Residual Magnetism in MR Suites after Field Rampdown of Superconducting Magnets

S. Sammet[1], F. Aguila[1], R. M. Koch[1], and M. V. Knopp[1]
[1]Department of Radiology, The Ohio State University, Columbus, Ohio, United States

Introduction

Recent reports have claimed that magnetic contamination can occur while decommissioning MRI systems suggesting potential degaussing costs of 100,000 US Dollars [1]. The rampdown of two superconducting clinical magnets, one at 8T and one at 0.7T, was done to evaluate residual magnetization within the MRI suite environments prior, during and after field-rampdown.

Material and Methods

The hospital based 8T superconducting magnet has a weight of 30 tons and a length of 3.26m. The magnet is housed in a 7.6m x 4.7m x 4m room. This room provides RF shielding and contains the stray magnetic field by using 240 tons of annealed low carbon steel. Residual magnetism was measured in the 8T MRI suite with two different gaussmeters (410 and 420 gaussmeter, Lake Shore Cryotronics, Westerville, OH, USA). The residual magnetic field at 34 respective points of interests was determined with both gaussmeters at 2, 9, 17 and 40 days after rampdown. The two gaussmeters were used to measure the 13 respective points of interests, for the hospital based 0.7T magnet room, at 3 days, 2 days, and 1 day before, 5 hours before, 2 minutes after, 3 hours after, 1 day, and 2 days after the quench.

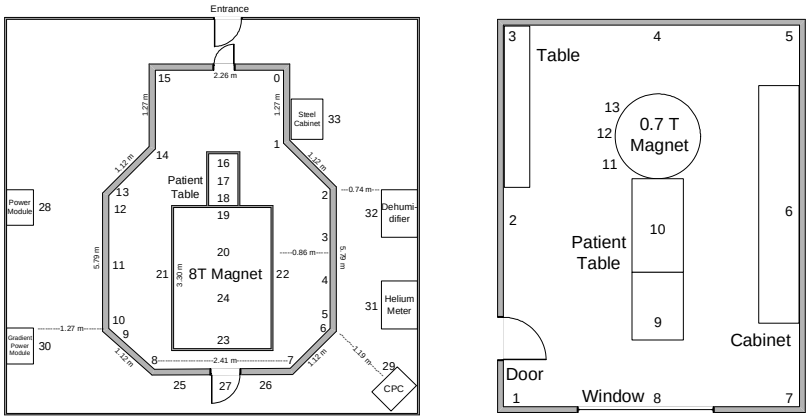
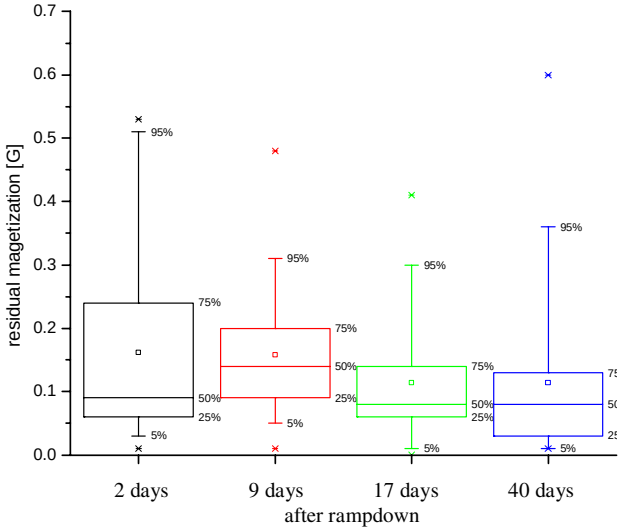
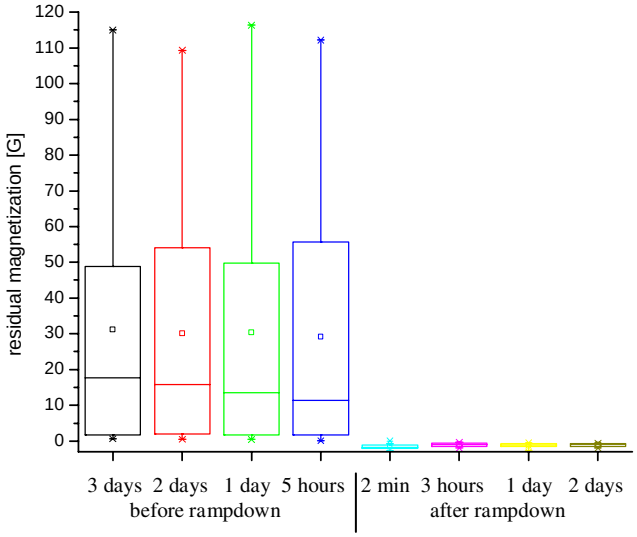


Figure 1 a) MRI suite of the 8T magnet with 34 measurement points of the residual magnetization. **b)** MRI suite of the 0.7T magnet with 13 measurement points of the magnetization.

Results

Residual magnetism, in the MRI suite after controlled rampdown of an 8T superconducting magnet, was not significantly elevated compared to magnetic fields in the environment. An elevation of 0.53 Gauss compared to earth's magnetic field [2] was determined inside the bore of the magnet. The walls of the iron shield did not show elevated magnetism of more than 0.35 Gauss. Through 40 days, no significant changes in magnetism could be seen compared to initial measurements directly after rampdown, as both gaussmeters consistently measured. Similar findings were also observed after the quenched shutdown of a 0.7T system, however a temporary negative remanence was observed that reversed over time.





Conclusion

A controlled rampdown of even an ultrahigh field MR system does not lead to retained magnetic contamination, while forced quenched rampdown of a mid-field system revealed temporary negative remanence. The steel shields and other components of the MR suites revealed no elevated residual magnetism, therefore, there is no need to degauss an MRI suite when an appropriate steel composition has been used in the iron shield. A controlled rampdown allows the immediate further use of the MRI suite in a hospital environment.

References

[1] Robb M: Magnetic Contamination: The Ghost of MRI Past. Radiology Today Vol. 5 No. 21 Page 22 (2004).
[2] Whalery KA and Holmez RT: The Earth's main magnetic Field. Phys. Educ. 34(4) 180-184 (1999).