

Adding Readout of Flow Switches for the Hall B Torus Magnet Power Supply

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This note presents the implementation of flow switches and their readout for controlling and monitoring the low conductivity water (LCW) flow through the torus coils of the Hall B torus magnet power supply (MPS).

Hall B’s Danfysik MPS has five internal flowmeters connected to five vendor-supplied flow switchboards that convert the frequency output of the flowmeter to a Boolean logic output via an optical switch. Each flow switchboard has a potentiometer to adjust the threshold level at which the Boolean logic is activated and an optical switch that outputs the flow meter’s frequency. A fault in any of the five flow switch outputs toggles the MPS waterflow status bit to indicate a fault.

Previously, the overall MPS waterflow bit was monitored. After a fast dump due to a problem with the waterflow bit, a decision to use a chassis that could monitor the frequency of the water flow sensors using the optional optical switch output on the flow switchboards was made.

It was determined that the chassis pulls the input high and that the optical flow switch is directional—like a diode. These features required modifications to the connector cabling; the flow readouts use the RS-232 output of the chassis connected

to a terminal server.

Table 1 shows the troubleshooting dates of the internal flow meters—dates before 2024-03-11 are reported in Hz from oscilloscope measurements, while 2024-03-11 is the converted flow, which has not yet been calibrated.

The MPS was commissioned on 2019-02-19, 2024-03-05 was before the MPS was flushed, 2024-03-06 was after the flush was completed, and 2024-03-11 was after the individual flow meter outputs were connected.

Figures 1(a)–(c) show an event where LCW was interrupted, Fig. 1(b), and the synced trips of the flow switches 1–5, Fig. 1(a). The MPS water flow status BF, Fig. 1(c), agrees with LCW supply interruption.

With the connection and readout of the internal flow meters of the MPS, an additional diagnostic tool is available to help with troubleshooting any interlocks that may be caused by LCW issues internal to the MPS itself.

Flow switch#	2019-02-19		2024-03-05				2024-03-06		2024-03-11		
	All valves open [Hz]	Valve trip value [Hz]	All valves closed [Hz]	All valves open [Hz]	Valve trip value [Hz]	Valve trip order	All valves open [Hz]	Valve trip order	All valves open [SLM]	Valve trip value [SLM]	Valve trip order
1	610	350	0	690	65–390		642		39.05	21.57–21.71	4
2	109	80	1	118	60–88	2	114	3	6.89	4.81–5.06	3
3	640	350	10.5	797	290–410		688		41.33	22.35–25.04	5
4	17.8	13	0	20.8	9–12		18.7	2	1.1	0.76–0.82	2
5	18	13	1.7	19.8	10–13	1	18.5	1	1.1	0.76–0.84	1

Table I. Flowmeter diagnostics.

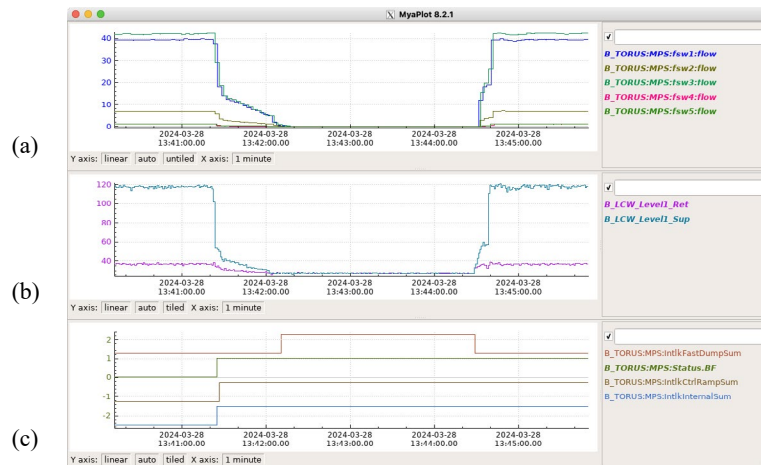


FIG. 1. LCW interruption on 2024-03-28.