data connection might be vulnerable offshore, considering the criticality of the data. For instance, high-priority data might be backed up daily or even more frequently, while less critical data might be backed up weekly.

5.4 Software Quality Attributes

1. The system must operate with at least 99.99% availability to continuously monitor the operational parameters of the ship. This only allows for 52 minutes of downtime per year.
2. The system should be able to accommodate additional sensors and updates in the future without significant changes or disruptions. The system must be compatible with all Poseidon Marine Systems' sensors designed after 2013 and should be capable of integrating with future sensor technologies and other systems.
3. Target a user error rate below 5% and aim for at least 90% positive user feedback regarding UI/UX in bi-annual surveys.
4. Ensure integration with all Poseidon Marine Systems' sensors manufactured post-2013 and provision for integrating future technologies.
5. Ensure the system can be easily modified to cater to evolving needs and technologies, while maintaining a standard where system updates or maintenance do not result in more than 0.01% of total annual downtime.

6 Other Requirements

6.1 Training

1. **Training Programs:** Develop and deliver training programs for different user roles.
2. **Knowledge Base:** Create a knowledge base or forum for users to share experiences and solutions.
3. **User Manuals and Documentation:** Provide comprehensive user manuals that adhere to technical documentation standards, ensuring clarity and ease of understanding for end-users.

6.2 Testing

1. **Unit Testing:** Verify the functionality of individual components, such as data retrieval from a single sensor or the generation of a maintenance ticket.
2. **Integration Testing:** Ensure that the UDRS effectively communicates with the sensor arrays and Maintenance Ticket Generator.
3. **System Testing:** Validate the end-to-end functionality of the entire Real-Time Ship Health and Maintenance System.

6.3 Support and Maintenance

1. **Support Desk:** Establish a support desk to assist users and resolve issues.
2. **Maintenance Window:** Define regular maintenance windows for performing updates and preventive actions.
3. **Notification System:** Notify users of upcoming maintenance or system changes.

6.4 Audit and accountability

1. **Audit Trails:** Implement detailed audit trails capturing user actions, data modifications, and access.
2. **Review Process:** Establish a process for periodic review of audit logs.
3. **Alerts:** Implement alerts for anomalous or unauthorized activities detected in audit logs.

6.5 Interoperability and Integration

1. **Middleware:** Use middleware solutions to enable communication among heterogeneous systems.
2. **Adapters:** Develop adapters to translate data and commands between systems with different communication protocols.
3. **Third-Party System Integration:** Ensure compatibility and integration capability with external or third-party systems, such as port management systems, logistics systems, or maritime traffic monitoring systems.
4. **Remote Accessibility:** Enable remote access and control of the system, ensuring secure and efficient interoperability with onshore facilities and external entities.

6.6 Compliance and Standards

1. **Transport Canada:** Adhere to regulations set by Transport Canada regarding ship operations, safety, and maintenance.
2. **International Maritime Regulations:** Adhere to laws and regulations set by the International Maritime Organization.
3. **PIPEDA:** Ensure compliance with the Personal Information Protection and Electronic Documents Act (PIPEDA) for handling and protecting personal information.
4. **Environmental Regulations:** Comply with Canadian environmental laws regarding emissions, waste management, and energy usage in maritime operations.

7 Test Scenarios

7.1 Login Verification

Test Case ID: TC -1

Description: The user tries to enter their provided user id and password and clicks on the login button. T user is denied access and notified if the credentials are incorrect or granted access if the credentials are correct.

Preconditions: The user has been provided with a valid user id and password.

Test Steps:

1. User accesses one of the terminals running the system
2. User enters their user id into the user id box
3. User enters their password into the password box
4. User presses submit

Expected Results: Upon submitting correct credentials, the user is granted access and directed to the "Main Page."

7.2 Logging Out

Test Case ID: TC -2

Description: The user logs out of the system and is returned to the login page.

Preconditions: The user is already logged into the system.

Test Steps:

1. The user clicks on the "log out" button
2. The user is returned to the login page

Expected Results: The user should be returned to the login page and relinquished access to the system.

7.3 Fixing Ship Issues

Test Case ID: TC -3

Description: The user finds issues recorded by the system and creates repair plans and reports to update the system's health status.

Preconditions: The user is logged in and there are items already on the issues page.

Test Steps:

1. User navigates to the "Health" page and checks each component's health status
2. User clicks on one flagged component and creates a repair plan
3. User navigates to the "Issues" page and sees the same flagged components
4. The system orders the flagged components by urgency
5. User clicks on one of the issues, different from the on of the health page and creates repair plan
6. User navigates to the repair plans page
7. The system displays the two repair plans created by the user
8. User clicks on one of the repair plans and creates a repair report

9. User marks the repair as “complete”
10. The system updates the status of the ship and verifies with the maintenance AI that this issue has been resolved
11. The user checks that the relevant components, issues, plans and reports are all updated on the system.

Expected Results: The system is updated reflecting the changes plans and reports created by the user.

7.4 Modifying Repair Plans and Reports

Test Case ID: TC -4

Description: The user demonstrates that pre-existing repair reports and plans can be modified by engineerin officers.

Preconditions: The user is logged in as an engineering officer and repair reports and plans are already inputtec into the system.

Test Steps:

1. User navigates to the “Repair Plans” page and views one of the plans
2. The user clicks on the “Edit” button
3. The user makes changes to the repair plan and clicks “Submit”
4. The user views the plan again and sees that the plan has been updated correctly
5. The user navigates to the “Repair Reports” page and views the report associated witl the plan they changed
6. The user checks that the plan information reflects the change they made to the repair plan
7. The user clicks on the “Edit” button for the repair report
8. The user makes changes to the repair report including changing the status to “complete”
9. The user clicks “submit”
10. The user views the repair report again to see that the report has been updated with their changes

Expected Results: The repair plan and report pages reflected the changes made by the user.

7.5 Checking UDRS Record Creation and Flagging

Test Case ID: TC -5

Description: This test checks if the Maintenance AI can process sensor data, create UDRS records, and correctly label them as "urgent" or "non-urgent".

Preconditions: The sensor array and Maintenance AI are working.
The UDRS database is ready for storing records.

Test Steps:

1. Send test sensor data to the Maintenance AI, including data for both urgent and non-urgent scenarios.
2. Confirm that the Maintenance AI creates UDRS records from this data.
3. Check that each record is correctly labeled as “urgent” or “non-urgent”.
4. Verify that the Maintenance AI sends these records to the UDRS database.
5. Check the UDRS database to see if it shows the new records correctly.

Expected Results: The Maintenance AI creates UDRS records properly.
Each record is accurately marked as “urgent” or “non-urgent”.

The UDRS database updates with the new records and shows them correctly.
If there's a problem with data transmission, the system should report an error.

7.6 Traceability Matrix

Requirement		**Use Case**	**Test Case**
Requirement ID	**Priority**	**Use Case ID**	**Test Case ID**
REQ-1-1	High	UC-1-1	TC-1
REQ-1-2	Medium	UC-1-1	TC-1
REQ-1-3	Low	UC-1-1	TC-1
REQ-1-4	Low	UC-1-1	TC-1
REQ-1-5	Low	UC-1-1	TC-1
REQ-1-6	Low	UC-1-1	TC-1
REQ-1-7	Medium	UC-1-2	TC-2
REQ-2-1	High	UC-2-2	TC-3
REQ-2-2	High	UC-2-1	TC-3
REQ-2-3	High	UC-2-1	TC-3
REQ-2-4	High	UC-2-2	TC-3
REQ-2-5	High	UC-2-1	TC-3
REQ-3-1	Medium	UC-3-1	TC-3
REQ-3-2	Low	UC-3-2	TC-4
REQ-3-3	High	UC-3-2	TC-3
REQ-4-1	Medium	UC-4-1	TC-3
REQ-4-2	High	UC-4-2	TC-3
REQ-4-3	Low	UC-4-2	TC-4
REQ-4-4	High	UC-4-2	TC-3
REQ-5-1	High	UC-5-1	TC-5
REQ-5-2	High	UC-5-1	TC-5
REQ-5-3	High	UC-5-2	TC-5
REQ-5-4	Medium	UC-5-1	TC-5
REQ-5-5	High	UC-5-1	TC-5

8 Entity Relationship Diagram

8.1 Entity Relationship Diagram

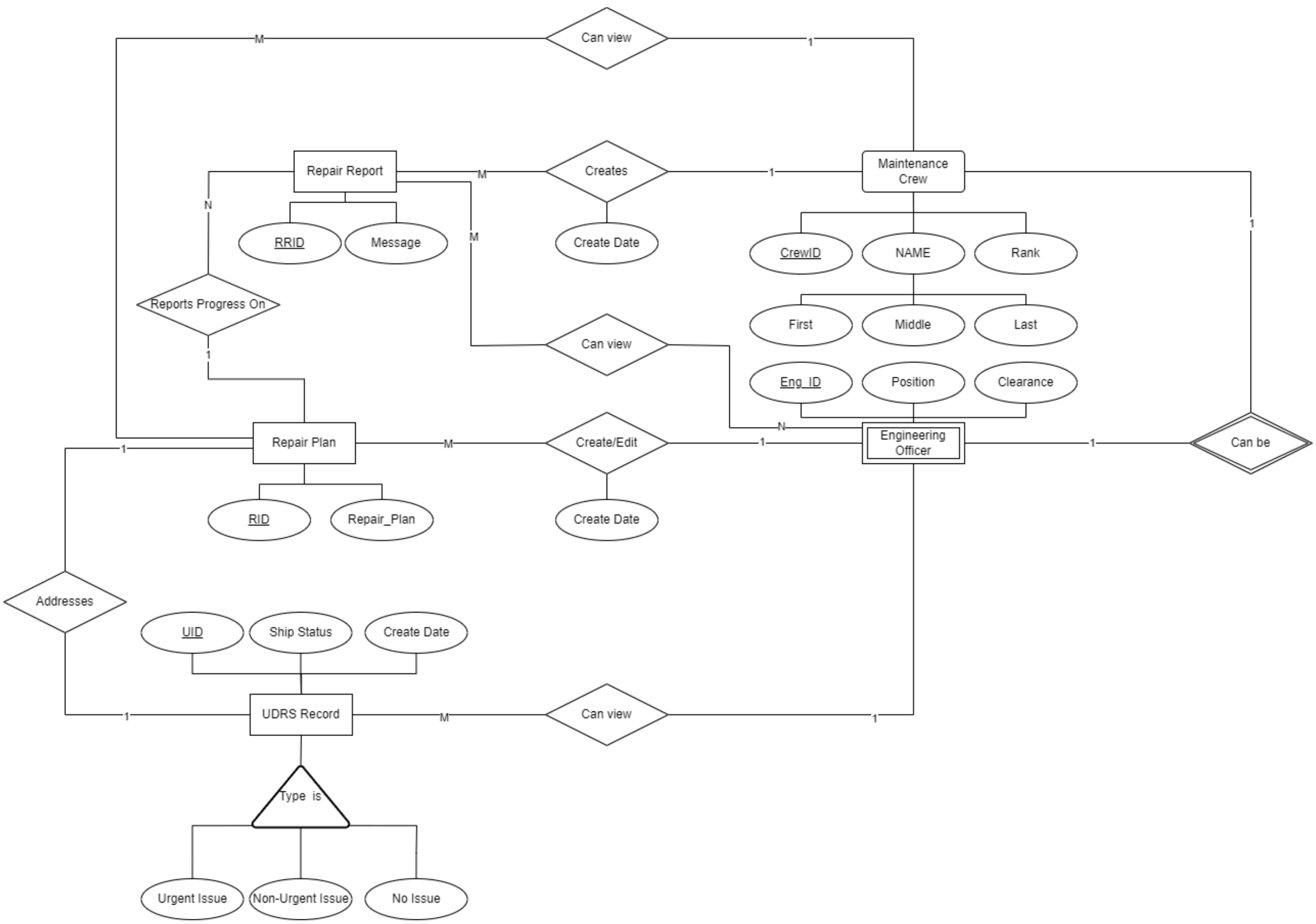

Figure 7.1 Entity Relationship Diagram

8.2 Database Schema

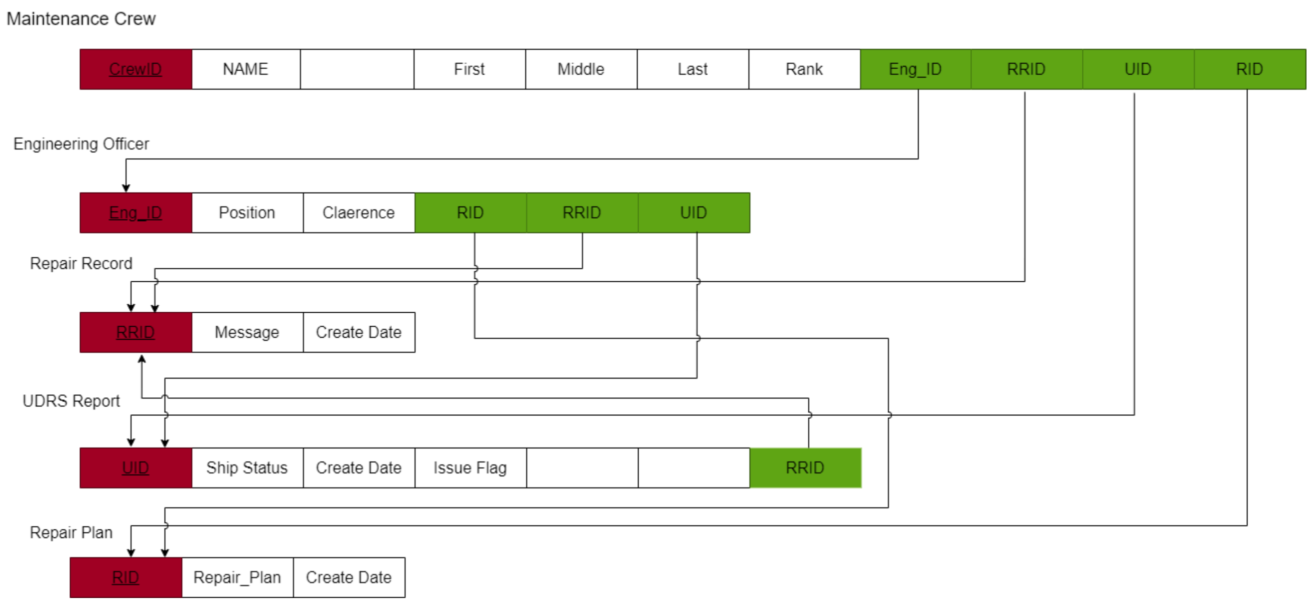

Figure 7.2 ERD Database Schema

8.3 Data Dictionary

Table 7.1 Data Dictionary

Object Class	Attributes
Maintenance Crew	CrewID(int), First_Name(varchar), Middle_Name(varchar), Last_Name(varchar), Rank(varchar), Eng_ID(varchar), RRID(int), UID(int), RID(int)
Engineering Officer	Eng_ID(int), Position(varchar), Clearance(varchar), RID(int), RRID(int), UID(int)
Repair Record	RRID(int), Message(varchar), Create_Date(timestamp)
UDRS Report	UID(int), Ship_Status(int), Create_Date(timestamp), Issue_Flag(bool), RRID(int)
Repair Plan	RID(int), Repair_Plan(varchar), Create_Date(timestamp)

8.4 Unique Keys

Table 7.2 Unique Keys Table

Type	Table	Column
Primary	Maintenance Crew	CrewID
Primary	Engineering Officer	Eng_ID
Primary	Repair Record	RRID
Primary	UDRS Report	UID

Primary	Repair Plan	RID

8.5 Foreign Keys

Table 7.3 Foreign Keys Table

Table	Column	Referenced Table	Referenced Column
Maintenance Crew	Eng_ID	Engineering Officer	Eng_ID
Maintenance Crew	RRID	Repair Record	RRID
Maintenance Crew	UID	UDRS Report	UID
Maintenance Crew	RID	Repair Plan	RID
Engineering Officer	RID	Repair Plan	RID
Engineering Officer	RRID	Repair Record	RRID
Engineering Officer	UID	UDRS Report	UID
UDRS Report	RRID	Repair Record	RRID

9 Prototype User Interface

9.1 Mock-Ups

9.1.1 Sign-In Page

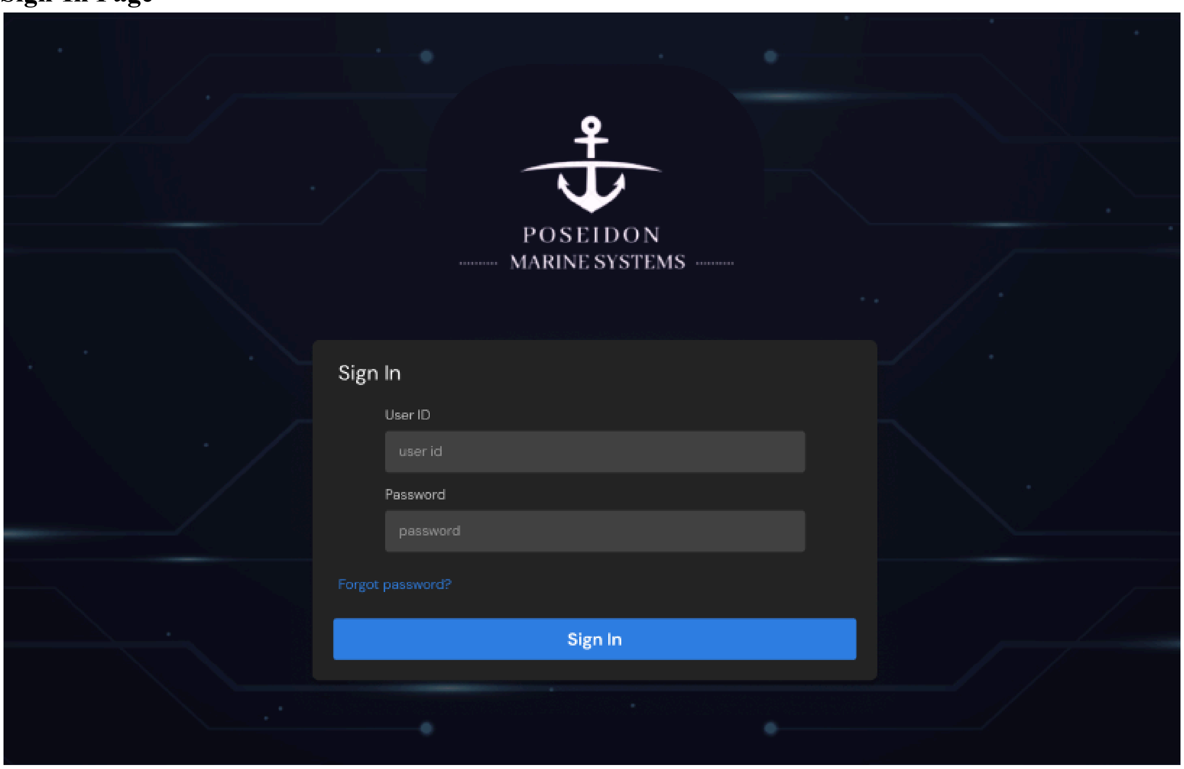

Figure 8.1 Sign In Page

9.1.2 Main Dashboard

Figure 8.2 Main Dashboard

9.1.3 Ship Status

Figure 8.3 Ship Status

9.1.4 Repair Plans

Figure 8.4 Repair Plans

9.1.5 Repair Reports

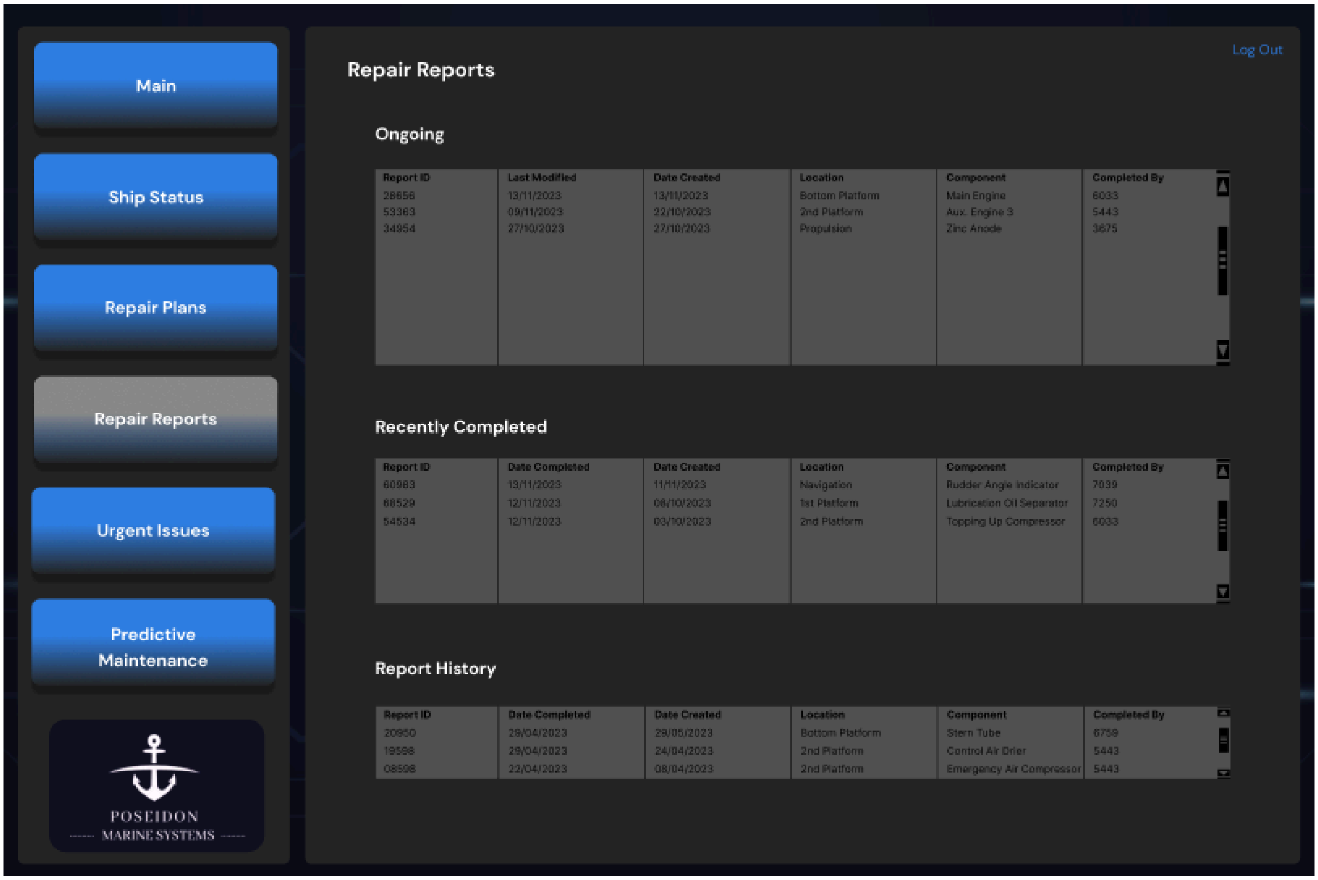

Figure 8.5 Repair Reports

9.1.6 Urgent Issues

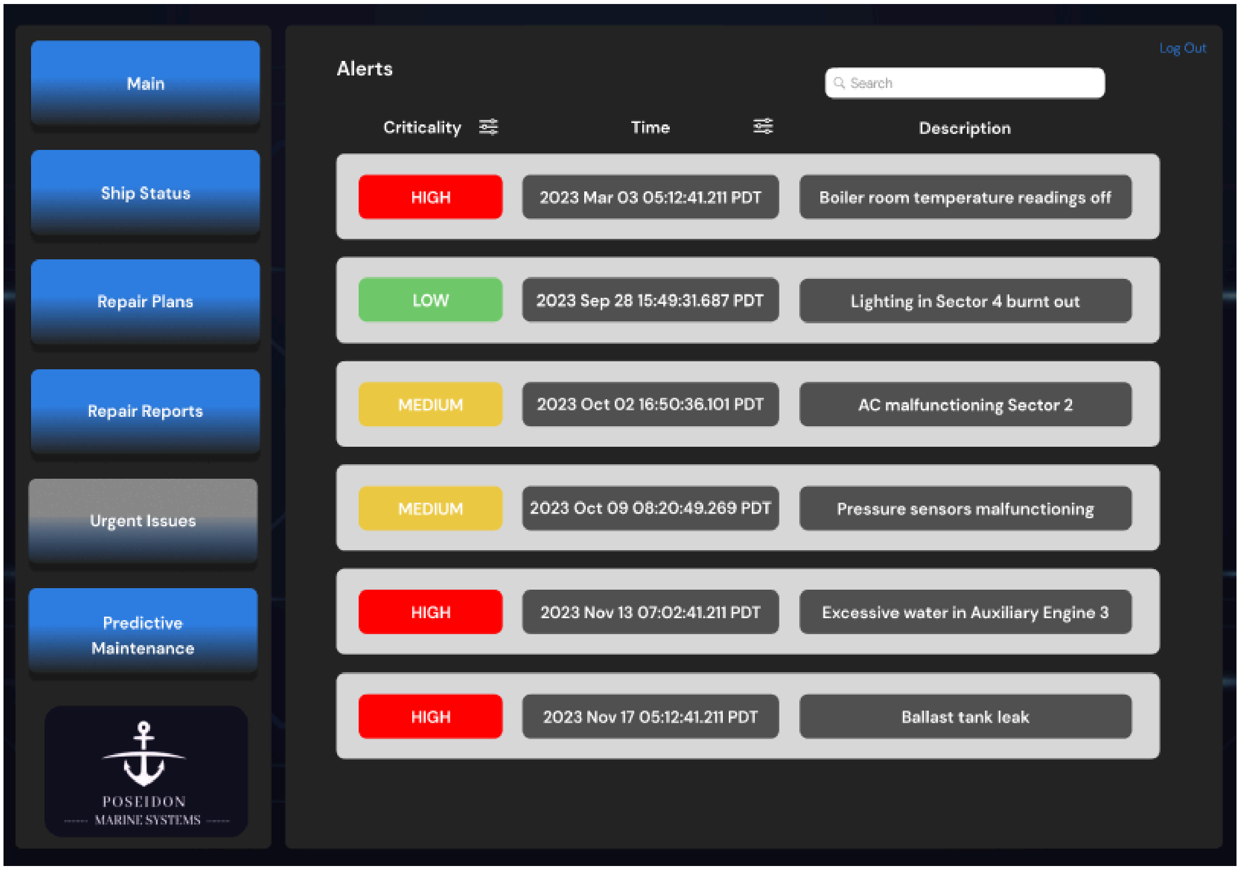

Figure 8.6 Urgent Issues

9.1.7 Predictive Maintenance

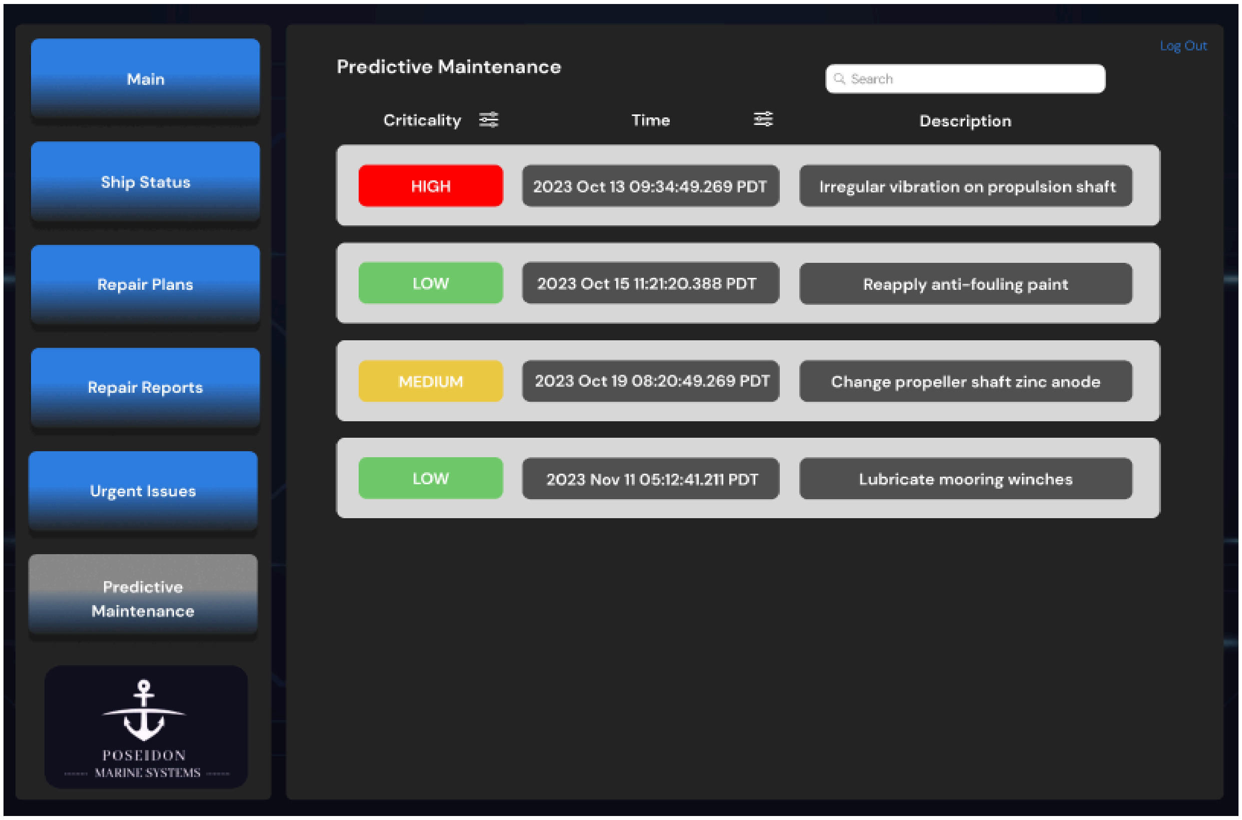

Figure 8.7 Predictive Maintenance

9.2 Storyboards

9.2.1 Logging In

After signing in through the Sign In page, the user would input their User ID and Password into the appropriate fields, then proceed to select the “Sign In” button. This action would transition the user to the Dashboard page of the Poseidon Marine Systems application.

9.2.2 Forgot Password

On the Poseidon Marine Systems Sign In page, a user who has forgotten their password clicks the “Forgot password?” link, which takes them to a dedicated page. Here, they are prompted to enter their User ID into a field and then click the “Notify Engine Department” button to initiate the password reset process. Instructions for resetting the password are then provided, either through a confirmation message or an email.

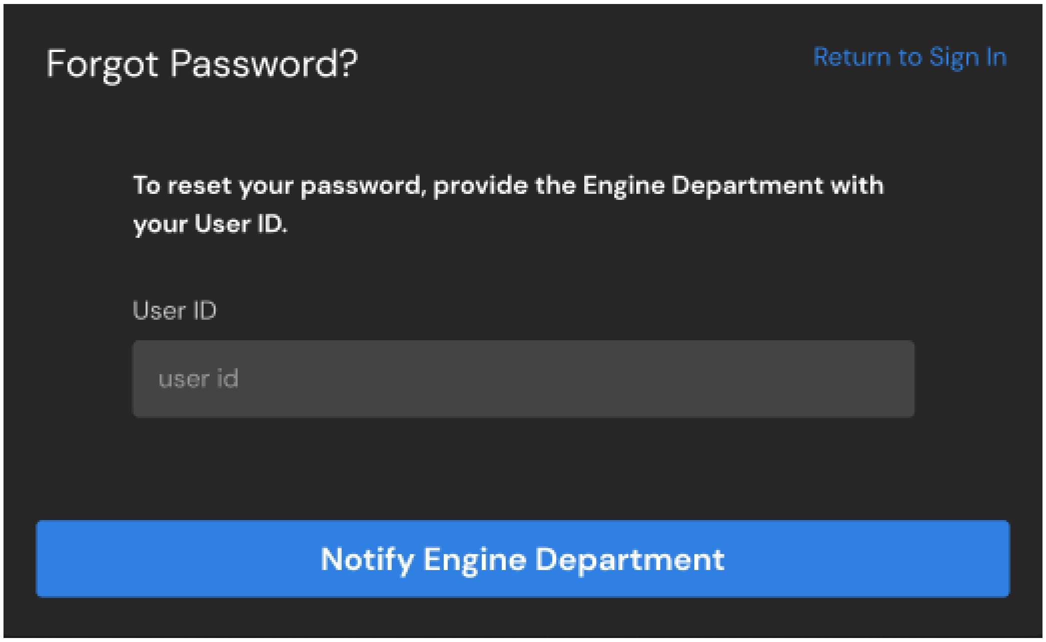

Figure 8.8 Forgot Password Page

9.2.3 Dashboard

Upon successful login, the user is redirected to the Dashboard page of the Poseidon Marine Systems interface, which is visually aligned with the sleek, maritime-themed aesthetic of the login screen. Here, the user encounters a navigation menu on the left side with the following options:

- "Expert Mode" offers an enhanced feature set or advanced analytical tools are available for experienced users such as engineers.
- "Ship Status": Allows the user to view the current operational status of their fleet.
- "Repair Plans": Enables planning and scheduling of maintenance and repair activities.
- "Repair Reports": Provides access to completed repair documents and histories.
- "Urgent Issues": Highlights immediate or critical issues that need attention.
- "Predictive Maintenance": Offers insights and recommendations for future maintenance needs to prevent potential issues.

A striking neon blue schematic of a ship serves as a visual guide for users, with areas of damage prominently marked in red, allowing for easy identification of vessel impairments. This feature is part of a suite of comprehensive tools designed for meticulous marine vessel management, ensuring that the ships are maintained in optimal condition. A "Log Out" option is also conveniently placed at the top right, ensuring secure exit when needed.

9.2.4 Ship Status

When a user navigates to the Ship Status page from the dashboard, they can see a comprehensive view of the ship's various systems categorized as Engine Systems, Propulsion Systems, Navigation Systems, and Structural Integrity. Each subsystem within these categories is indicated by a color-coded status: green signifies operational systems, yellow indicates potential issues that may require monitoring, and red alerts to immediate action needed.

For instance, a red marker next to a system like the Main Engine would catch the user's attention, signaling a critical issue. Clicking on this red marker would expand to provide detailed information on the specific problem, such as a detected fault by the Unified Diagnostic Reporting System (UDRS). The detailed view would include the date, time, urgency level, and issue number, along with a description of the detected issue, such as water in the lubrication oil, and offer maintenance recommendations. The system prompts the maintenance crew with actionable steps and the option to create a repair plan directly from this interface. This streamlined process allows for quick response and resolution, ensuring the vessel's systems return to optimal functioning swiftly.

9.2.5 Repair Plans

When a user navigates to the Repair Plans page from the dashboard interface, the maintenance crew can oversee various aspects of vessel repairs. The page is divided into three sections:

- "Active Plans": This section lists all ongoing repair tasks, each with a unique Plan ID. Details such as the last modification date, creation date, location, component involved, and priority level are displayed, enabling the crew to easily track current maintenance operations and prioritize them accordingly.

- "Recently Completed Plans": Once repairs are finalized, they are moved to this segment. It archives tasks that have been recently addressed, serving as a quick reference for the crew to review the latest completed maintenance activities.

- "Plan History": This is a comprehensive log of all past repair plans, providing a historical record of maintenance actions taken over time.

Each plan is tagged with a priority status, which helps in filtering the tasks by urgency, ensuring that critical repairs are attended to promptly. This systematic approach to managing repairs enhances the efficiency and effectiveness of the vessel's maintenance regime.

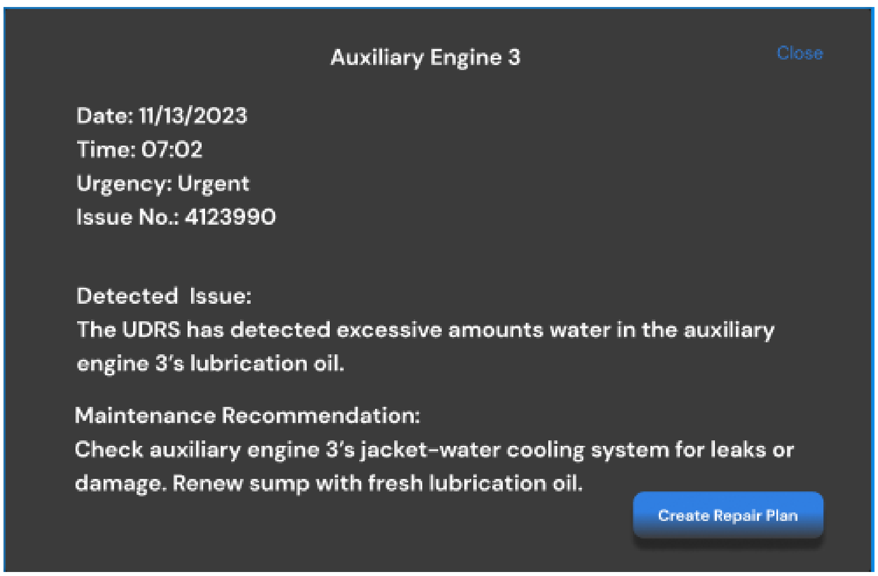

Figure 8.9 Example of Issue Description Page Leading to "Create Repair Plan"

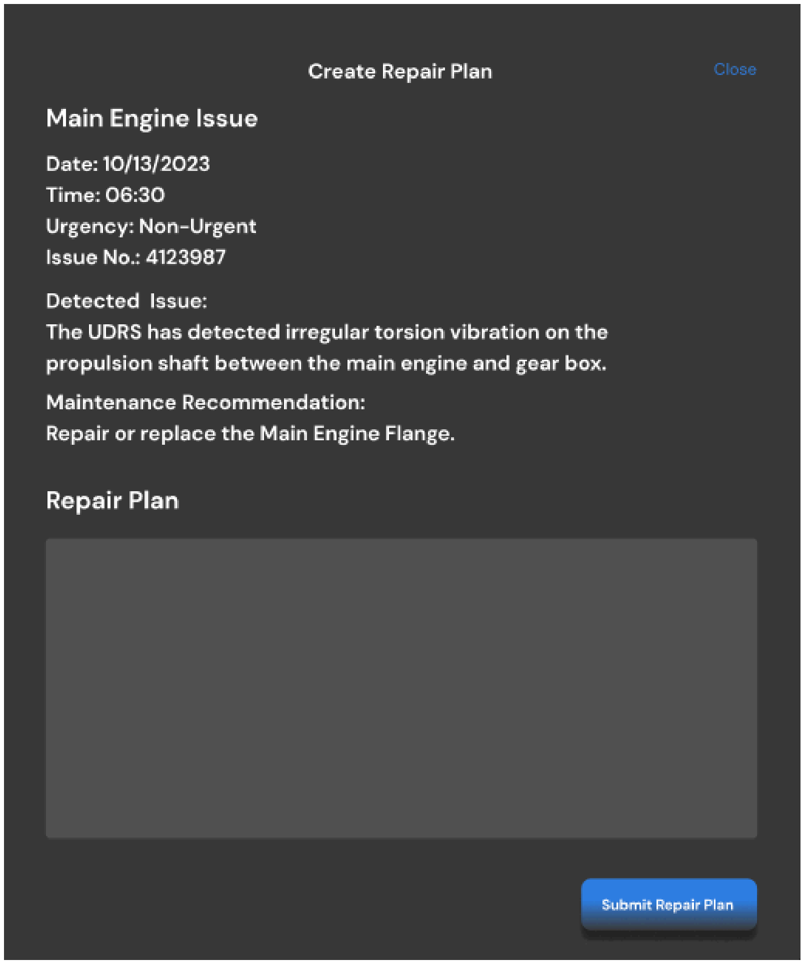

Figure 8.10 Create Repair Plan Page

9.2.6 Repair Reports

The Repair Reports page is designed to function as a historical log, capturing a detailed record of all completed repair activities. This page will list each repair report along with relevant details such as completion dates, providing users with an audit trail of maintenance actions. This enables maintenance crews and ship management to track repairs over time, assess the frequency of certain issues, and evaluate the effectiveness of the repairs.

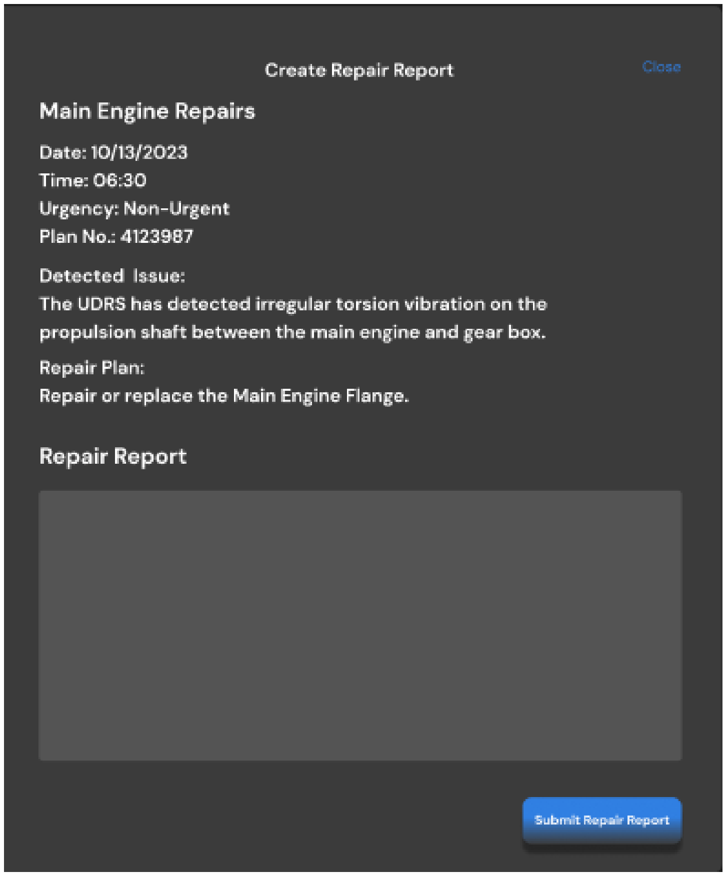

Figure 8.11 Example of "Create Repair Report" Page

9.2.7 Urgency Issues

The Urgent Issues page functions as a central hub for alerts and notifications regarding the ship's condition. The page is intuitively designed, with alerts categorized by their level of criticality using a color-coded system where:

- Red indicates "High" criticality, suggesting immediate attention is required, such as for a ballast tank leak.
- Yellow represents "Medium" criticality, implying that the issue should be addressed soon, like malfunctioning pressure sensors.
- Green denotes "Low" criticality for less urgent matters, such as lighting issues.

The notifications are organized chronologically, with the most recent alerts displayed at the top, ensuring that the newest and potentially most pressing issues are seen first. This allows the maintenance crew to quickly assess and prioritize issues based on their severity and recency, streamlining the decision-making process for repairs and interventions.

9.2.8 Predictive Maintenance

The Predictive Maintenance page on the Poseidon Marine Systems would offer a smart analysis of ship components, predicting when they might need servicing. By using past data and current performance metrics, it would list components with a status indicator such as "Healthy," "Minor Wear," or "Service Soon." This feature aims to schedule maintenance effectively, prevent unexpected failures, and maintain the vessel's operational integrity

Appendix: Issues List

No issues for this iteration.