



Fermi National Accelerator Laboratory

A Department of Energy National Laboratory Managed by Fermi Research Alliance, LLC

Functional Requirements Specifications

Muon Campus Recycler RF AIP

June 2013



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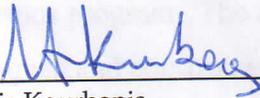
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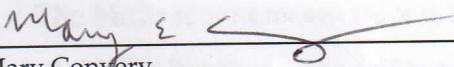
A. Approvals

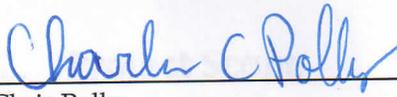
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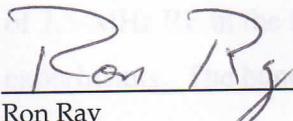
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Recommended for Approval by:

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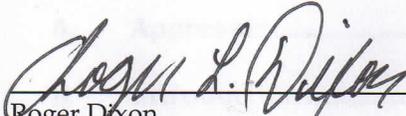
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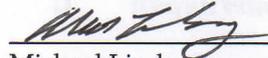
 7/2/13
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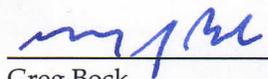
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B. Introduction

The Recycler will be used to re-bunch 8-GeV protons from the Booster for the Muon Campus program. The new 2.5-MHz RF system that will be used for these manipulations will be designed and constructed under the Muon Campus Recycler RF AIP. The Muon g-2 experiment plans to use the Recycler for forming the proton bunches that hit their production target. The Mu2e experiment plans to use the same method for forming proton bunches which will be transported to the Delivery Ring for resonant extraction to their production target.

The Muon g-2 experiment requires that the full-intensity (4×10^{12} protons) Booster batch comprised of 82 53-MHz bunches be redistributed into four 2.5 MHz bunches of 10^{12} protons. These bunches should be extracted from Recycler no closer than 10 ms from each other to allow for muon decay and data acquisition in the detector. Because the revolution time of muons in the g-2 ring is 149 ns, the longitudinal extent of each bunch must be less than this.

The Mu2e requirements are less stringent than the above, and also include re-bunching into four 2.5 MHz bunches. The full bunch must be contained in 200 ns with a bunch-length.

C. Project Scope

The Muon Campus Recycler RF AIP covers the design, construction, installation, and testing of 2.5-MHz RF in the Recycler for bunch formation in support of the Mu2e and Muon g-2 experiments. The bunch formation scheme will be identical for the two experiments.

The Muon Campus Recycler RF AIP will assemble and install seven 2.5-MHz cavities and associated RF amplifiers, controls, cooling, and support hardware within the Recycler. Two extra "bare" 2.5 MHz cavities will be assembled.

D. Requirements

- a. The Recycler RF system will redistribute 82 53 MHz bunches of 8 GeV protons into four 2.5 MHz bunches.
 - The four bunches will have similar intensity (within 20%);
 - At least 90% of the particles in each of the four 2.5 MHz bunches will be contained within 120 nsec.
 - Bunch formation will be completed in less than 100msec (at least 90 msec are required for the RF manipulations).
- b. The 2.5 MHz Recycler RF will be capable of CW operation.
- c. The 2.5-MHz Recycler RF is expected to operate for 15 years with an estimated shutdown period of one month every year;
- d. The 2.5-MHz Recycler RF and its components are subject to compliance with FESHM;
- e. All of the components and subsystems will be manufactured using Fermilab QA procedures and standards.