Cooldown and Warmup Cycles in MQXFA tests at BNL

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MQXFAP1 COOLDOWN

Start of LH$_2$ fill for 4.5 K cooldown

$N\text{$_2$ COOLDOWN}$
MQXFAP1 COOLDOWN

MQXFAP1 ΔT VS T\text{AVG}
MQXFAP1 WARMUP

MQXFAP1 FINAL WARMUP

LEAD END TEMPERATURE
NON-LEAD END TEMPERATURE

TEMPERATURE (K) vs. ELAPSED TIME (HRS)
MQXFAP1 FINAL WARMUP ΔT VS T_{AVG}

MQXFAP1 WARMUP
MQXFAP2 COOLDOWN

![Graph showing temperature over elapsed time for lead and non-lead end temperatures.]

- Lead End Temperature
- Non-Lead End Temperature
MQXFAP2 COOLDOWN

MQXFAP2 COOLDOWN $\Delta T$ VS $T_{AVG}$

$\Delta T$ (K)

$T_{AVG}$ (K)
MQXFAP2 WARMUP

MQXFAP2 FINAL WARMUP (PARTIAL)

LEAD END TEMPERATURES

NON-LEAD END TEMPERATURES

TEMPERATURE (K)
ELAPSED TIME (HRS)
MQXFAP2 WARMUP

MQXFAP2 WARMUP ΔT VS T_{AVG}
MQXFAP1b COOLDOWN

LEAD END TEMPERATURE

NON-LEAD END TEMPERATURE

0 10 20 30 40 50 60 70 80 90 100
TEMPERATURE (K)
ELAPSED TIME (hrs)
MQXFAP1b COOLDOWN

MQXFAP1b COOLDOWN $\Delta T$ VS $T_{AVG}$

$\Delta T$ (K) vs $T_{AVG}$ (K) graph.
MQXFAP1b WARMUP

NOTE: WARMUP STARTED AFTER QUENCH 37 AT 4.5 K. THERE WAS ONLY GAS IN CRYOSTAT AT THE BEGINNING OF THE WARMUP, WHICH STARTED AT ABOUT 2.5 HRS ELAPSED TIME.
MQXFAP1b WARMUP

MQXFAP1b WARMUP ΔT VS $T_{AVG}$

$\Delta T$ (K)

$T_{AVG}$ (K)