Software Requirements Specification (SRS) for Hot Swap Mode

System Name: Direct Liquid Cooling (DLC) In-Row
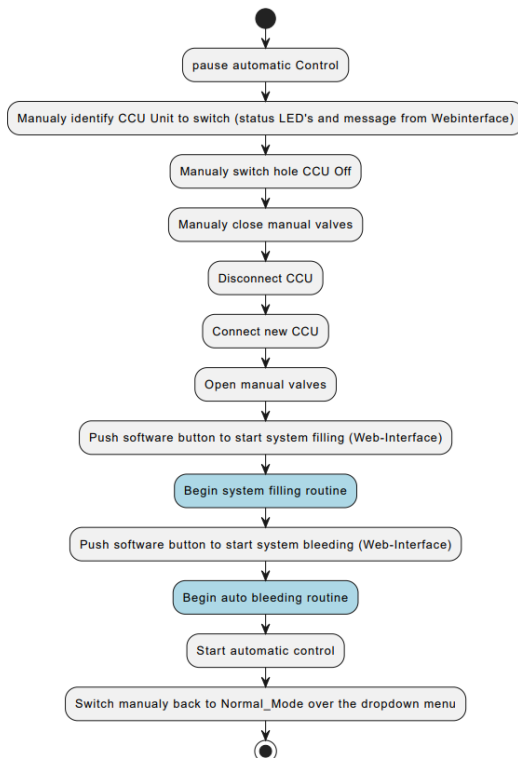
Module: Hot Swap Mode

Version: 1.0

Date: May 22, 2025

1. Introduction

Hot Swap Mode

Internal

1.1 Purpose

This document defines the software requirements for the **Hot Swap Mode**, which enables safe and controlled replacement of a CCU (Coolant Control Unit) without shutting down the entire system.

1.2 Scope

The software manages CCU identification, user-guided manual operations, automated filling and bleeding routines, and reactivation of the system's automatic control.

2. Functional Requirements

FR0: Enter into the Hot Sswap Mmode

- The user has to activate the hot swap mode via the HMI/ WebUI.

FR1: Pause Automatic Control

- The system shall pause all automatic PID controls when Hot Swap Mode is activated.

FR2: Identify CCU to Swap

- The system shall assist the user by activating **status LEDs** and displaying a **message in the Web Interface** to identify the CCU to be replaced.

FR3: Manual CCU Shutdown

- The software shall instruct the user to:
  - Manually switch the CCU off
  - Close manual valves

FR4: Disconnect Old CCU

- The user shall physically disconnect the selected CCU.

FR5: Connect New CCU

- After connection, the system shall recognize the new CCU as a new hardware instance.
- User shall define position of new CCU over the HMI / webUI
- Check the new pumps if the latest pump firmware is installed. If not, they will be updated automatically.

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Commented [CR1]: We should also describe how is the behaviour of the remaining CCUs that have to continue their operation. Do they run acc. To the last logged value as long as they don´t have PID controls?

Commented [PP2R1]: Yes they should run based on the last logged values

Commented [CR3]: Why do they need to be activated? In my understanding they are permanently activated and showing the status?

Commented [PP4R3]: By activating status LED I meant showing status RED LED when CCU need to be replaced.

Commented [CR5]: Does the user have to define in the web UI which CCU he wants to change or is this automatically defined by the software according to existing error loggings?

Commented [PP6R5]: Should be identified based on error logged in the system data log

Commented [CR7]: What does this mean in particular? Is it only the CAN connection as there is no manual switch off on the CCU?

Commented [PP8R7]: Step by step instructions to turn off the pumps then followed by disconnecting the cables/connection

Internal

FR6: Manual Valve Operation

- The system shall prompt the user to open manual valves before proceeding.

FR7: Start System Filling

- The user shall press a software button in the Web Interface to start the **system filling routine**.
- The software shall initiate pump activation and monitor pressure until the system is filled up to xx bar for secondary return pressure P2.

FR8: Start Bleeding Routine

- The user shall trigger the **auto bleeding routine** from the Web Interface.
- The software shall run all pumps at 40% speed for 2 minutes, stop the pumps, and validate pressure.

FR9: Resume Automatic Control

- Once filling and bleeding are complete, the software shall restart the automatic PID controller.
- The system shall display a message for the user that the hot swap procedure has been successfully completed.

FR10: Manual Return to Normal Mode

- The system shall allow the user to **switch back to Normal Mode** using the dropdown menu.

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3. Non-Functional Requirements

NFR1: Safety

- Ensure pumps and valves are locked unless the appropriate manual steps are confirmed completed.

NFR2: Responsiveness

- All UI prompts and status updates shall be visible to the user within 1 second of triggering the next step.

NFR3: Usability

Comments (margin):

Commented [CR9]: Is there a difference in the filling routine whether the CCU is prefilled or not?

Commented [PP10R9]: Yes there should be based on if CCU is newly placed/replaced other scenario if coolant is less due to leakage or bleeding

Commented [CR11]: Or better the last logged pressure level before exchanging the defect CCU? Could be logged as a routine when starting the Hot swap mode?

Commented [PP12R11]: Could be done but will it be useful to use the last logged value from the defected CCU?

Commented [CR13]: Shouldn´t there be a testrun for the new pumps similar to the one during commissioning?

Commented [PP14R13]: Yes there should be, that'll be good to make sure CCU is ready and in good state

Commented [CR15]: If we do that, the maintaining of the required cooling performance is not guaranteed. Isn´t the bleeding done automatically, because the other pumps will continue operation? Is there any manual bleeding required e.g. with the manual bleeders at the highest point of the TCS (external from CDU)? If that is the case there should be an advise of the system for the user to do so.

Internal

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- Provide guided instructions in the Web Interface at each step of the Hot Swap sequence.

NFR4: Compatibility

- The system must detect and integrate the new CCU seamlessly with existing networked units.

4. System Interfaces

4.1 Hardware Interfaces

- CCUs
- Manual valves
- Filling pump
- Pressure sensors

4.2 Software Interfaces

- Web-based UI (for prompts and user buttons)
- CIOC logic (for PID and control routines)

5. Assumptions and Constraints

- The user follows physical disconnection and reconnection procedures correctly.
- CCU being connected is compatible and properly addressed.
- Manual valves are physically operated as per software prompts.

Internal