Purpose: A system for planning and delivery of Intensity Modulated Neutron Radiotherapy (IMNRT) was developed using in-house treatment planning and delivery systems. Results of commissioning tests are presented including validation measurements using representative patient plans and the TG-119 test suite, and evaluation of total body dose.

Methods: Tissue Equivalent (TE) ionization chambers flowed with TE gas and an ionization chamber array filled with TE gas were used for point dose and planar dose distribution comparisons with calculated values. Validation plans were delivered to water and solid water phantoms using TG-119 measurement points and evaluation techniques. Planar dose measurements were performed in solid water and gamma pass rates calculated using 3%/3mm and 5% threshold criteria. Gamma and neutron doses were evaluated at 50cm off axis for IMNRT and conventional neutron therapy plans to evaluate effects on out-of-field dose.

Results: Measured and calculated doses for eleven representative plans (6 prostate/5 H&N) agree to within -0.8Å±1.4% and 5.0Å±6.0% within and outside the target, respectively. All twelve TG-119 point measurements delivered in solid water were within respective confidence intervals derived by TG-119. Ten of twelve measurements in water were within respective confidence intervals. Mean differences for all measurements were 0.5% (max=7.0%) and 1.4% (max=4.1%) in water and solid water, respectively. The mean gamma pass rate for all cases was 92.7% (min=88.6%). Out-of-field dose equivalent from IMNRT is ~10 times higher than from photon IMRT but not significantly higher than from conventional fast neutron therapy.

Conclusions: Ion chamber validation results for IMNRT commissioning are comparable to those from photon IMRT. Gamma pass rates for planar dose distributions are lower than typical for photon IMRT but may be improved with improved planar dosimetry techniques. Significantly higher out-of-field doses require careful clinical consideration to assure that benefits of IMNRT outweigh potential risks of second malignancy.