Software Requirements Specification (SRS) - Automatic Mode for DLC 150kW

System Name: System Automatic Operation

Routine Name: Automatic Mode
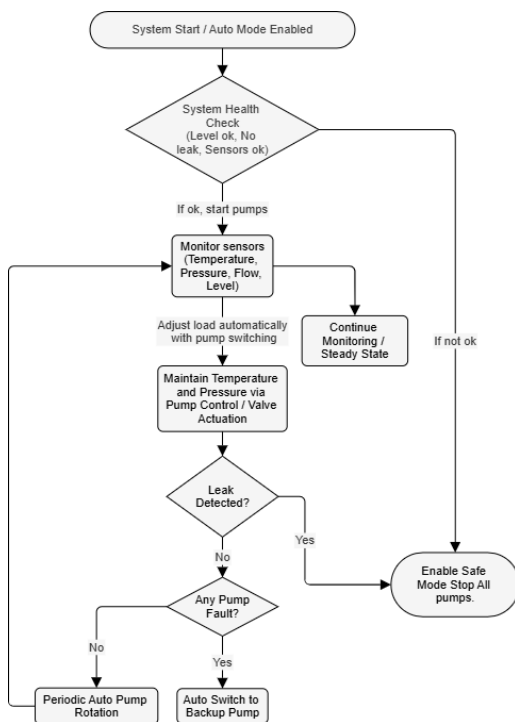
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1. Introduction

Automatic Mode

Internal

1.1 Purpose

The purpose of this document is to define the software requirements for the Automatic Mode operation of the 150kW Direct Liquid Cooling (DLC) system. This mode ensures autonomous regulation of coolant flow, pressure, and temperature using feedback and values within the Coolant Control Unit (CCU).

1.2 Scope

The automatic mode software manages.

- Pump control and sequencing.
- Regulation of coolant flow and temperature.
- System safety through continuous monitoring.
- Fault detection (e.g. leakage, pressure deviation or pump failure).
- Communication with higher-level HMI for visualization, controlling and supervision.

1.3 System Overview

The system comprises:

- **3 centrifugal pumps** (Primary. Secondary, and Standup/Backup)
- **Temperature sensors**
- **Pressure sensors**
- ~~**Level sensors (Reservoir monitoring)**~~
- **Leakage sensor (Rope type)**
- **Valve**
- **HMI / Web UI** for control and visualization

> **Commented [AR1]:** Level sensor is not applicable for InRack

2. System Architecture

Inputs:

- Temperature (Primary In, Primary Out, Secondary In, ~~Secondary Out~~)
- Pressure (Primary in and out and Secondary in loop)
- Flow rate (Coolant loop)
- ~~Level (Tank)~~
- Leak detection sensor

> **Commented [AR2]:** Secoundary Out is not applicable for InRack

> **Commented [AR3]:** Level sensor is not applicable for InRack

Outputs:

- Pump Start/Stop Control
- Valve Control

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- Alarm and Status Indicators
- Data to HMI/Web Interface

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3. Functional Requirements

3.1: Automatic Mode Operation

1. System starts in Standby state.
2. Upon start command:
    - The control module evaluates all sensor readings (no fault, sufficient coolant level, no leakage).
    - All **Three Pump** starts automatically.
3. System continuously monitor flow rate, pressure, and temperature.
4. Based on system heat load (based on temperature rise/fall or flow drop/rise):
    - Other 2 pumps starts/stops automatically for load sharing.
5. The system performs **automatic pump rotation** (lead-lag switching) every 15 secs system should calculates required pumps and run time for even aging.
6. In case of **pump fault**, the next available pump automatically starts.

3.2: Temperature Regulation

- Target coolant outlet temperature is maintained by controlling pump speed (If VFD based) or by sequential pump operation.
- High temperature alarm if outlet temperature exceeds setpoint + 5 °C.
- Low temperature alarm if below setpoint - 5 °C.

3.3: Pressure Control

- Maintain nominal loop pressure via pump control.
- Trigger pressure alarms if :
    - Pressure > max threshold ->Overpressure alarm.
    - Pressure < min threshold -> Underpressure alarm.

3.4: Flow Monitoring

- Verify minimum flow rate before allowing system to run.
- Trigger low-flow alarm if measured flow < threshold for 10 sec.

3.5: ~~Level Monitoring~~

> **Commented [AR4]:** Level sensor is not applicable for InRack

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- ~~Level sensor continuously monitors coolant tank.~~
- ~~If level < low threshold -> Low Level Alarm and prevent pump start.~~
- ~~If level < critical -> system should shut down the pumps.~~
- ~~If level > high threshold -> Overfill Alarm~~

3.6: Leak Detection

- Continuous monitoring by rope leak sensor.
- If leakage detected:
  - Immediate alarm.
  - Automatic pump shutdown.
  - System transitions to **Safe Mode**.

Commented [PP5]: As of now only alarm is implemented. Customer or service person should take that call if to shut down the unit based on the alarm raised.

3.2: Fault Handling and Safety

- Any sensor fault triggers **diagnostic alert**.
- Pump failure triggers **auto-switch to backup pump**.
- System transition to **Fail Safe State** on:
  - Leakage
  - ~~Low Level Critical~~
  - Overpressure

Commented [PP6]: As of now only alarm is implemented. Customer or service person should take that call if to shut down the unit based on the alarm raised.

3.2: Communication and HMI Interface

- All parameters (Temperature, flow, level, pressure, pump status, alarm state) should be displayed on
  - Local HMI
  - Web UI
- Operator can:
  - Monitor real-time measurements.
  - Enable/Disable automatic mode.