



A. Approval 0

B. Introduction 0

C. Project Scope 0

D. Requirements: Fermi National Accelerator Laboratory 7

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

Functional Requirements Specifications

Muon Campus Beam Transport AIP

June 2013

Fermilab

Fermi National Accelerator Laboratory

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

Functional Requirements Specifications

Muon Campus Beam Transport AIP

June 2013



Table of Contents

A. Approvals 4

B. Introduction 6

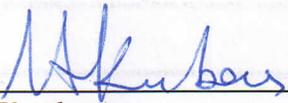
C. Project Scope 6

D. Requirements 7

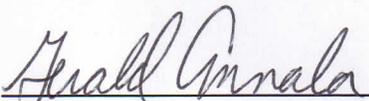


A. Approvals

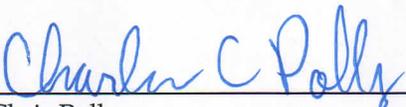
Prepared by:

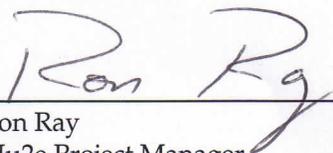

 _____ 07/02/13
 Ioanis Kourbanis Date
 MC Beam Transport AIP Manager
 Accelerator Division

Recommended for Approval by:


 _____ 7/2/13
 Gerald Annala Date
 AIP Director
 Accelerator Division


 _____ 7/2/13
 Mary Convery Date
 Muon Campus Program Coordinator
 Accelerator Division


 _____ 7/2/13
 Chris Polly Date
 Muon g-2 Project Manager
 Particle Physics Division


 _____ 7/2/13
 Ron Ray Date
 Mu2e Project Manager
 Particle Physics Division



Approved by:

Roger Dixon 7-3-13
Roger Dixon Date
Accelerator Division Head

Michael Lindgren 7/3/2013
Michael Lindgren Date
Particle Physics Division Head

Stuart Henderson 7/3/13
Stuart Henderson Date
Associate Laboratory Director for Accelerators

Greg Bock 7/3/13
Greg Bock Date
Associate Laboratory Director for Particle Physics

B. Introduction

Protons of 8-GeV kinetic energy from the Recycler will be extracted and transported through the P1, P2, and M1 (former AP1) beamlines to the Muon Campus. Recycler extraction elements, a 43 meter beamline stub connecting the Recycler to the P1 line, and aperture improvements to efficiently transport 8-GeV beam in the P1, P2, and M1 beamlines will be designed and constructed under the Muon Campus Beam Transport AIP. 8GeV primary beam for the Muon g-2 experiment will hit their production target in the AP0 target vault at the end of the M1 beamline. Protons for the Mu2e experiment will bypass the target station via the M3 line and will then be transported to the Delivery Ring for resonant extraction to their production target. The changes to the upstream M3 line required to optically match into the downstream section which will be shared by Mu2e primary protons and g-2 secondary beam are also covered by the Beam Transport AIP.

C. Project Scope

The Beam Transport project will provide an extraction system (Lambertson and kicker magnets) from Recycler, the beamline connection from Recycler to the P1 line, aperture improvements needed to transport the 8 GeV proton beam efficiently in the P1,P2 and M1 beamlines as well as instrumentation, controls and electrical infrastructure upgrades in those beamlines.

D. Requirements

- a. Bunches of 8-GeV protons from the Recycler will be extracted to the P1 line
 - 99% efficiency with beam transverse emittances up to 18 pi-mm-mrad (95% normalized) and a 95% momentum width of $\pm 0.28\%$
 - The extraction kicker will be able to operate at Peak Repetition Rate of 100 Hz and an average rate 12 Hz (30 Hz max).
 - The extraction kicker will have a rise time of 120 nsec, flat top of 200 nsec and fall time of 400 nsec.
- b. Bunches of 8-GeV protons will be transported through the P1, P2, and M1 line to the g-2 target
 - 99% efficiency with beam transverse emittances up to 18 pi-mm-mrad (95% normalized) and a 95% momentum width of $\pm 0.28\%$
 - P1, P2 and M1 optics compatible with M1 final focus region
- c. Bunches of 8-GeV protons will be transported through the P1, P2, M1, and M3 line to the Delivery Ring for resonant extraction to the Mu2e target
 - 99% efficiency with beam transverse emittances up to 18 pi-mm-mrad (95% normalized) and a 95% momentum width of $\pm 0.28\%$
 - P1, P2, M1 and upstream M3 optically matched to downstream M3
- d. Recycler extraction and proton-transport beamline components are expected to operate for 10 years with an estimated shutdown period of one month every year;
- e. Recycler extraction and proton-transport beamline components are subject to comply with FESHM;
- f. All of the components and subsystems will be manufactured using Fermilab QA procedures and standards.