#### Isotope Production Beamline Recommissioning

Revision Number: 3

Technical Custodian: Stephen Benson, Chris Tennant

Estimated Time to Perform: 1–2 Days (2–4 shifts)

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Procedure Overview

Set up the Isotope Production beamline and commission beamline hardware.

Hazards

1. Pinch hazards of the target removal system.

Prerequisites

1. LERF accelerator checked out and able to run 32 MeV beam to the 1X target.
2. All isotope beamline elements installed and aligned.
3. Isotope beamline diagnostics installed and checked out using hot checkout procedures.
4. Added horizontal 1X01 corrector strength must be installed and polarity checked.
5. Target system installed and operational but without any gallium. A solid block of graphite is an acceptable target.
6. Beam authorization must be given by the head of acceleration operations. Only tune beam will be required for this procedure.
7. Before operation, all cavities except for FL02-4 should be tuned to be close to the proper frequency using an RF cart. Cavity FL02-4 should be stepped off by at least 100,000 steps.
8. A camera must be set up to view the downstream face of the radiator, which will be replaced with a YAG flag. This implies that the isotope target hutch is open during this run.

Tune beam tests

# Recover setup to 1X dump

* 1. Restore the settings from September 18, 2020 and cycle all magnets.
	2. Run the Cold Start-up Procedure: <http://opsdocs.acc.jlab.org/ops_docs/online_document_files/LERF_online_files/LERF_Cold_Startup_Procedure.pdf>
		1. Use the September 18, 2020 allsave to restore the magnet and RF values.
		2. Use 57450 G-cm for MDQ2F04 (the 1X spectrometer magnet)
		3. MFELEXT and MFELARC1 should be off. MFELINJ should be on and set to 9300 G-cm.
	3. Turn on tune beam and adjust the drive laser and cavity 3 phase and laser power to get 6.7 pC charge (31.25 µA, 330 mV on the ICM0F06 on FEL scope A) and the correct spots on ITV0F04 and ITV0F06 (saved on Sept. 16).
	4. Verify that the beam is centered in the injector cryounit, the MQJ0F05 and MQJ0F06 quads, and the ITV0F01 viewer (use the 0F03, 0F05 and 0F06A correctors to center in each of these).
	5. Verify that all zone 2 cavities except for FL02-4 are set to their September 18 values from the 1 kW CW run. Add about 2 MV to the gradient sums.
	6. Thread the beam to the 1X01 viewer and crest the FL02 cavities using the beam on that viewer. Adjust the gradients to center the beam in the 1X quadrupole with the 1X horizontal corrector set to 1.6 kG-cm.
	7. Verify that the beam gets to the 1X surrogate target viewer. Iterate the module gradients and the 1X corrector setting until the beam is centered in the 1X quadrouple and the surrogate target viewer.
	8. Allsave the configuration “Initial 32 MeV beam to isotope target”

# Tune mode checkout to the 1X target

* 1. Change the micropulse repetition rate to 18.7125 MHz and verify that the laser phase is correct. Shorten the macropulse to 150 usec to keep the viewers from saturating.
	2. Turn on tune beam with 156 microamps of current (560 mV on the BCM) if it is not already on.
	3. Set the laser/buncher phase to zero the buncher GASK (on FELScope3, channel 1). You might have to increase the current to about 200 uA (600 mV on the BCM) to do this. Afterwards reset the current to 160 uA.
	4. Run the injector phasing script to determine the injector cavity phases.
	5. Perform an allsave “Injector setup with known phases”.
	6. Adjust the laser phase to get compact spots on the 0F04 and 0F06 viewers and very small losses on the BLMs in the injector region. Note the change in phase.
	7. Crest the zone 2 cavities on the 1X01 viewer.
	8. Verify that the beam is centered in the 1F and 2F quadrupoles (using the dither tool and the next downstream viewer on the last two quadrupoles in the triplet centering horizontally in the horiztonal focusing quad and vertically in the vertically focusing quad). Center horizontally in both the 2F01 and 2F03 quadrupoles and then use the gradients to center in the 1X quadrupole, with the 1X horizontal corrector set to 1.6 kG-cm, using the 1X viewer to verify centering.
	9. Record the 1X01H corrector current necessary to get the beam centered on the surrogate target viewer when the beam is centered in the 1X01 quadrupole.
	10. Record all spot sizes on viewers. Might have to go to 50 usec or less on the macropulse length to prevent saturation.
	11. Allsave this configuration “Tune beam to 1X dump at 32 MeV”.
	12. Vary the 1F03 quads while measuring the spot size on the 1F04 viewer to obtain an emittance measurement at the linac exit. (This step is optional if pressed for time)
	13. Put all the 1F and 2F quads back on loop with their previous values.
	14. Verify that all BLMs are loss free when their head voltages are set to at least -1000 Volts.

# Set up for foil run

* 1. Set current at 52 µA (400 mV on the BCM).
	2. Record the beam spots on the viewers.
	3. Allsave this configuration as “Setup for foil run”.
	4. Go to controlled access.
	5. With Radcon assistance, remove the YAG viewer flag and lamp and re-install the tungsten radiator in its place.
	6. Install the graphite block with foils on it and close up the hutch.

# Backout procedure

* 1. Restore the settings from the last allsave that reached the 1X dump or the settings from September 18, 2020.
	2. Perform a weekend shut-down procedure.

# Task complete.