**rev.1.0**

April 10, 2015

**MQXFSM1 (quadrupole coil in a mirror structure)**

**Test Plan**

**Test Cycle I**

1. **Magnet in cryostat at 300 K**
   * + Electrical Checkout: Sequential resistance measurements, strip heater and strain gauge checkout through the instrumentation “tree” of the header assembly, Hi-pot test
     + Hi-pot schedule: Coil to ground (with heaters grounded or floating) at 1000 V, protection heater to ground (with coils grounded or floating) at 1000 V
     + RRR measurements before cool down
2. **Operation at 4.5 K** 
   * Electrical checkout and quench detection checkout, Hi-pot test, see Section 1 for the Hi-pot schedule
   * Set 120 mΩ dump configuration for initial ramps:
     + manual trip at 1000 A
     + protection heater (PH) provoked quenches at Imax ≤ 5 kA
3. **Operation at 1.9 K** 
   * Set 30 mOhm dump configuration for training quenches
     + - * Quench training at 20 A/s in first ramps, then continue at mixed ramp rates: start at 50 A/s and then continue at 20 A/s
         * Quench ramp rate dependence study

Ramp up at dI/dt = 10 A/s, 20 A/s, 50 A/s, 100 A/s, 200 A/s, 300 A/s

Ramp down starting at dI/dt = 300 A/s from Inom (16.5 kA or 95% of Imax achieved during training), identify the highest ramp rate not quenching the magnet

* + - * + Voltage Spike Analysis for all training and ramp rate quenches
        + Magnet inductance measurements at 50 A/s, 200 A/s, 300 A/s
        + Quench temperature dependence study at 20 A/s

1. **Operation at 4.5 K (after 1.9 K)**
   * + - Verify quench plateau at 20A/s, or at mixed ramp rates (start at 50 A/s and then continue at 20 A/s)
       - Magnet inductance measurement at 200 A/s
       - Splice resistance measurements
2. **Quench Protection Study at 1.9 K**
   * + - Set 60 mOhm dump configuration for quench protection study
       - Check the lowest required power density quenching the magnet at different currents Imag = 0.2Inom, 0.5Inom, 0.8Inom and Inom. All heaters are fired, gradually increase the HFU voltage.
       - PH delay as a function of the magnet current. Compare performance of the IL and OL heaters.
       - PH delay as a function of the peak power density at Imag=0.6Inom, 0.8Inom and Inom.
       - PH delay as a function of the HFU decay time constant at Imag=0.6Inom, 0.8Inom and Inom.
       - Reproducibility check for the IL and OL heater delay at different magnet current
       - Quench integral (QI) and quench propagation (from the OL to the IL) study with dump delay of 1000 ms (“No Dump” configuration)
         * Start with a manual trip at low currents (Iq/ISSL=0.3) without the dump resistor
         * Gradually increase the magnet current. Stop testing if the QI is 2 MIITs higher than in the spontaneous training quenches with a standard protection settings.
       - QI study with small dump resistor (5 mΩ)
       - Fast extraction study
3. **Warm up to 300 K**

* RRR measurements

**Test Cycle II**

1. **Not finalized, depending on results of the Test Cycle I**