#### Isotope Production Beamline Commissionig

Revision Number: 1

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Estimated Time to Perform: 2 Days

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Procedure Overview

Set up the Isotope Production beamline to allow 1 kW of beam to an isotope target.

Hazards

1. Radiation activation of the target
2. Pinch hazards of the target removal system.

Prerequisites

1. LERF accelerator checked out and able to run 12 MeV beam to the 1G dump with no losses indicated on the beam loss monitors.
2. All isotope beamline elements installed and aligned.
3. Isotope beamline diagnostics installed and checked out using hot checkout procedures.
4. Target system installed and operational but with a test target of aluminum rather than gallium inside boron nitride.
5. ERR must have occurred and all action items must have been addressed.
6. Beam authorization must be given by the head of acceleration operations. Initially only tune beam will be requested, but CW beam will be requested once it is shown that this can be done safely.
7. Before operation, all cavities should be tuned to be close to the proper frequency using an RF cart.
8. A camera should be set up to view the front face of the radiator, which should be replaced with a phosphor coating.

Tune beam tests

# Recover setup to 1G dump

* 1. Restore the settings from July 17 and cycle all magnets.
	2. Turn on tune beam and adjust the drive laser and cavity 3 phase and laser power to get 60 pC charge and the correct spots on ITV0F04 and ITV0F06.
	3. Verify that the beam is centered in the injector cryounit, the 0F and 1F quadrupoles, and the ITV0F01 viewer.
	4. Verify that the zone 2 cavities 7 and 8 are properly crested using the 1G01 viewer.
	5. Verify that the beam loss is negligible on all BLMs when their voltages are set to at least -1000 V. If necessary, use the laser buncher gang phase or the 0F quads to reduce losses.
	6. Unmask all BLMs, withdraw all viewers and ramp up the duty cycle until CW beam is achieved with 40 microamps of beam to the 1G dump. Record the injector current cavity voltage.
	7. Return to tune beam and record images on all viewers at 40 microamps of current

# Tune mode checkout to the 1X target

* 1. Turn on all zone 2 cavities whose tuners are working and set the gradients so that the gradient sum is at least 40 MV/m.
	2. Load in the 1F quad settings for an energy of 25 MeV.
	3. Turn on tune beam with 40 microamps of current.
	4. Turn the extraction magnet off and turn the isotope dipole on and set to 30.5 kG-cm (~20 MeV, should be about 48.6 A)
	5. Find the beam on the 2F03 viewer and BPM
	6. Attempt to find the beam on the 1X viewer or BPM. Use the isotope dipole as a spectrometer to phase the cavities in zone 2. If necessary, change the gradients to achieve 20 MeV when on crest. Transient phasing cavities 1, 5, and 6 might help getting the energy close.
	7. Once all the zone 2 cavites are phased, raise the 1X dipole to 38.151 kG-cm (25 MeV) and put through hysteresis. Raise the gradients until the beam is centered in the 1X quad.
	8. Carefully center in the 1F and 2F quadrupoles on the 1X viewer and then use the gradients to center in the 1X quadrupole.
	9. Set the 1X quad to produce a minimum beta function but non-zero eta function at the 1X viewer and record the beam size. Return the 1X quad to its nominal value once you are done.
	10. Use the 2F01, 2F02, and 2F03 quads to get a spot size of 6 mm full width on the 1X01 viewer. Steer to the center of the temporaty target viewer flag. Record the BPM position in the 1X line and the spot size and position on ITV1X01.
	11. Vary the 1F03 quads while measuring the spot size on the 1F04 viewer to obtain an emittance measurement at the linac exit.
	12. Put all the 1F and 2F quads back on loop.
	13. Verify that all BLMs are loss free when their head voltages are set to at least -1000 Volts.
	14. Allsave this configuration “Tune beam to 1X dump at 25 MeV”.

# Run CW beam to the 1X test target

* 1. Remove the camera that is monitoring the temporary target viewer flag.
	2. Withdraw all viewers and verify that all vacuum valves are open and magnets are on loop.
	3. Verify that the BLMs are unmasked and that the losses are negligible when running 40 microamps pulsed (use the AMS to monitor the BLM signals during the macropulse).
	4. Switch to beam mode 7 (CW beam) and slowly increase the duty cycle while monitoring the vacuums in the 1F and 1X beamlines. When 6% duty cycle is reached, verify that the vacuum levels are fine before going CW.
	5. Run until vacuum levels and temperatures have reached equilibrium. Record these.
	6. Allsave this configuration “CW beam to 1X dump at 25 MeV”.
	7. Shut down the beam and have Radcon survey the radiation levels around the 1X dump

# Backout procedure

* 1. Restore the settings from the last allsave that reached the 1X dump or the settings from July 17.
	2. Perform a weekend shut-down procedure.

# Task complete.