

Control System and Experiment for RAON HWR Cryomodules

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Abstract

A prototype of half-wave resonator (HWR) cryomodules is fabricated and tested. Cables and tray are installed for horizontal test. The design and the piping and instrumentation diagram (P&ID) of the HWR cryomodule are presented. The HWR cryomodule is tested with developed programmable logic controller (PLC) and experimental physics and industrial control system (EPICS) control systems. The heat loads of the HWR cryomodule for static and dynamic are measured.

Tray and Cable Installation

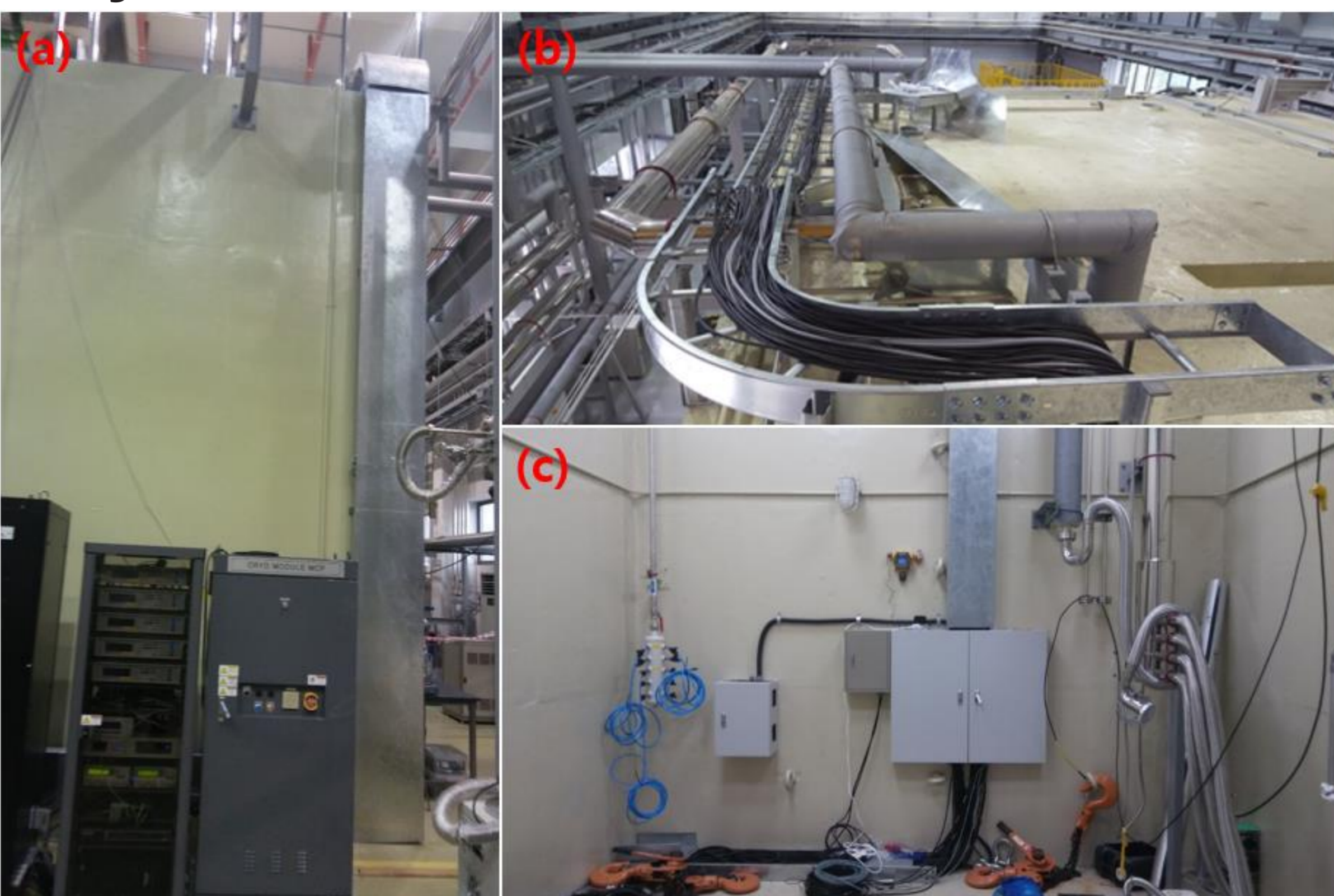


Figure 1: Pictures of tray and cables for horizontal test. (a) PLC rack and tray, (b) cables in tray on the roof of the horizontal test bunkers and (c) cables with connectors, tray, local box, compressed air port, RF power lines and helium transfer lines inside of the bunker.

Horizontal Test

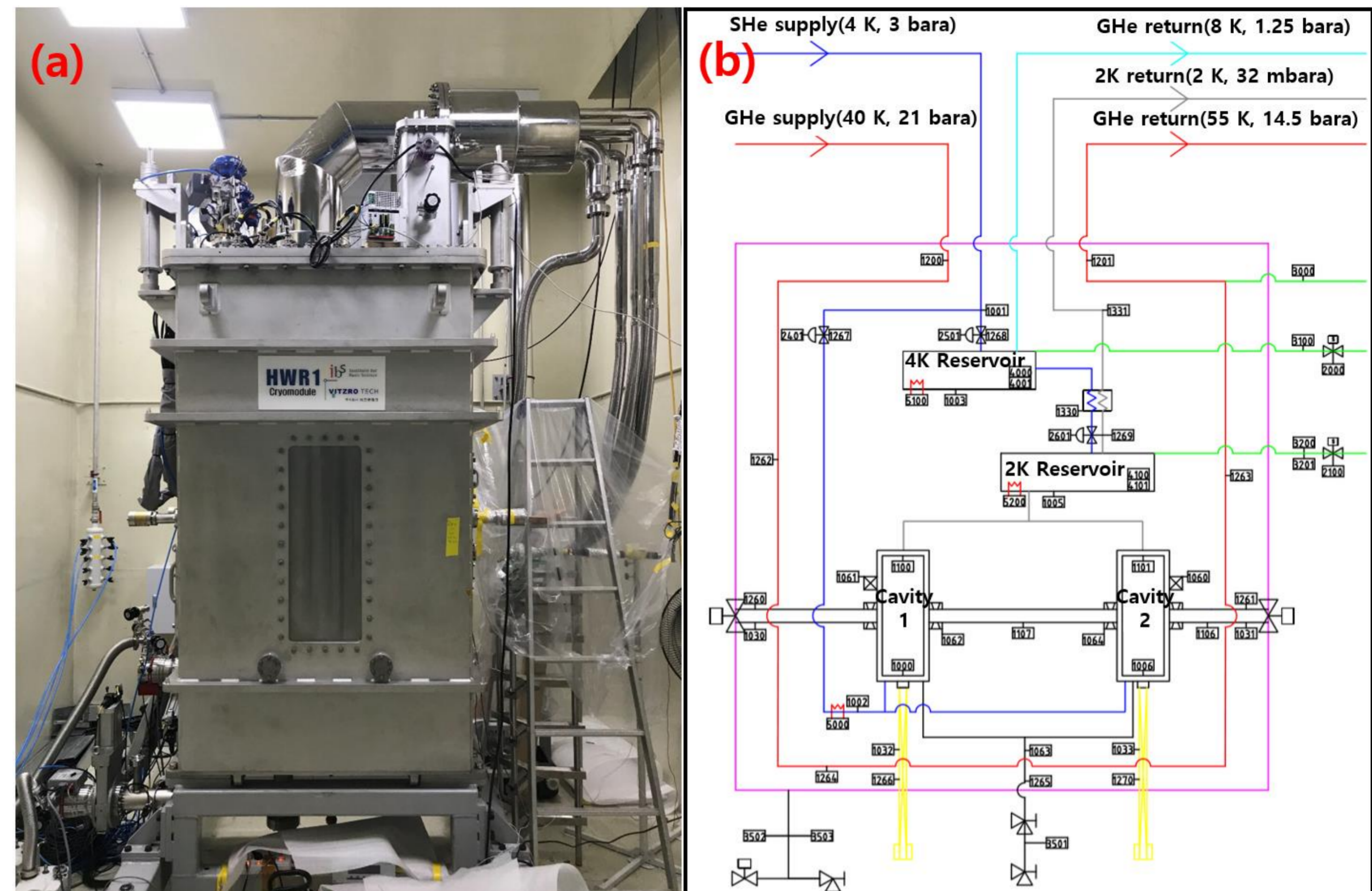


Figure 4: Picture of (a) the HWR cryomodule in horizontal test facility and (b) the P&ID for the HWR cryomodule.

HWR Cryomodule

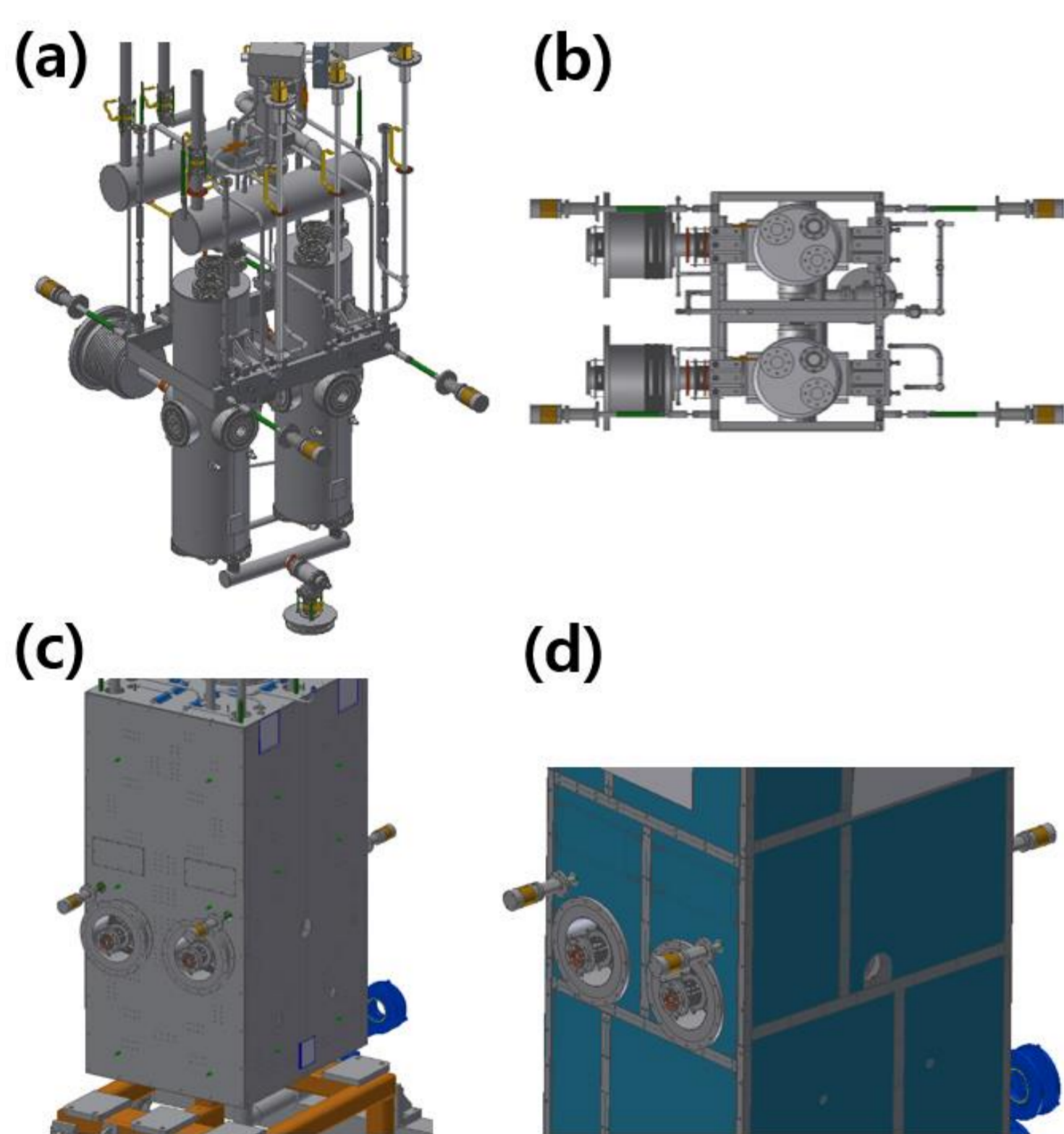


Figure 2: Design of a HWR cryomodule. (a) Liquid helium reservoirs, cavities and couplers, (b) top view of cavities, (c) thermal shield and (d) magnetic shield.

Feedthrough ID	Component	Material	Temperature	Pressure	Notes
FT-001	Temperature Sensor	316L SS	2.1 K	0.1 bar	For cavity temperature monitoring
FT-002	Pressure Gauge	316L SS	2.1 K	0.1 bar	For cavity pressure monitoring
FT-003	Heater	316L SS	2.1 K	0.1 bar	For cavity temperature control
FT-004	Solenoid Valve	316L SS	2.1 K	0.1 bar	For helium flow control
FT-005	Tuner	316L SS	2.1 K	0.1 bar	For RF system tuning
FT-006	Level Monitor	316L SS	2.1 K	0.1 bar	For helium level monitoring

Figure 3: Information of feedthrough connectors. Feedthrough connectors are used for temperature sensors, tuners, level monitors, heaters, pressure gauges and solenoid valves.



Figure 5: RF test of a HWR cryomodule for (a) SSPA and (b) connection of a coaxial line to an input coupler in the cryomodule. The solid state power amplifier (SSPA) has the drive frequency of 162.5 MHz, continuous-wave (CW) operating mode and the maximum power of 7 kW.

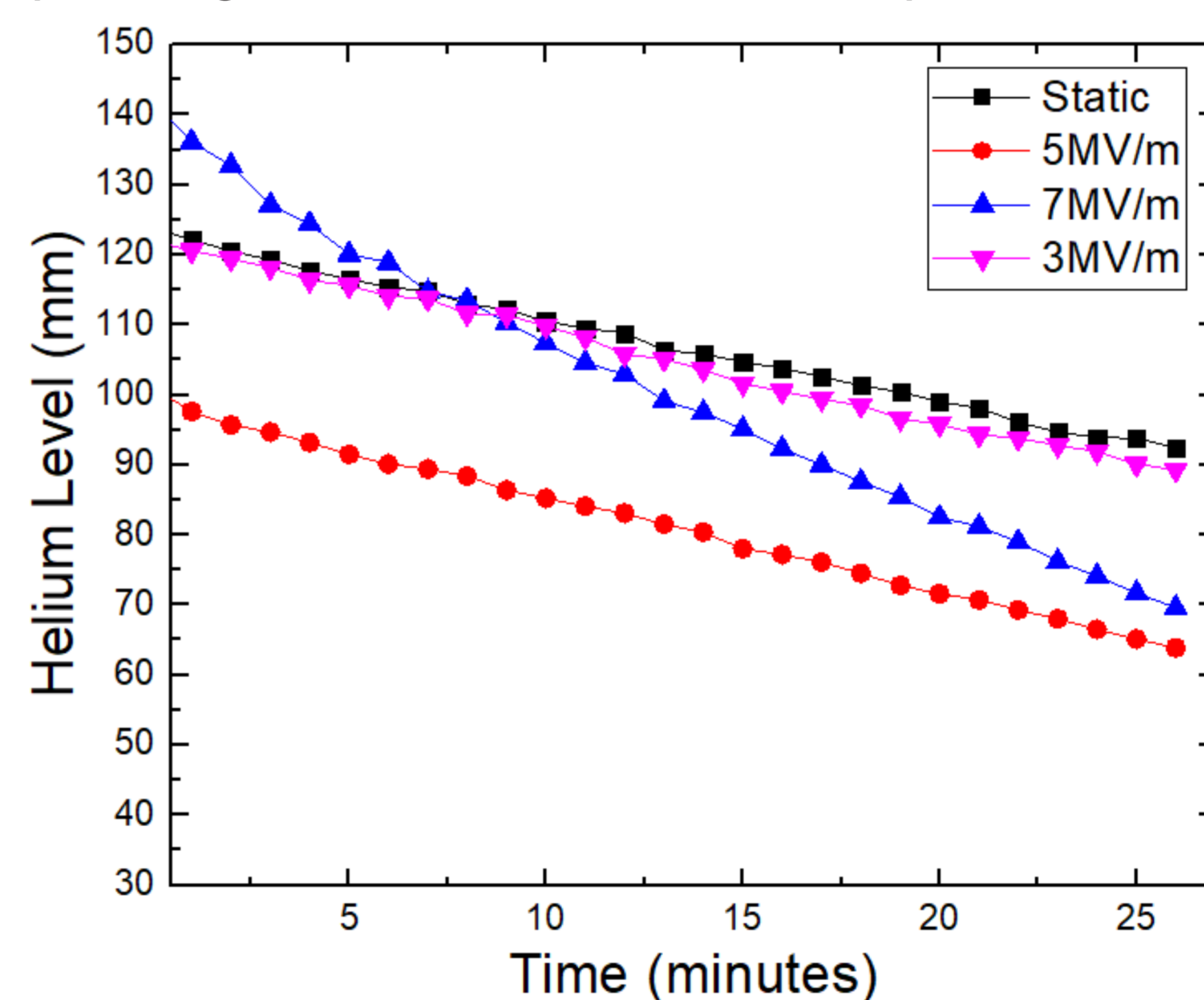


Figure 6: Static and dynamic heat load measurement for a HWR cryomodule at 2.1 K. The static heat load is 6.6 W. The total heat loads for 3, 5 and 7 MV/m are 7.0 W, 8.7 W and 14.5 W, respectively.

Conclusion

- A prototype of HWR cryomodules is developed and tested.
- Tray and cables are installed for horizontal test.
- The 3D drawing and P&ID of the HWR cryomodule are shown.
- PLC and EPICS for the HWR cryomodule are developed.
- RF system is shown for HWR cryomodule test.
- Static and dynamic heat loads are measured.