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Direct Helium Recovery in MEG System with ATL160

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The Magnetoencephalography (MEG) Center on the Anschutz Medical Campus of University of Colorado, Denver, USA, is a leading neuroscience center dedicated to research and development of new electrophysiological methods for the study of human brain function with an emphasis on major mental disorders such as schizophrenia, bipolar disorder and autism.

The MEG system is a 248 channel SQUID magnetometer (see Figure 1) housed in a double-layered, mu-metal, magnetically shielded room (MSR). Liquid helium consumption of the MEG averages 9.3 liters per day, and helium refills are needed every four days. Annual liquid helium cost is significant, and unreliable delivery constantly threatens uninterrupted system operation. In addition, the MEG suite occupies limited space within a hospital environment. Electromagnetic interference and vibration induced noise are also of great concern for maintaining optimized performance.

Figure 1. The MEG system installed on a H-frame gantry for translational movement and rotation.

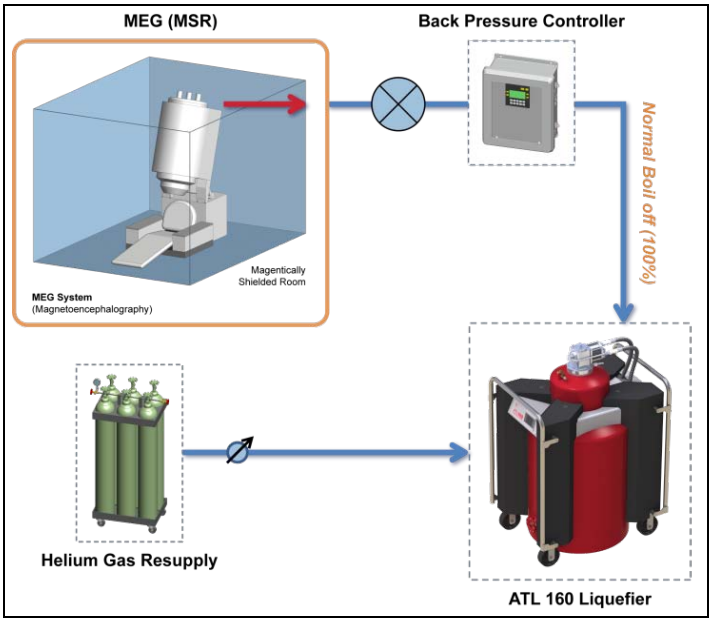

Figure 2. Direct Recovery System for MEG using the ATL160.

ATL technology offers an ideal solution for these challenges. Quantum Design proposed to the MEG Center a direct recovery (DR) plan for helium recovery, as shown in Figure 2. Helium boil off from the MEG is directly channeled to the ATL160 using all metal piping and manifold; thus 100% of all normal boil off is recaptured without contamination. There will be some loss during liquid helium transfer from the ATL back to the MEG. This loss can be replenished using helium gas cylinders through the second gas input on the ATL160.

Quantum Design successfully installed an ATL160 with air-cooled compressor in the MEG Center in late August of 2012. Due to its small overall profile, the ATL160 is easily tucked away in a narrow closet in the corner of the MEG suite. Custom-made helium recovery line, assembled using copper pipe, flexible brass tubing and self-sealing Snaptite connectors, runs from the top of the MEG dewar all the way to the gas input on the ATL160 with no permeable surface for air.

Figure 3 (left) ATL160 in the closet (right) Copper recovery line running to ATL160

The ATL160 has been in continuous operation for several weeks, with a daily liquefaction rate ranging from 13 to as high as 18 liters. Normal boil off from the MEG is about 9.3 liters/day, which is completely reliquefied. The additional liters produced come from the gas cylinders via the second input, where flow rate is controlled on demand by an ATL pressure setting. Several liquid transfers from ATL to MEG have been carried out successfully. Most importantly, there has been no adverse noise effect to the ultra-sensitive MEG after the installation and operation of the ATL160.

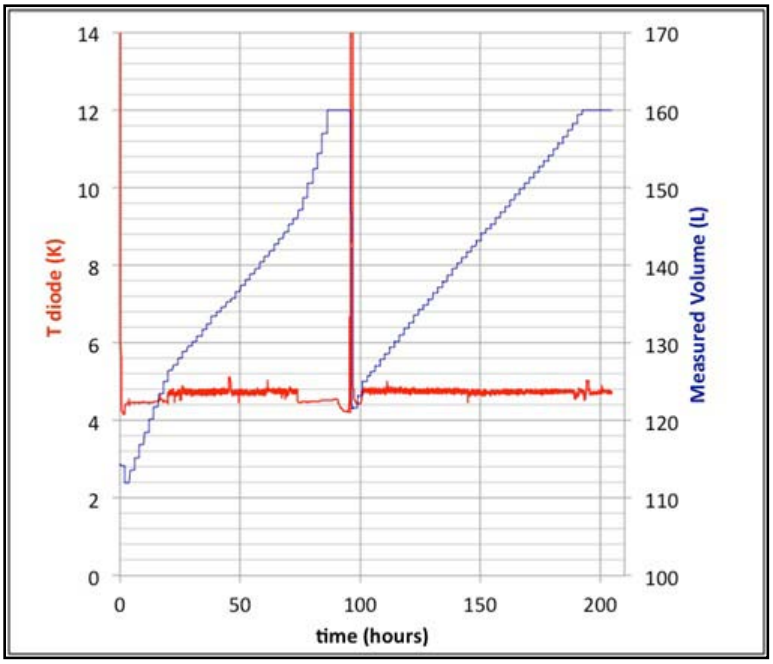

Figure 4. Time trace of temperature and liquid level in the ATL over 2 recovery cycles. The first liquefaction run was a combination of MEG-recovered with cylinder gas (0-~20hrs), MEG-recovered gas (~20-~75hrs) and finally MEG-recovered with cylinder gas (~75-~96hrs). The second liquefaction run was MEG-recovered with cylinder gas for less than 5 hours then purely MEG-recovered gas for the remainder.

Since installation and initial cool-down, our ATL team has been working with the center's staff remotely, closely monitoring the ATL160 over the internet and adjusting its key parameters to optimize performance.

This is the world's first ATL installation using direct recovery with a MEG, and has been greatly successful and appreciated at a MEG Center.