# Project X Siting Concepts

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Project X – Project Engineer
Project X Physics Study
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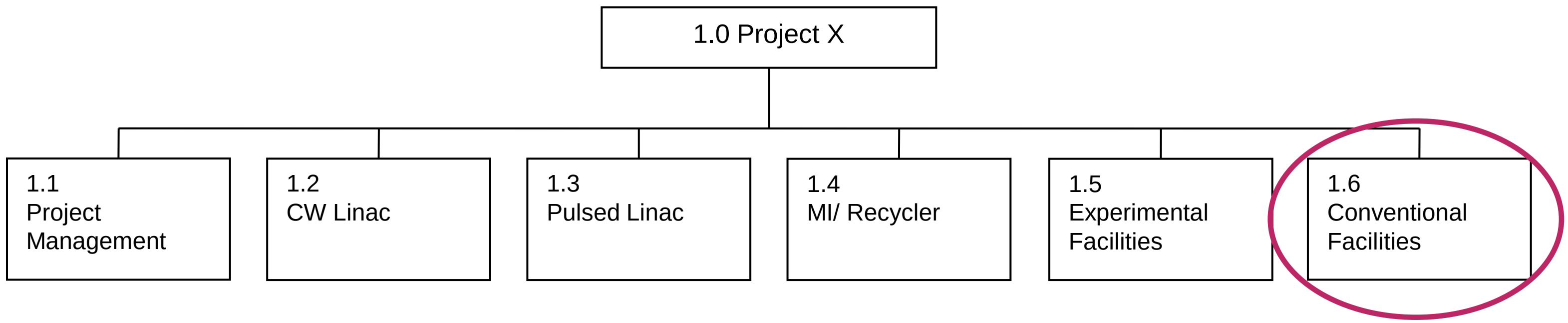
# Organization




- Project Office

| | | | |
|---|---|---|---|
| Project Manager | S. Holmes | Deputy Project Manager | TBD |
| Project Scientist/Accelerators | S. Nagaitsev | International Coordinator | S. Mishra |
| Project Scientist/Experiments | R. Tschirhart | Budgeting/Scheduling | E. Peoples |
| Project Engineer | M. Kaducak | Financials | M. Smith |

- Level 2

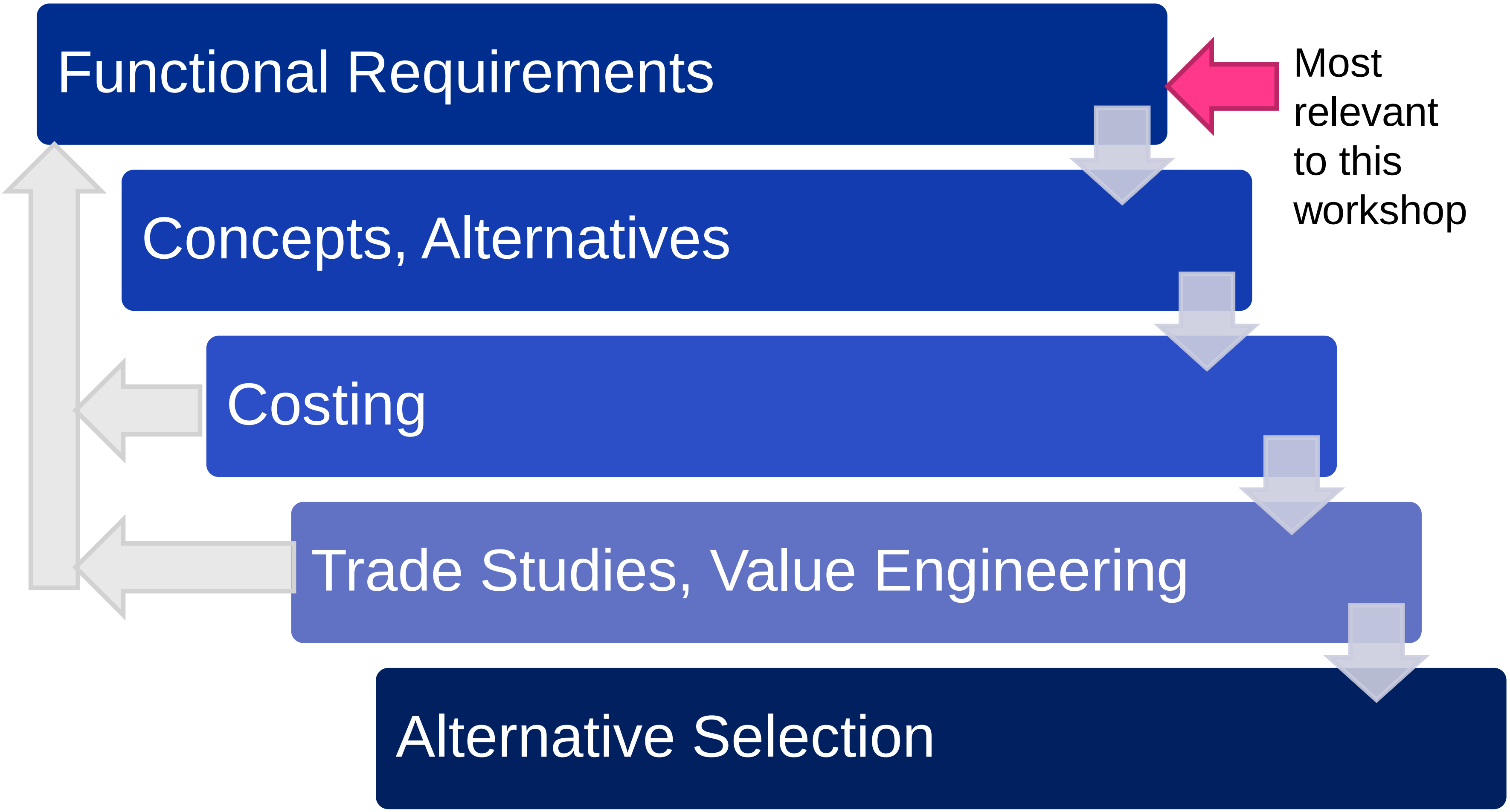
| | |
|---|---|
| CW Linac | R. Kephart, V. Lebedev |
| Pulsed Linac | N. Solyak |
| Main Injector/Recycler | I. Kourbanis |
| Experimental Facilities | R. Tschirhart |
| Conventional Facilities | R. Alber |

- Level 3

  Complete complement assigned

Russ Alber and Jonathan Hunt of FESS do the real siting work

# Process (Oversimplified)

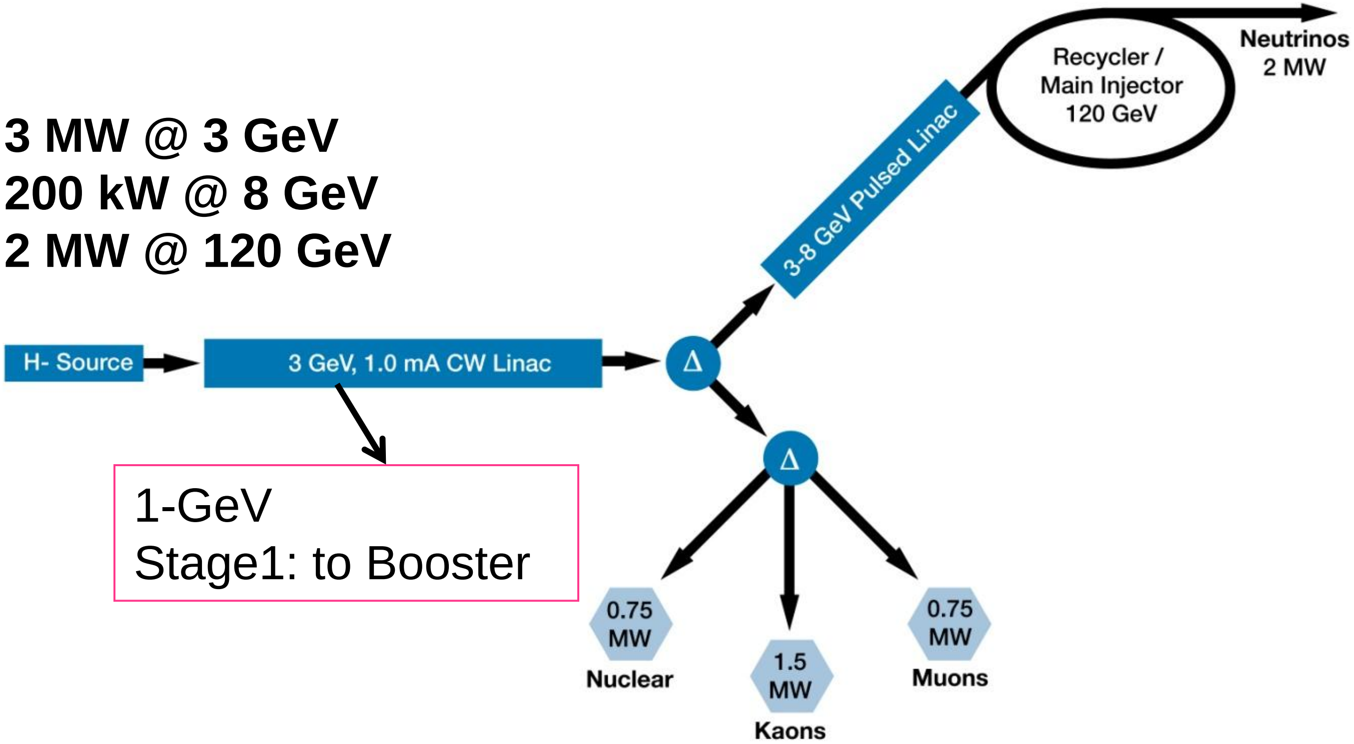


# Siting Considerations (no particular order of priority)

- Functionality
- Effects on Operating Programs
- Upgradeability
- Maintainability
- Cost (total system and life cycle)
- Aesthetics
- Environmental Impact

# Project X Reference Design

**3 MW @ 3 GeV**
**200 kW @ 8 GeV**
**2 MW @ 120 GeV**



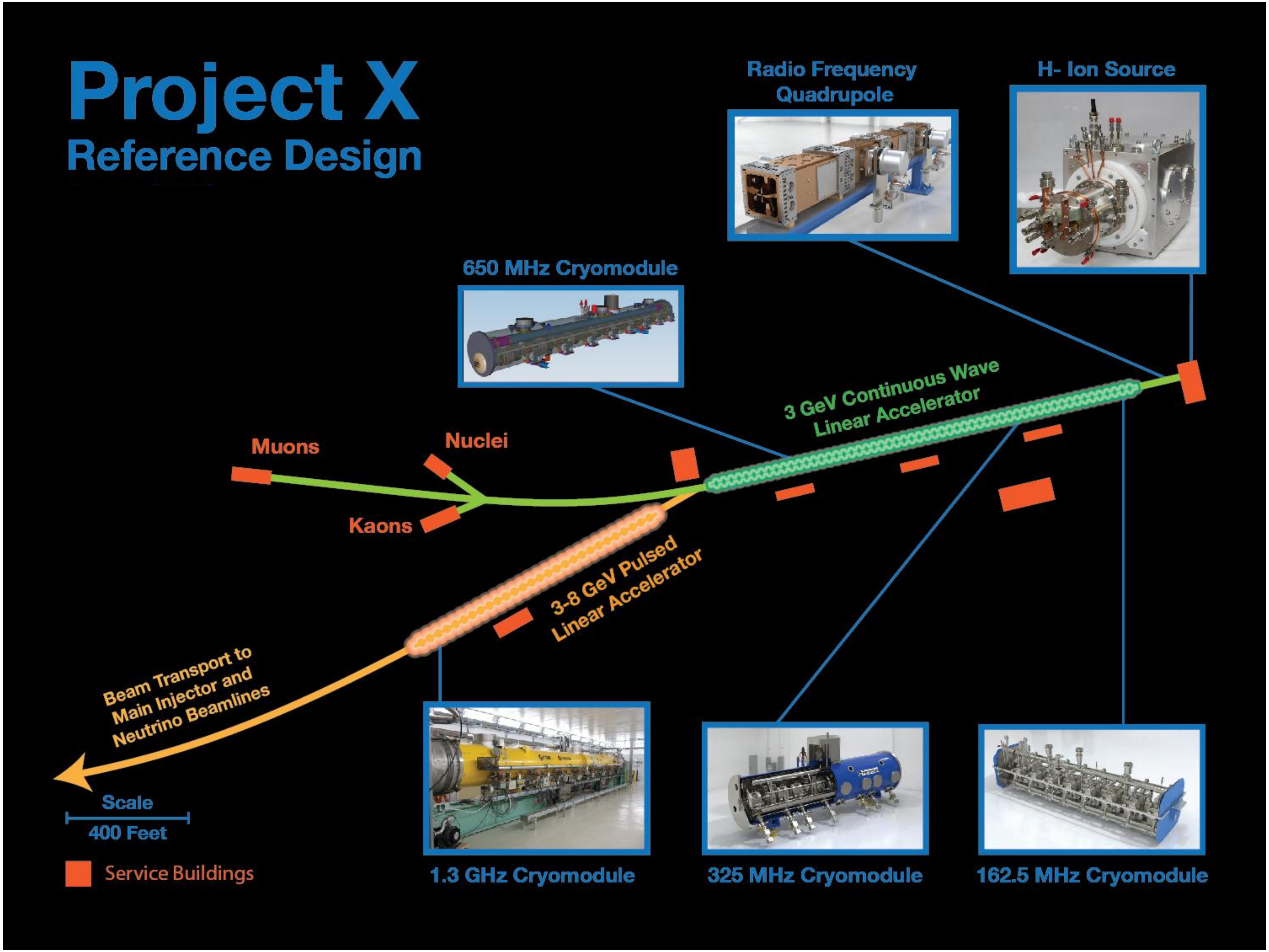

1-GeV
Stage1: to Booster

# Example Power Staging Plan for the Research Program

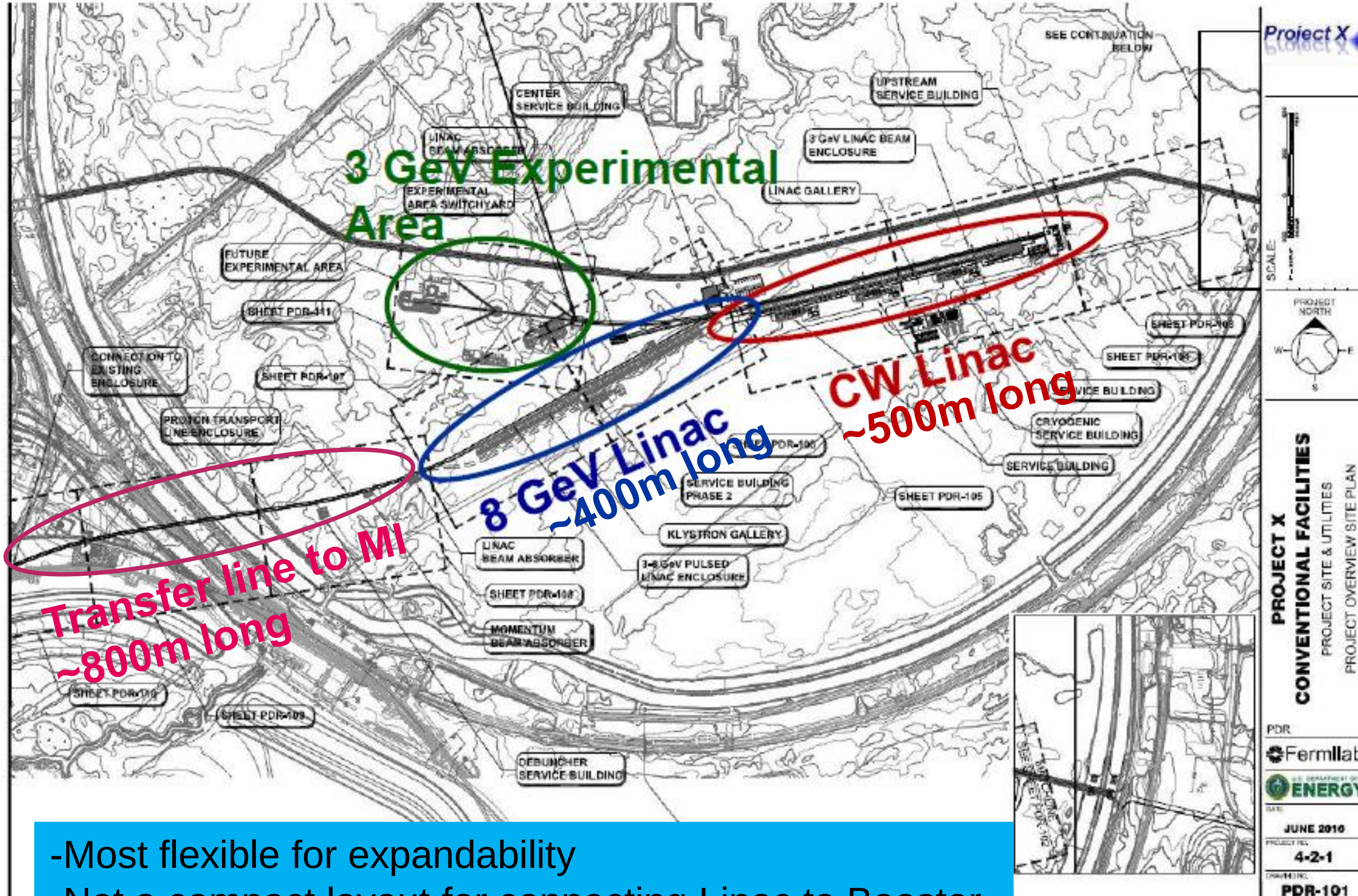
| Program: | Onset of NOvA operations in 2013 | Stage-1: 1 GeV CW Linac driving Booster & Muon, n/edm programs | Stage-2: Upgrade to 3 GeV CW Linac | Stage-3: Project X RDR | Stage-4: Beyond RDR: 8 GeV power upgrade to 4MW |
|---|---|---|---|---|---|
| MI neutrinos | 470-700 kW** | 515-1200 kW** | 1200 kW | 2450 kW | 2450-4000 kW |
| 8 GeV Neutrinos | 15 kW + 0-50 kW** | 0-42 kW* + 0-90 kW** | 0-84 kW* | 0-172 kW* | 3000 kW |
| 8 GeV Muon program e.g, (g-2), Mu2e-1 | 20 kW | 0-20 kW* | 0-20 kW* | 0-172 kW* | 1000 kW |
| 1-3 GeV Muon program, e.g. Mu2e-2 | ----- | 80 kW | 1000 kW | 1000 kW | 1000 kW |
| Kaon Program | 0-30 kW** (<30% df from MI) | 0-75 kW** (<45% df from MI) | 1100 kW | | |
| Nuclear edm ISOL program | none | 0-900 kW | 0-900 kW | | |
| Ultra-cold neutron program | none | 0-900 kW | 0-900 kW | | |
| Nuclear technology applications | none | 0-900 kW | 0-900 kW | 0-1000 kW | 0-1000 kW |
| # Programs: | 4 | 8 | 8 | 8 | 8 |
| Total max power: | 735 kW | 2222 kW | 4284 kW | 6492 kW | 11870kW |

Priority is currently on design, costing of Stage 1 Linac and interfaces to experiments

* Operating point in range depends on MI energy for neutrinos.
** Operating point in range is depends on MI injector slow-spill duty factor (df) for kaon program.

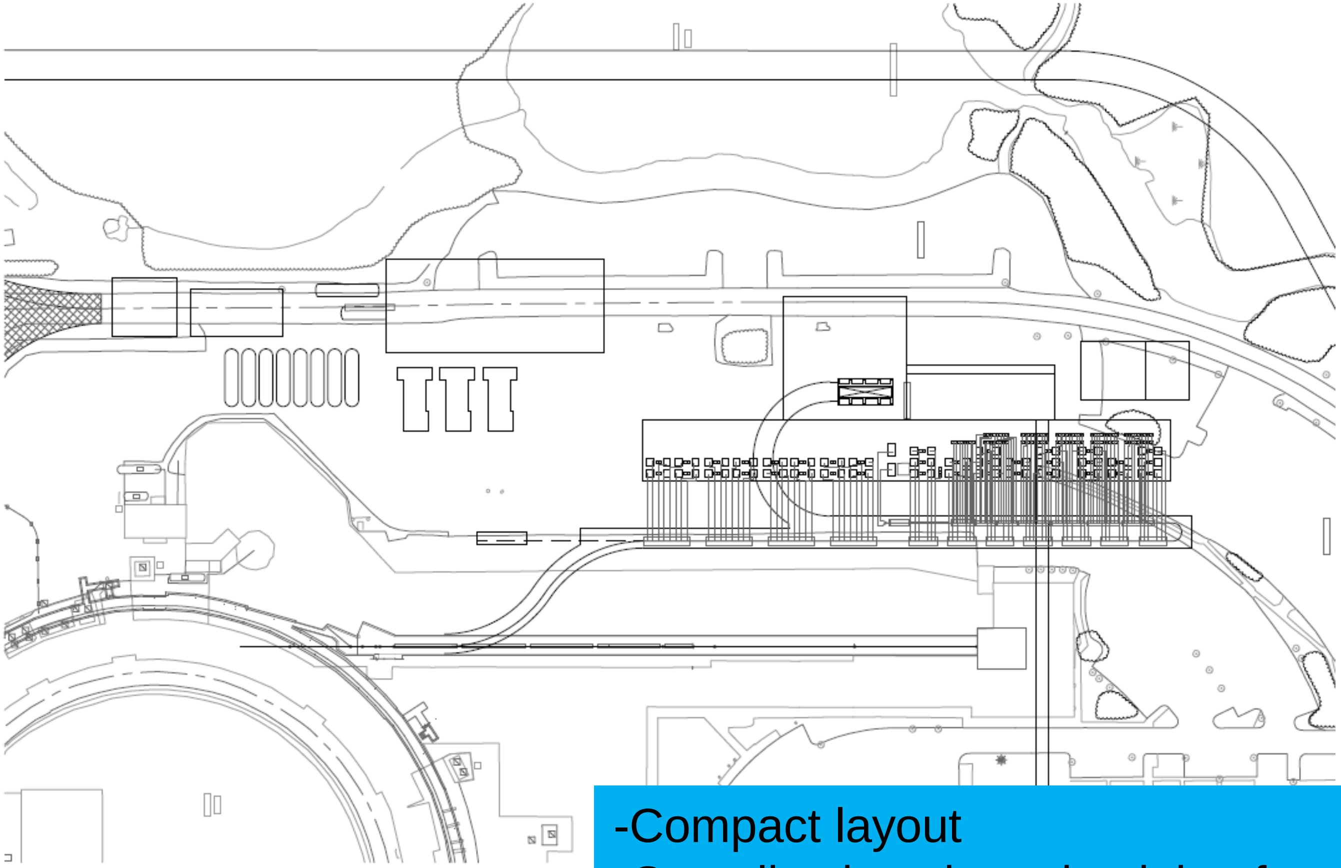

Project X
Reference Design
Radio Frequency Quadrupole
H- Ion Source
650 MHz Cryomodule
3 GeV Continuous Wave Linear Accelerator
Muons
Nuclei
Kaons
3-8 GeV Pulsed Linear Accelerator
Beam Transport to Main Injector and Neutrino Beamlines
Scale
400 Feet
Service Buildings
1.3 GHz Cryomodule
325 MHz Cryomodule
162.5 MHz Cryomodule

# “Reference Design”



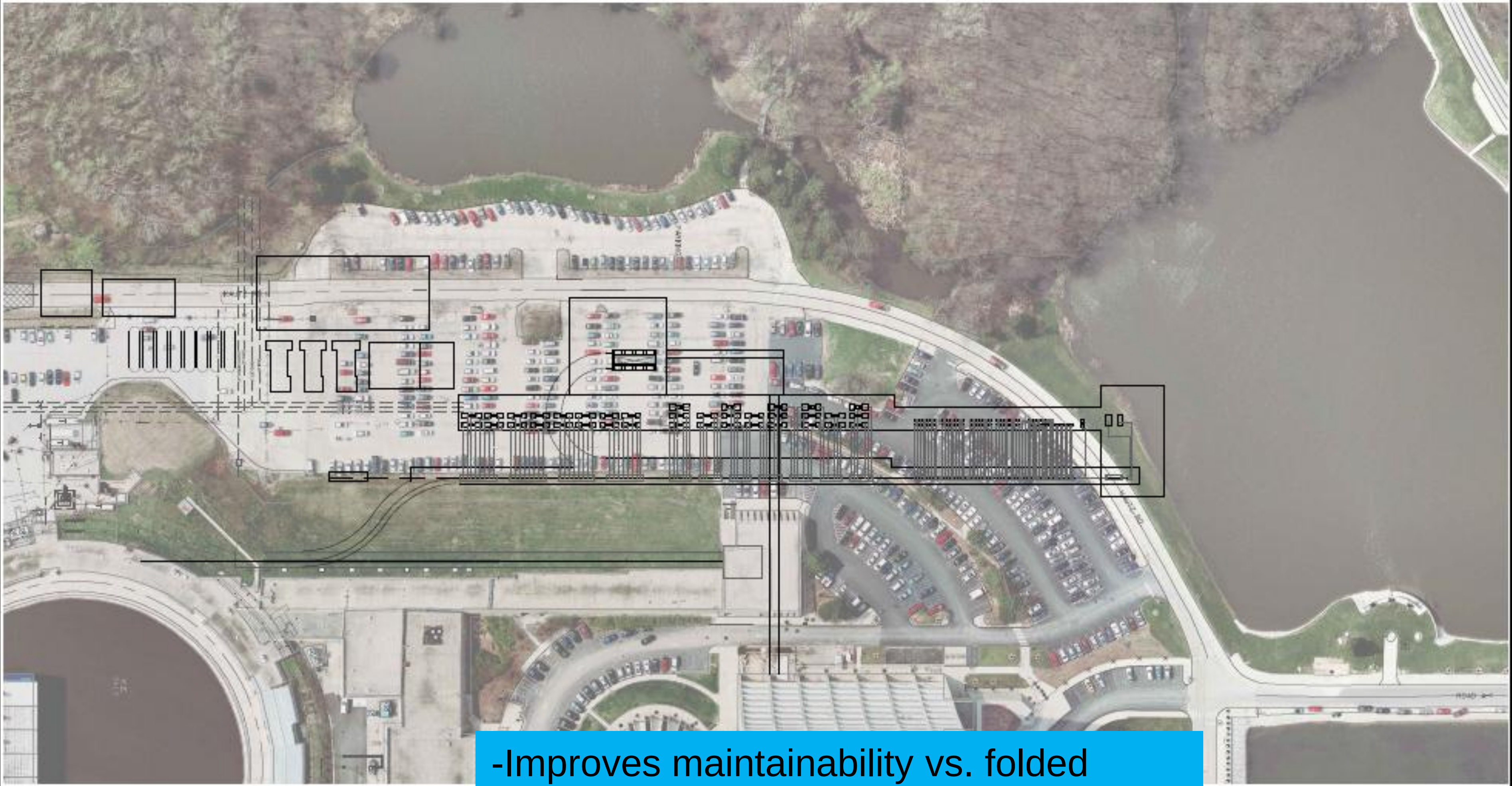

-Most flexible for expandability
-Not a compact layout for connecting Linac to Booster

# Stage 1 Linac - Folded in Parking Lot



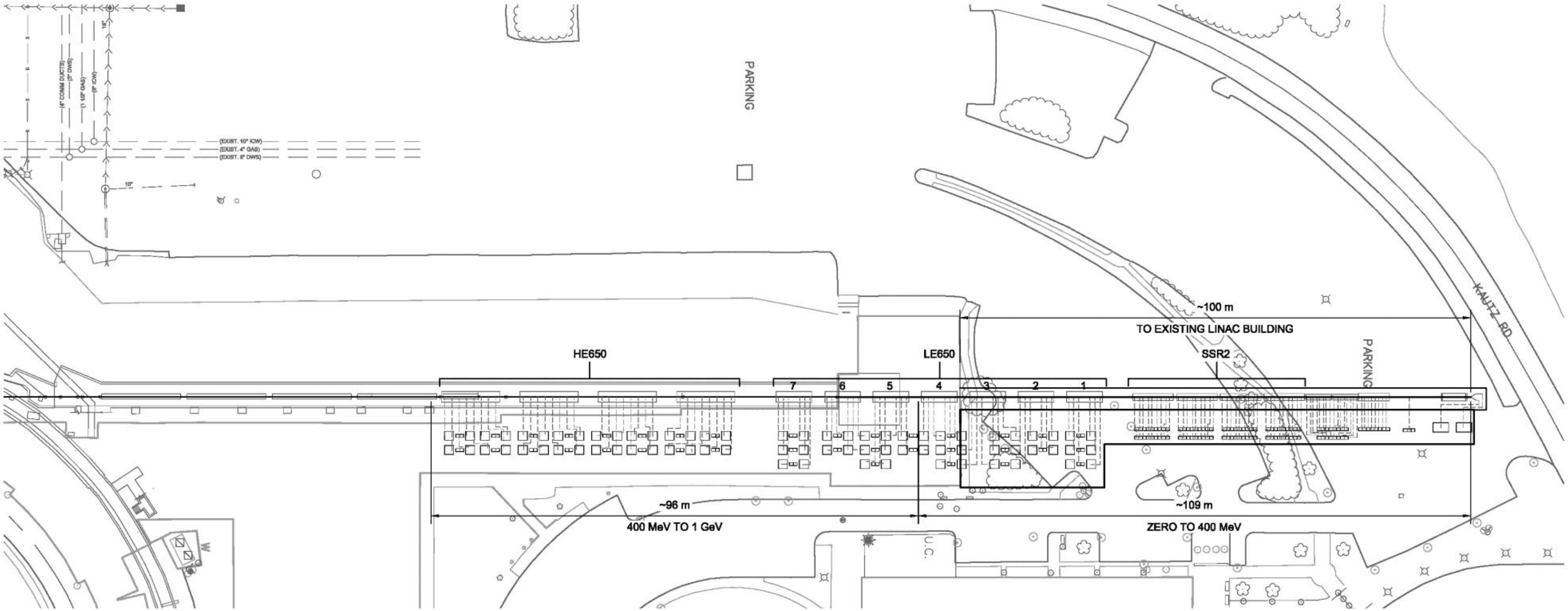
-Compact layout
-Complications in maintaining front end

# Stage 1 Linac - Straight in Parking Lot

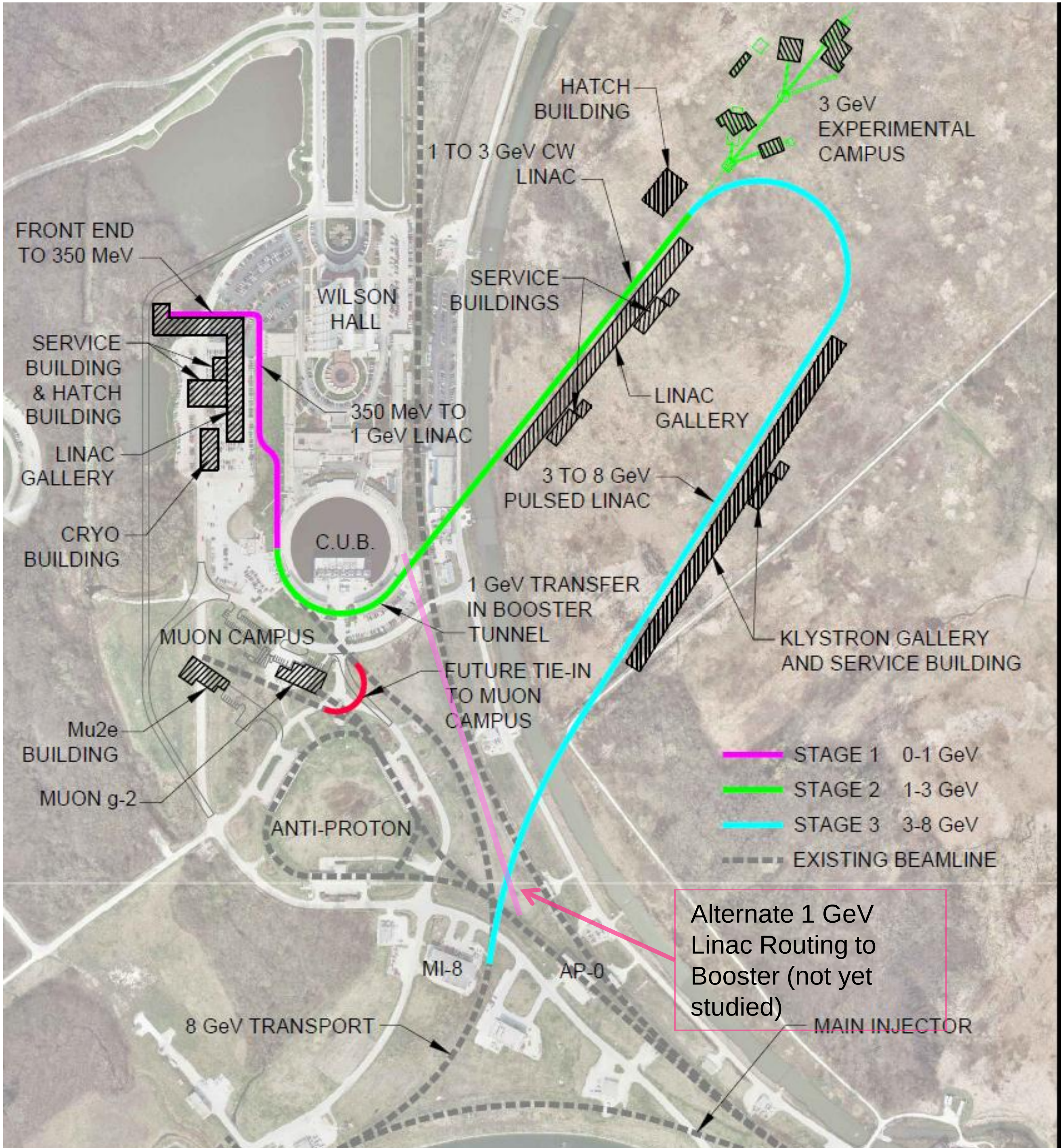


-Improves maintainability vs. folded
-Aesthetically controversial

# Stage 1 Linac – Use of existing Linac space

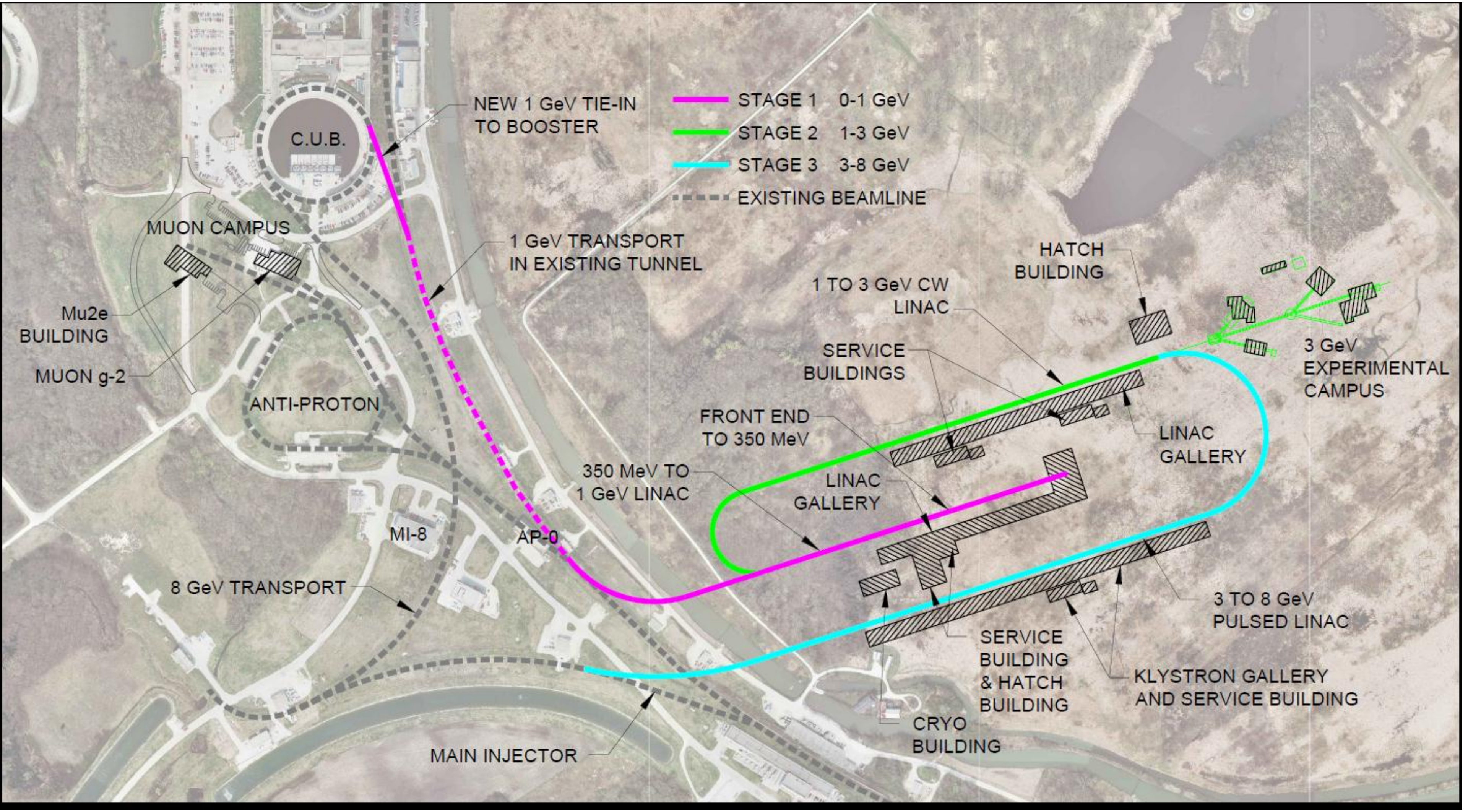



-Potential savings
-Requires extended operations downtime




# Staged Layout – Parking Lot Linac

# Staged Layout – Linac Upstream of AP0 (C. Polly)



# Summary

- The “reference design” configuration has been fairly well detailed for a project at this stage.
- Configurations based on a staged approach are just now being developed and require further definition of the interfaces to experiments.
  - This workshop is designed to help.
- Cost estimating for conventional facilities and machine hardware is mostly straightforward.
- There will be cost pressure applied in the downward direction.

# The End…or is it?

# Backup

# Muon Campus Beam Configuration (from mu2e CDR)

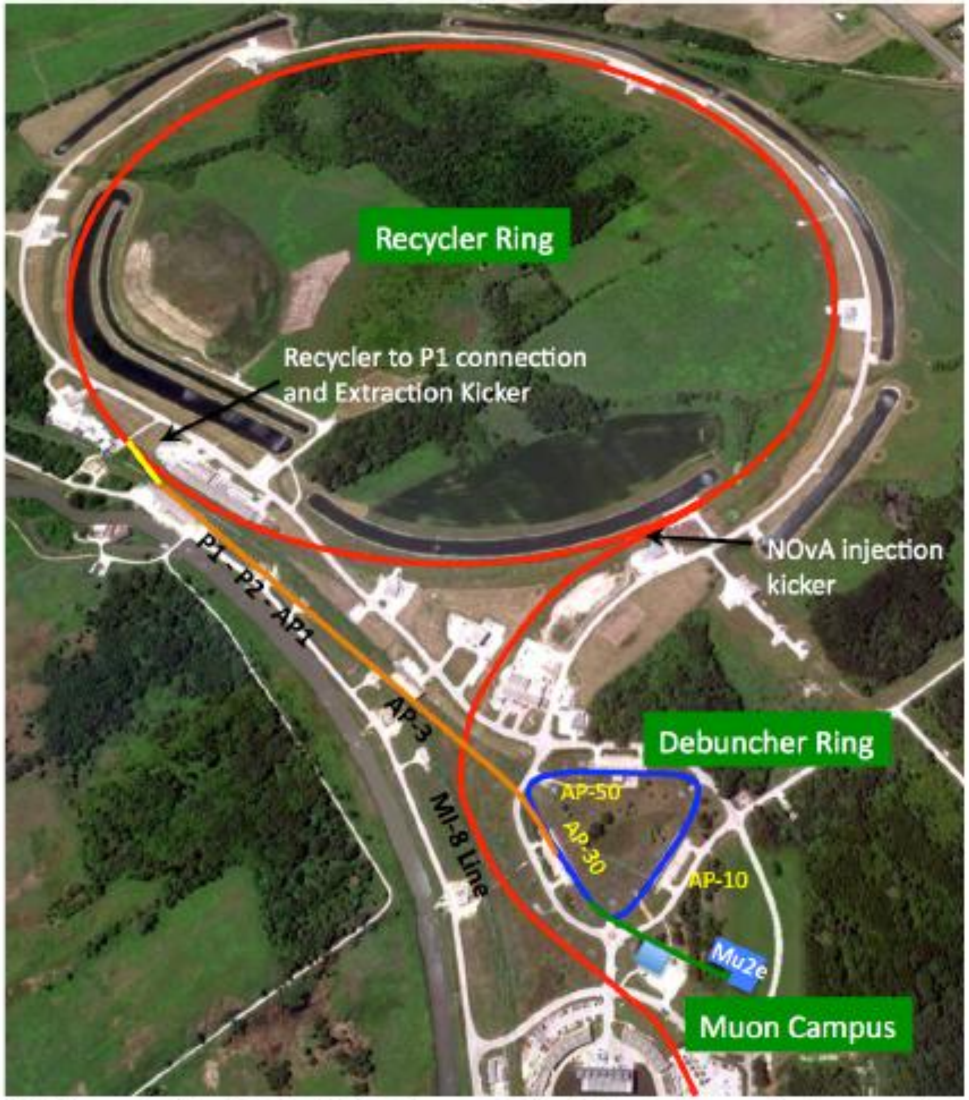
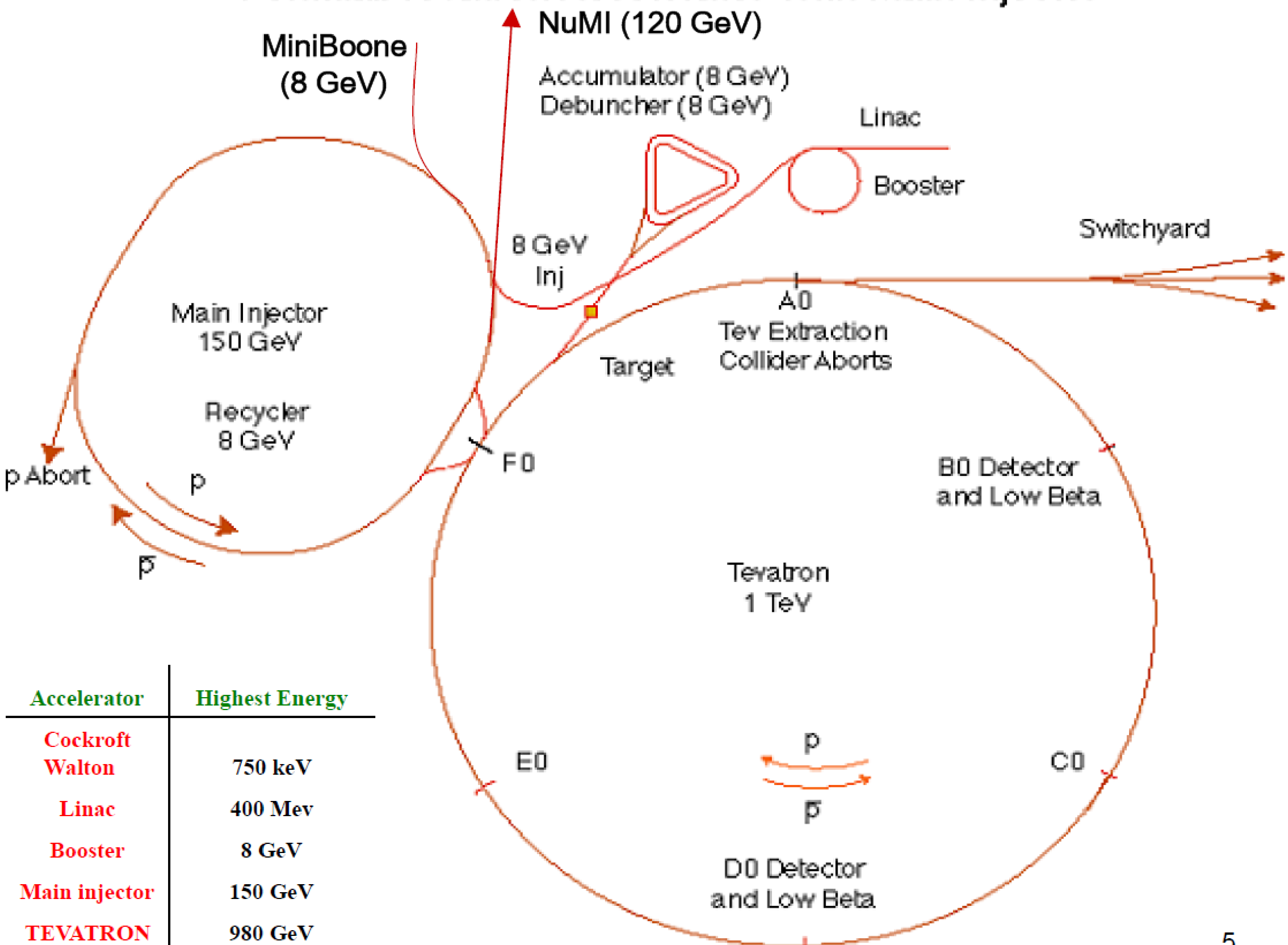



Figure 2.1. Layout of the Mu2e facility (lower right) relative to the accelerator complex that will provide proton beam to the detector. Protons are transported from the Booster through the MI-8 beamline to the Recycler Ring where they will circulate while they are re-bunched by a new 2.5 MHz RF system. The reformatted bunches are kicked into the P1 line and transported to the Debuncher Ring where they are slow extracted to the Mu2e detector through a new external beamline.

# FermilabTevatron Accelerator With Main Injector




| Accelerator | Highest Energy |
|---|---|
| Cockroft Walton | 750 keV |
| Linac | 400 Mev |
| Booster | 8 GeV |
| Main injector | 150 GeV |
| TEVATRON | 980 GeV |

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# LBNE : Near Site Layout

# Linac Cryomodule Count

| | Section | Freq (MHz) | Energy (MeV) | Qty. Cryomodules Reference Design | Qty. Cryomodules Stage 1 | Type | ~Length of each CM |
|---|---|---|---|---|---|---|---|
| | HWR ($\beta_G$=0.1) | 162.5 | 2.1-10 | 1 | 1 | HWR, solenoid | 5.26 m |
| | SSR1 ($\beta_G$=0.22) | 325 | 10-42 | 2 | 2 | SSR, solenoid | 4.76 m |
| CW | SSR2 ($\beta_G$=0.47) | 325 | 42-160 | 4 | 4 | SSR, solenoid | 7.77 m |
| | LB 650 ($\beta_G$=0.61) | 650 | 160-460 | 7 | 7 | 5-cell elliptical, doublet | 7.1 m |
| | HB 650 ($\beta_G$=0.9) | 650 | 460-3000 | 19 | 4 | 5-cell elliptical, doublet | 11.21 m |
| Pulsed | ILC 1.3 ($\beta_G$=1.0) | 1300 | 3000-8000 | 28 | - | 9-cell elliptical, quad | 11.7 m |