

APS Upgrade Project

Removal and Installation Plan

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APS Upgrade Project

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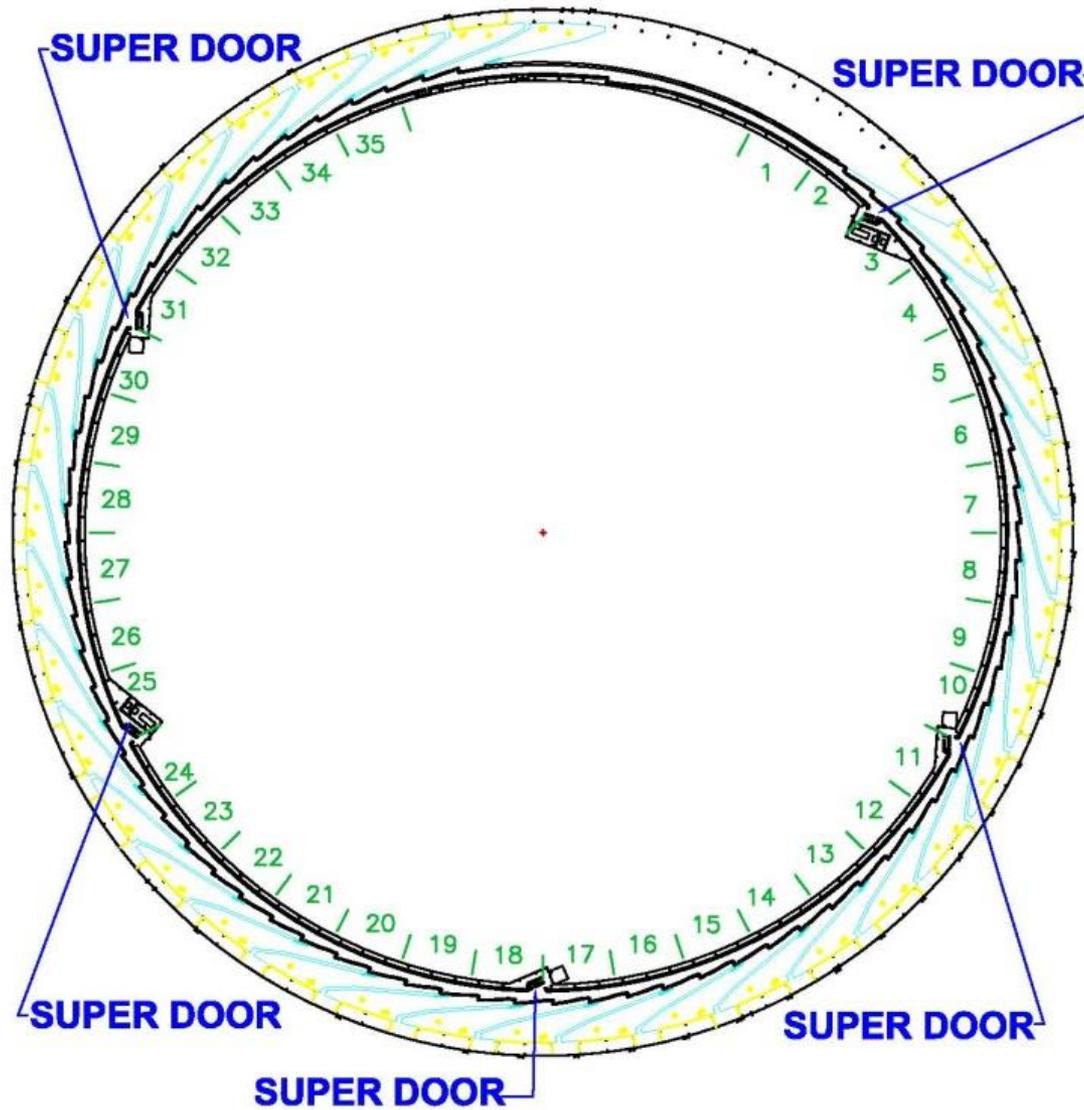
Outline

- Overview
- Removal Plan
- Installation Plan
- Space Requirements
- Comparison to Other Facilities
- Conclusion

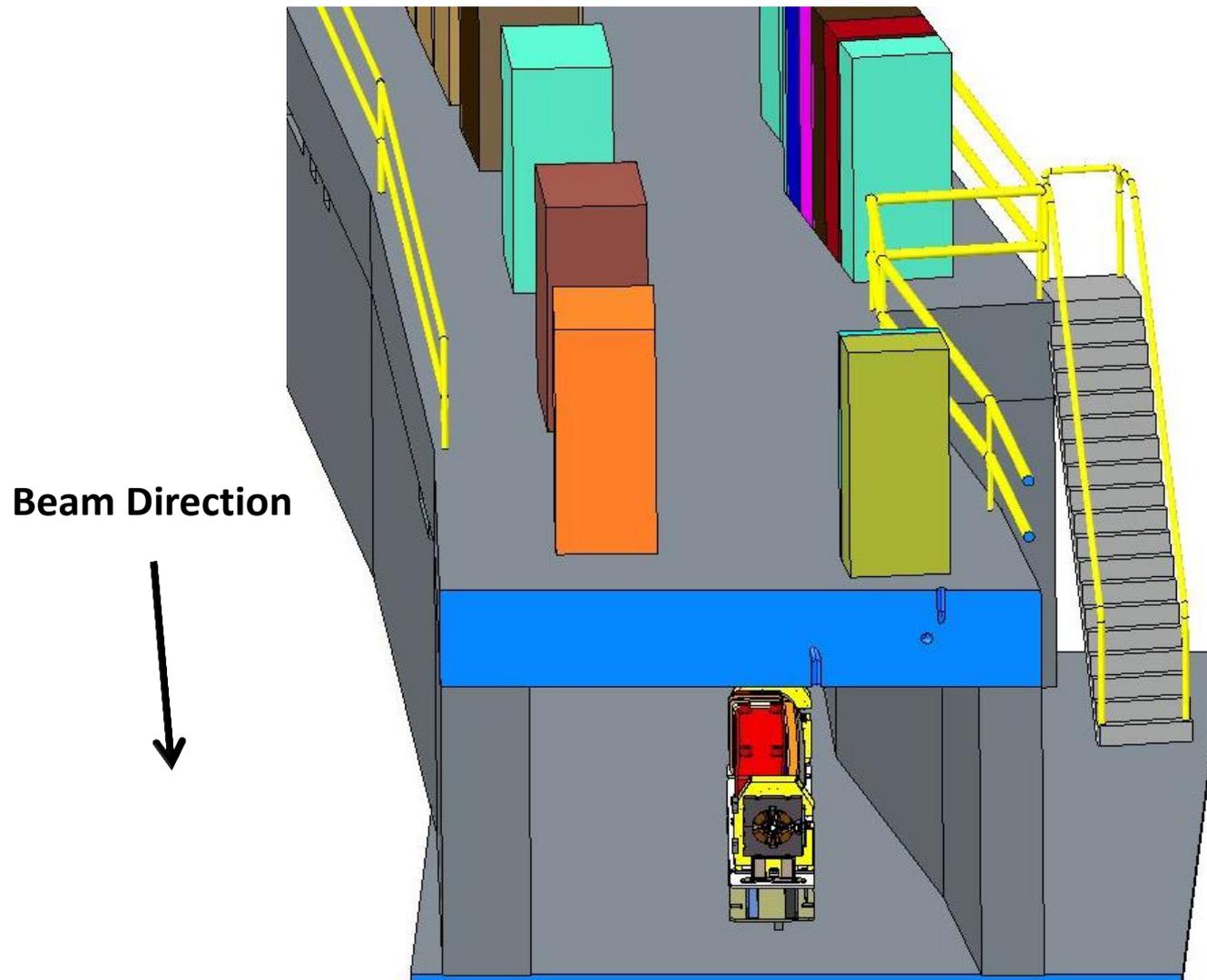
Overview

- The APS Upgrade requires that the existing storage ring and the associated power and electronic systems be replaced. The storage ring is located in a tunnel, and the power and electronic systems are located on the mezzanine above the tunnel.
- The storage ring is 1104 m in circumference and access is through five “super doors”.
- Over 1800 tons of material will be removed and be replaced with over 3000 tons of new components.
- The goal for the duration of the removal and installation work is nine months in order to support a twelve month overall installation and commissioning period.
- Necessary components, equipment, resources and facilities must be ready prior to the start of work.

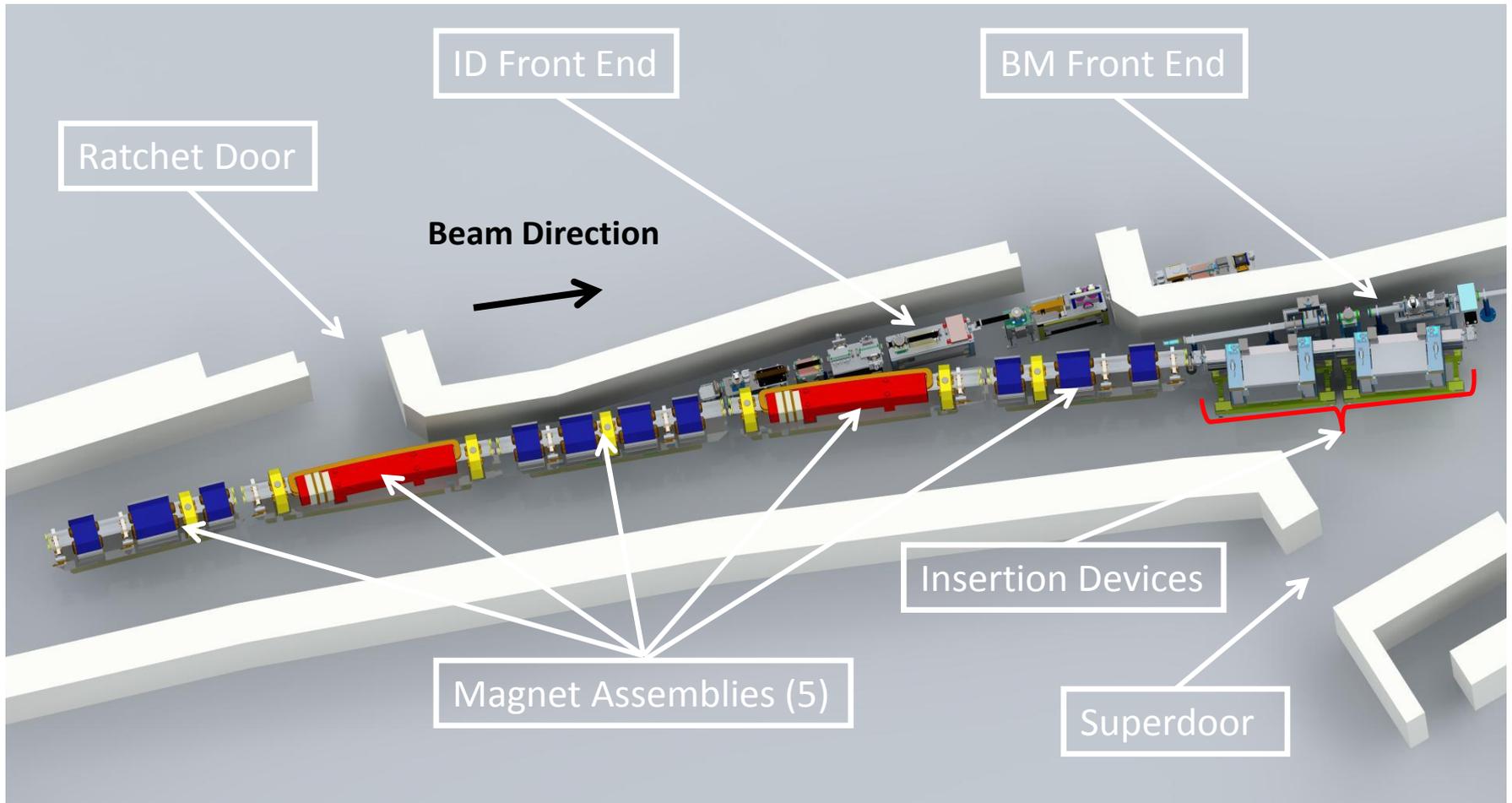
Overview – Storage Ring



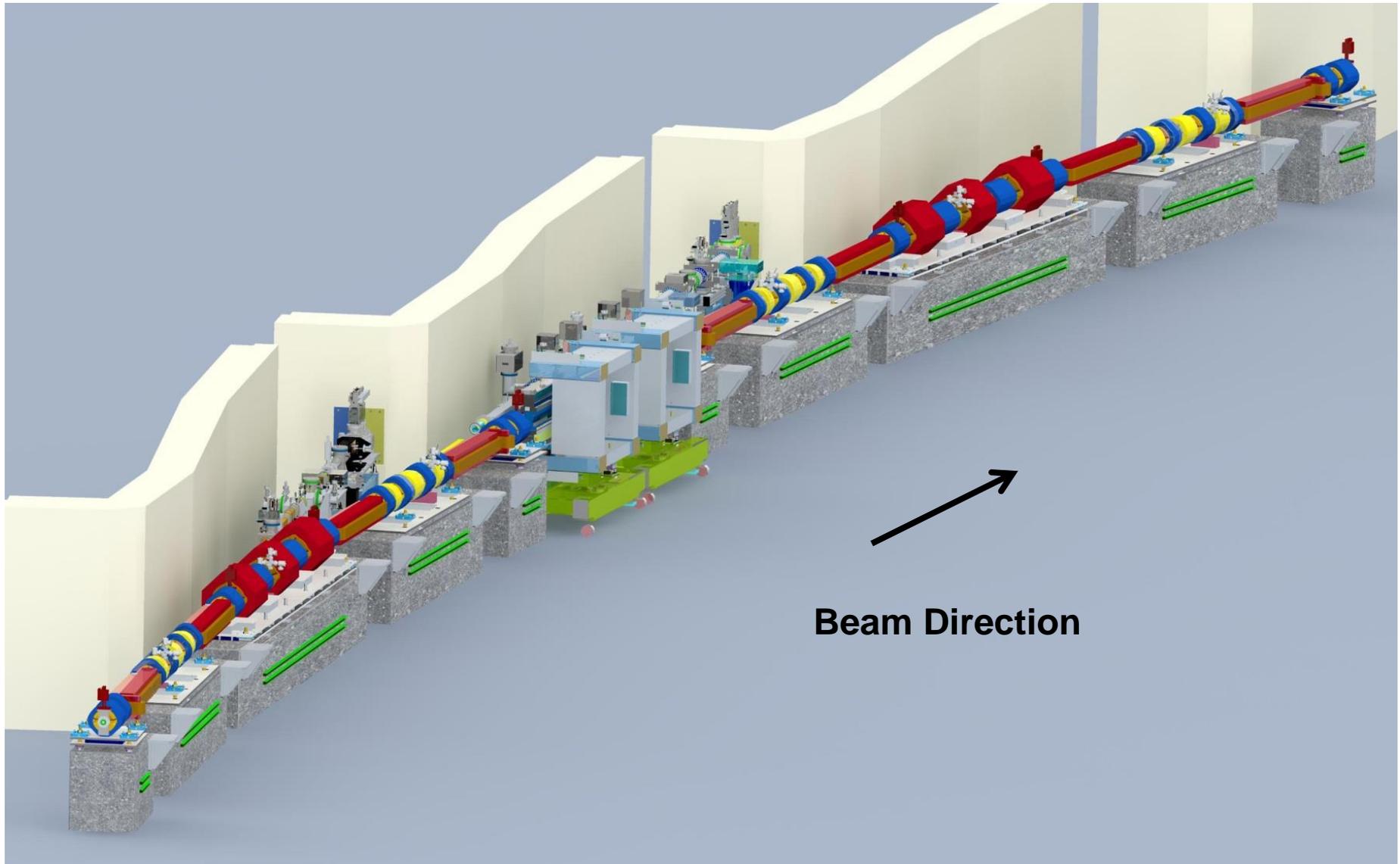
Overview - Mezzanine and Tunnel



Overview - One Sector of the Existing Storage Ring



Overview – Two Sectors of MBA Storage Ring



Overview – Removal and Installation Schedule

TASK	Removal		Installation						
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9
Remove IDs and front ends	■								
Remove mezzanine electronics	■								
Remove magnet girder assemblies	■								
Prepare tunnel surfaces		■							
Install mezzanine electronics			■						
Install new magnet girder assemblies			■						
Make vacuum and mechanical connections			■						
Install front ends			■						
Install insertion devices							■		
Final alignment								■	
Integrated system testing							■		

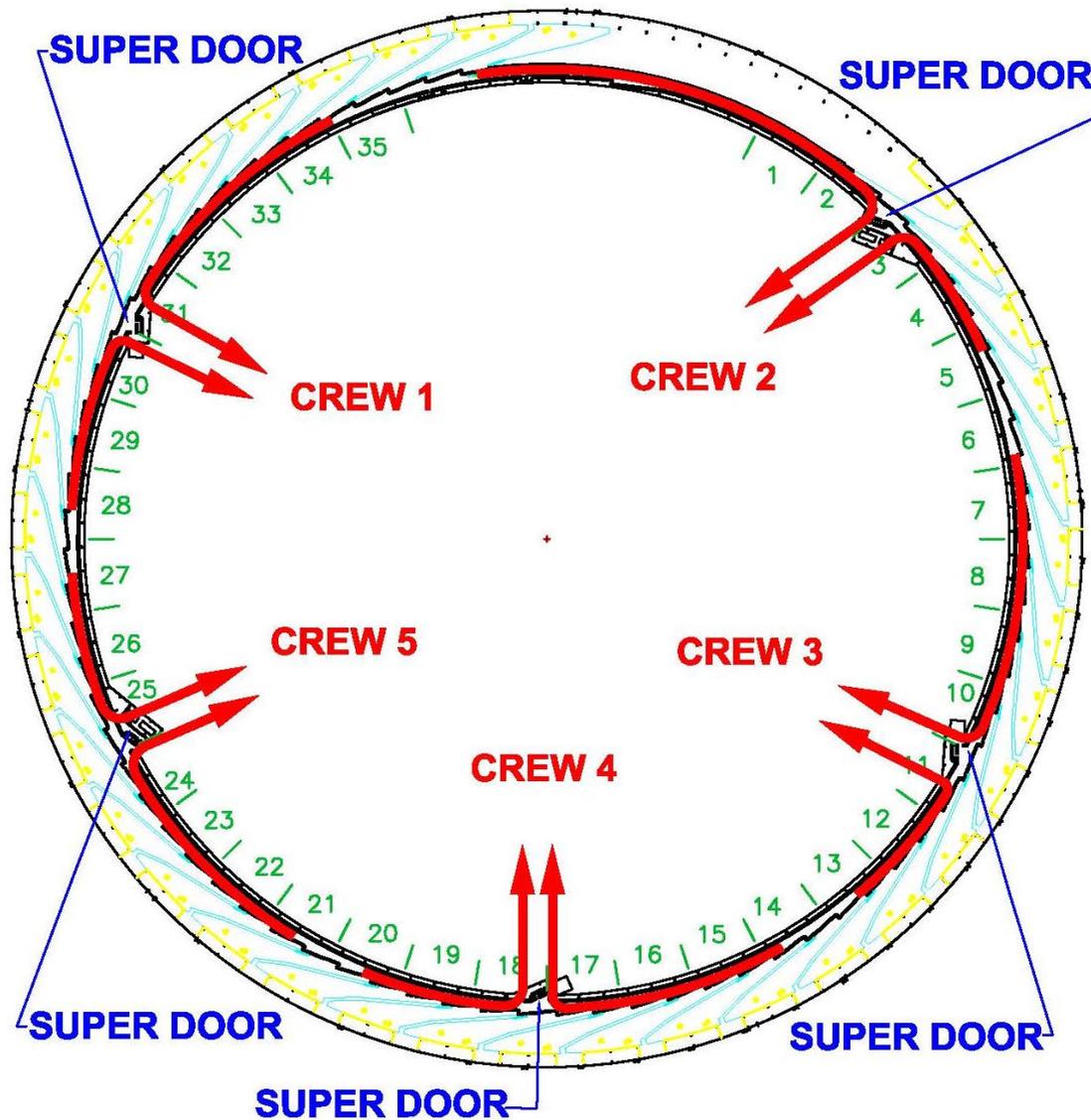
Removal Assumptions

- Cooling water and HVAC systems will not require major rework during the installation period.
- Removed tunnel and mezzanine equipment will be stored elsewhere on site for disposal at a later date.
- Planning assumes two shifts and a five day work week.
- For the purposes of our working model, we are assuming 40 identical sectors.

What will be removed

- Inside the storage ring tunnel:
 - Magnet/girder assemblies and supports
 - Most cable and wiring
 - Front ends
 - Insertion devices
 - Beam to storage ring line (BTS) and injection equipment
 - Four RF cavities and waveguides located in Sector 38
- On the storage ring mezzanine:
 - All magnet power converters and associated electronics
 - All diagnostics electronics including cabinets
 - All controls electronics
 - All vacuum electronics

Storage Ring Removal



Each crew will use one of the five super doors on the infield side of the building. Storage ring components will be removed starting at the super door and then outward progressively to roughly the mid-point between the super doors. Removed materials will be trucked to the onsite disposition facility.

Tunnel Removal Tasks

- Storage ring tunnel clearing
 - Lockout/tagout electrical
 - Shut down and vent vacuum systems
 - Drain water lines and hoses
 - Disconnect bellows, rad survey inside vacuum chambers and cap ends
 - Remove IDs and transport to ID processing facility
 - Remove Front Ends and transport to upgrade work space
 - Remove four RF cavities and waveguides and transport to accelerator storage space for use as operational spares
 - Remove girders and supports, BTS and injection equipment, and transport to disposition building
 - Pull, cut to segments and remove cables
 - Remove grouted pedestals and finish floor

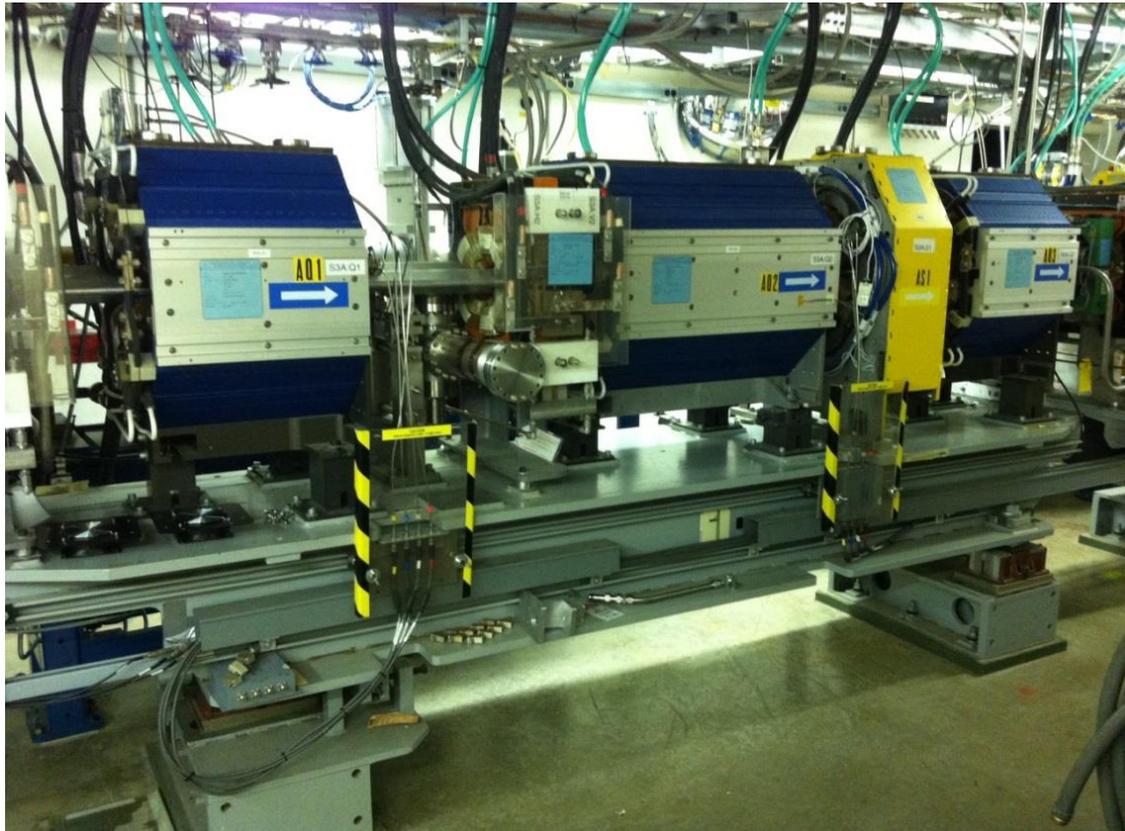
Insertion Device



All IDs will be removed first.

This is a semi-routine activity.

Typical Existing Magnet/Girder Assembly



~200 assemblies (five per sector) of three basic types:

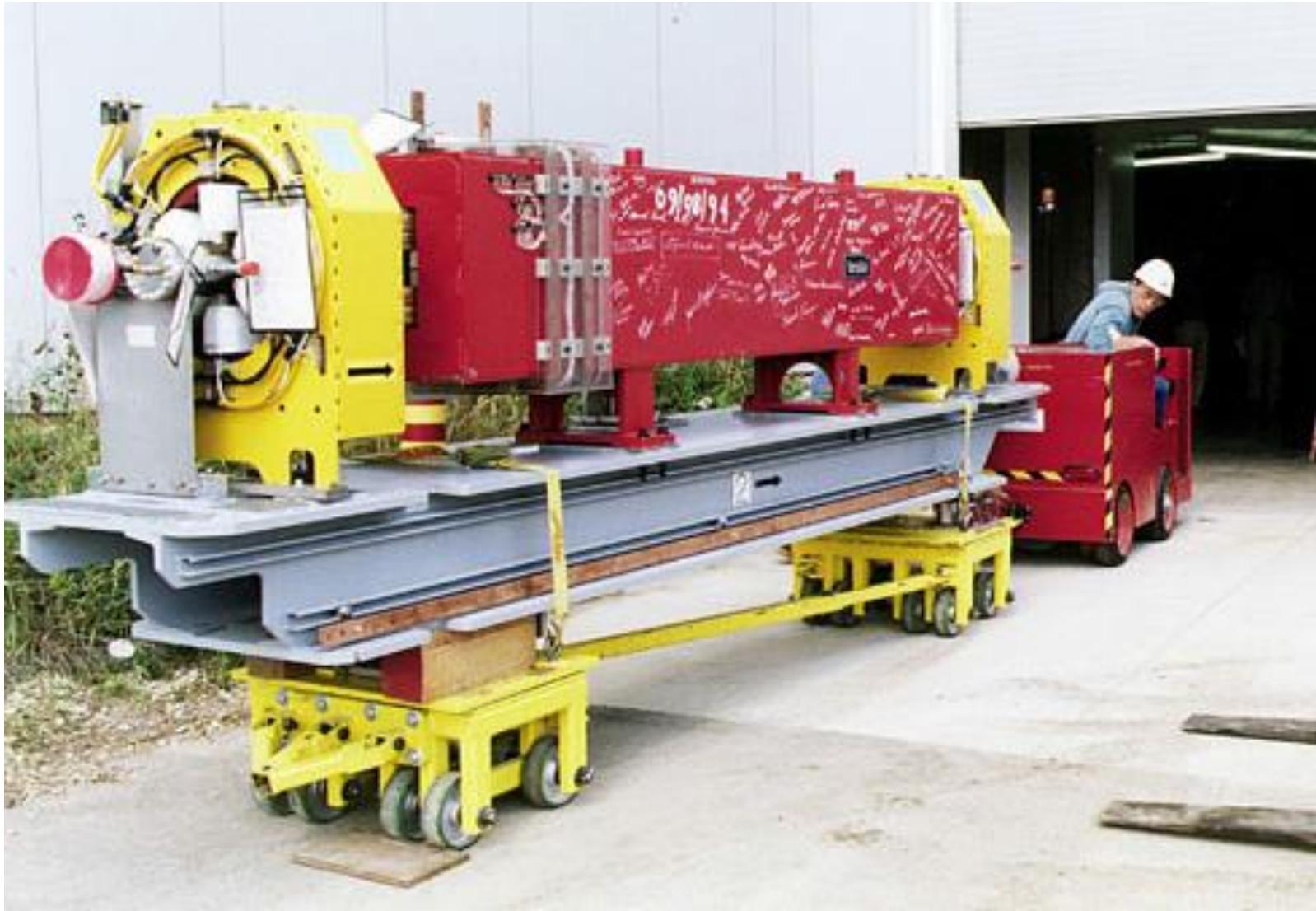
Lengths: 12 ft, 14 ft, 17 ft

Weights: 6.9 tons, 7.8 tons, 11.3 tons

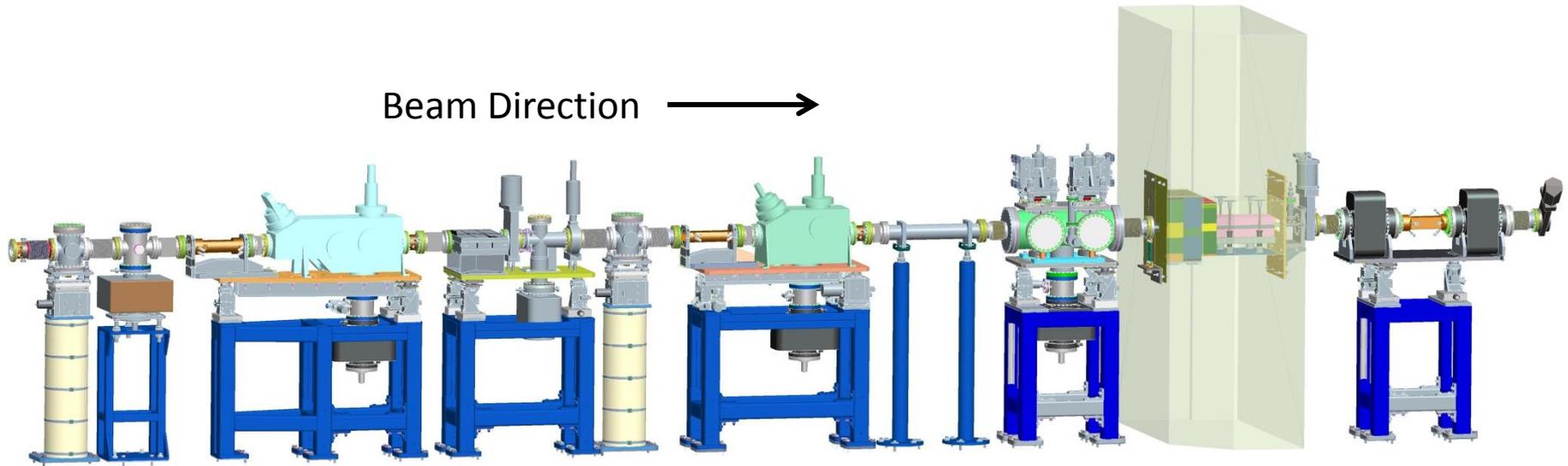
Total weight: 1761 tons

~ 14 magnet power and 16 cooling water connections per assembly.

Moving Girder with Dolly and Tug



Front End



All (~60) front ends will be removed through the “ratchet” doors into the experimental hall.

Tunnel Removal Tasks Continued

- Tunnel surface preparation
 - Protect the RF cavities and waveguides
 - Remove girder support pedestal
 - Remove grout and mounting studs
 - Smooth and finish floor
 - Prepare and paint walls and ceiling (subject to schedule constraints)

- Tunnel removal process complete
 - Tunnel is clean, dry and prepared
 - Ready for installation

Electronics Removal on Mezzanine

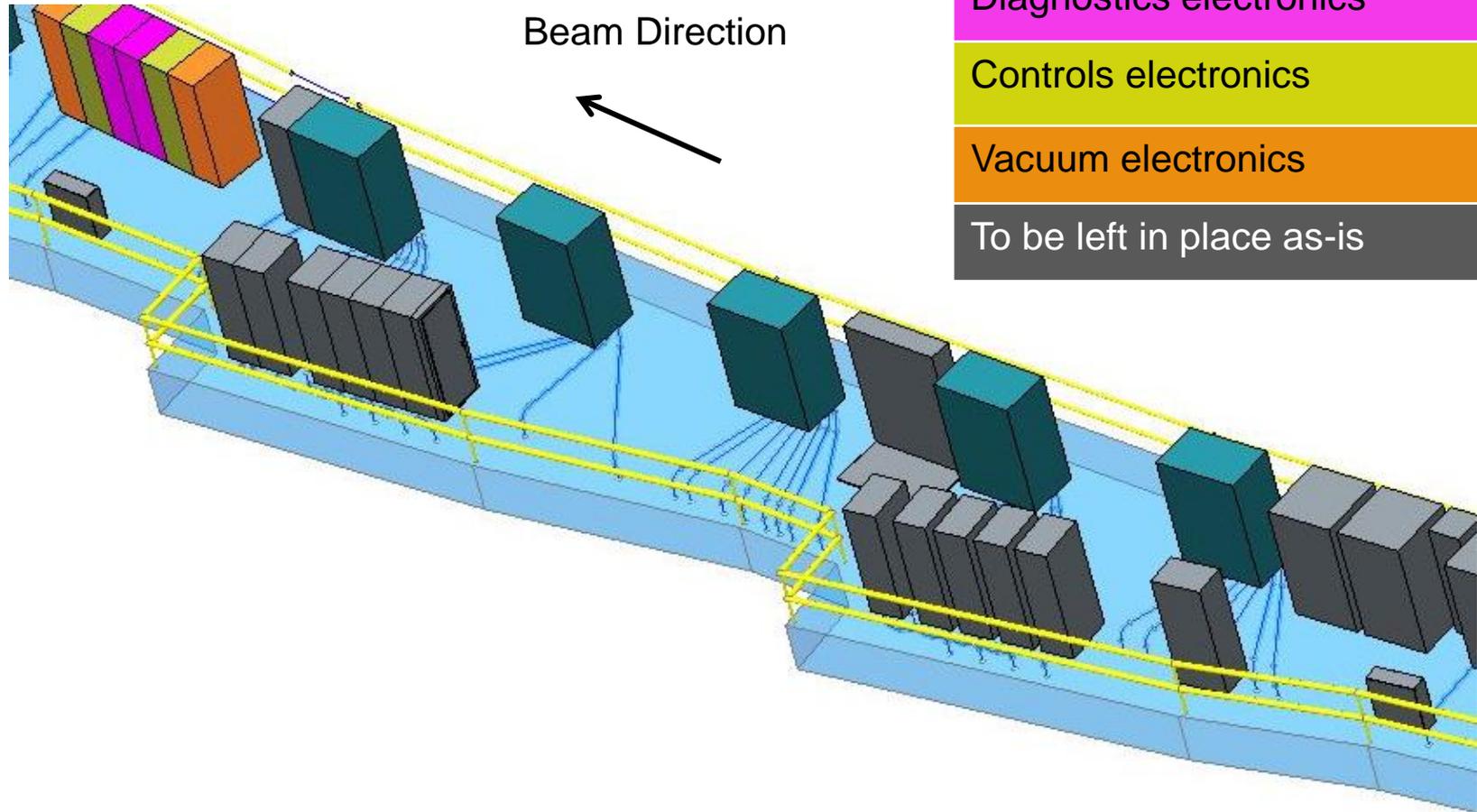
Power supply converters

Diagnostics electronics

Controls electronics

Vacuum electronics

To be left in place as-is



Mezzanine Removal Tasks

- Lockout/tagout
- Disconnect cables and remove connectors
- Remove:
 - All power supply converters
 - Vacuum controls
 - Control electronics
 - All beam diagnostics electronics including cabinets
- Lower the removed items to Building 400 main floor and transport out to disposition building

Material for Disposal

Item Description	Weight [tons]	Volume [cu yd]	Type of Waste	Quantity	Type of Containers
Girder assemblies	1761	1449	Low level rad	10	B-25 bin
			Richardson metal suspension	176	40 cu yd dumpster
Power cables	65	17	Richardson metal suspension	6	20 cu yd dumpster
DC Converter electronics	27	40	Electronics recycling	4	40 ft semi-trailer
Other electronics	24	88	Electronics recycling	8	40 ft semi-trailer
Totals	1877	1594			

NOTE: The numbers of bins, dumpsters, and semi-trailers were calculated by volume and adjusted by weight capacity.

Removal Effort Summary

Removal Activity	Person-Hours
IDs and Front Ends	9,658
Storage Ring	37,300
Mezzanine Electronics	11,640
Total	58,598

This is roughly 98 people per shift for two months

Typically 5 crews, 2 shifts, 5 days per week to complete removal

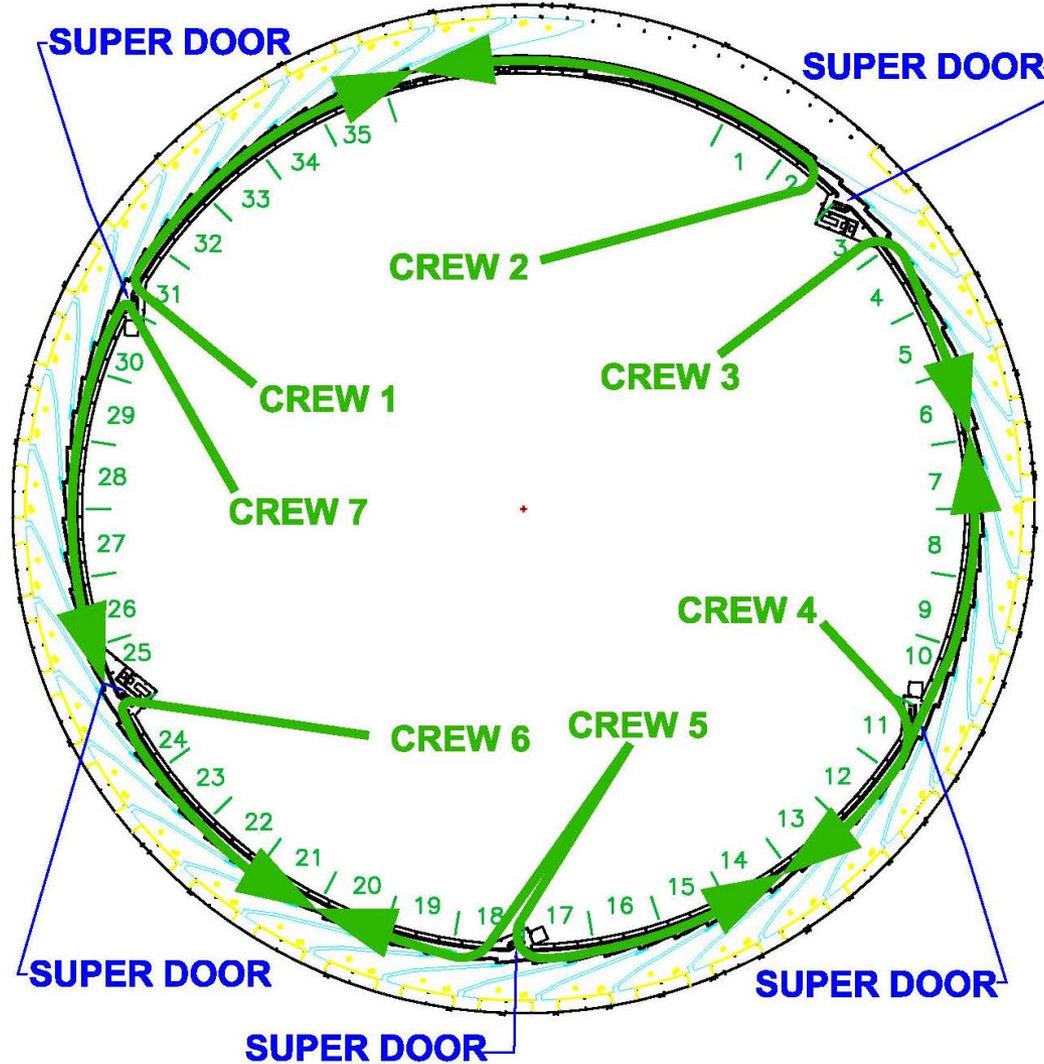
Removal and Installation Schedule

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Prepare tunnel surfaces		■							
Install mezzanine electronics			■						
Install new magnet girder assemblies			■						
Make vacuum and mechanical connections			■						
Install front ends			■						
Install insertion devices							■		
Final alignment								■	
Integrated system testing							■		

Installation Assumptions

- Planning assumes two shifts and a five day work week.
- For the purposes of our working model, we are assuming 40 identical sectors.
- All components to be installed must be assembled, tested and staged prior to the start of the removal and installation period.
- Installation is considered complete after system testing without beam has been done.

Storage Ring Installation



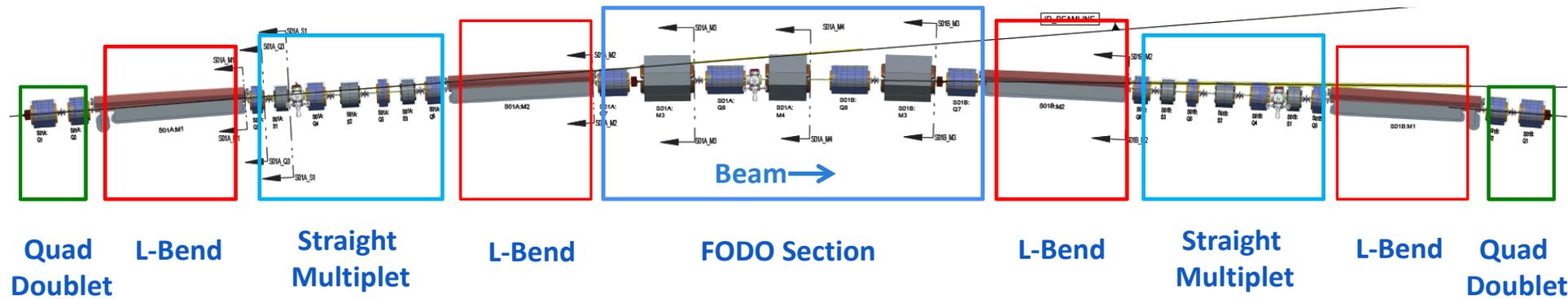
Installation crews will share super doors without interference. Equipment to be installed for the day's work will be staged outside of the super doors (infield area). Staging pads at the super doors and temporary cover may be needed.

Main Installation Tasks

- Storage ring tunnel
 - Re-establishment/checking of survey monument system
 - Installation of magnet/support/vacuum assemblies
 - Installation of the front ends
 - Installation of the insertion devices

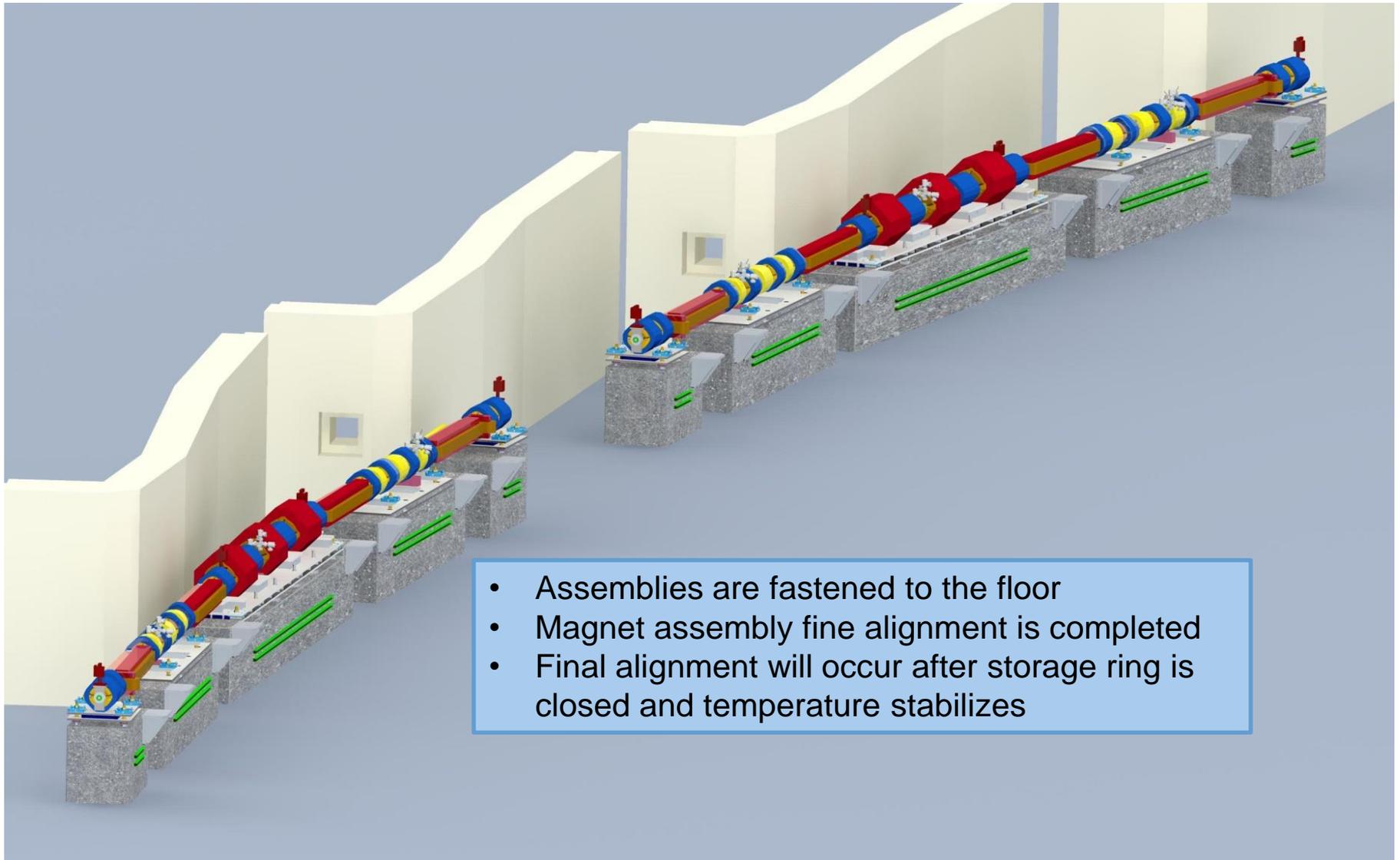
- Mezzanine
 - Installation of cabling from the electrical racks to the storage ring equipment
 - Installation of power converters, diagnostics, controls and vacuum electronics

Magnet/Support Assembly Installation



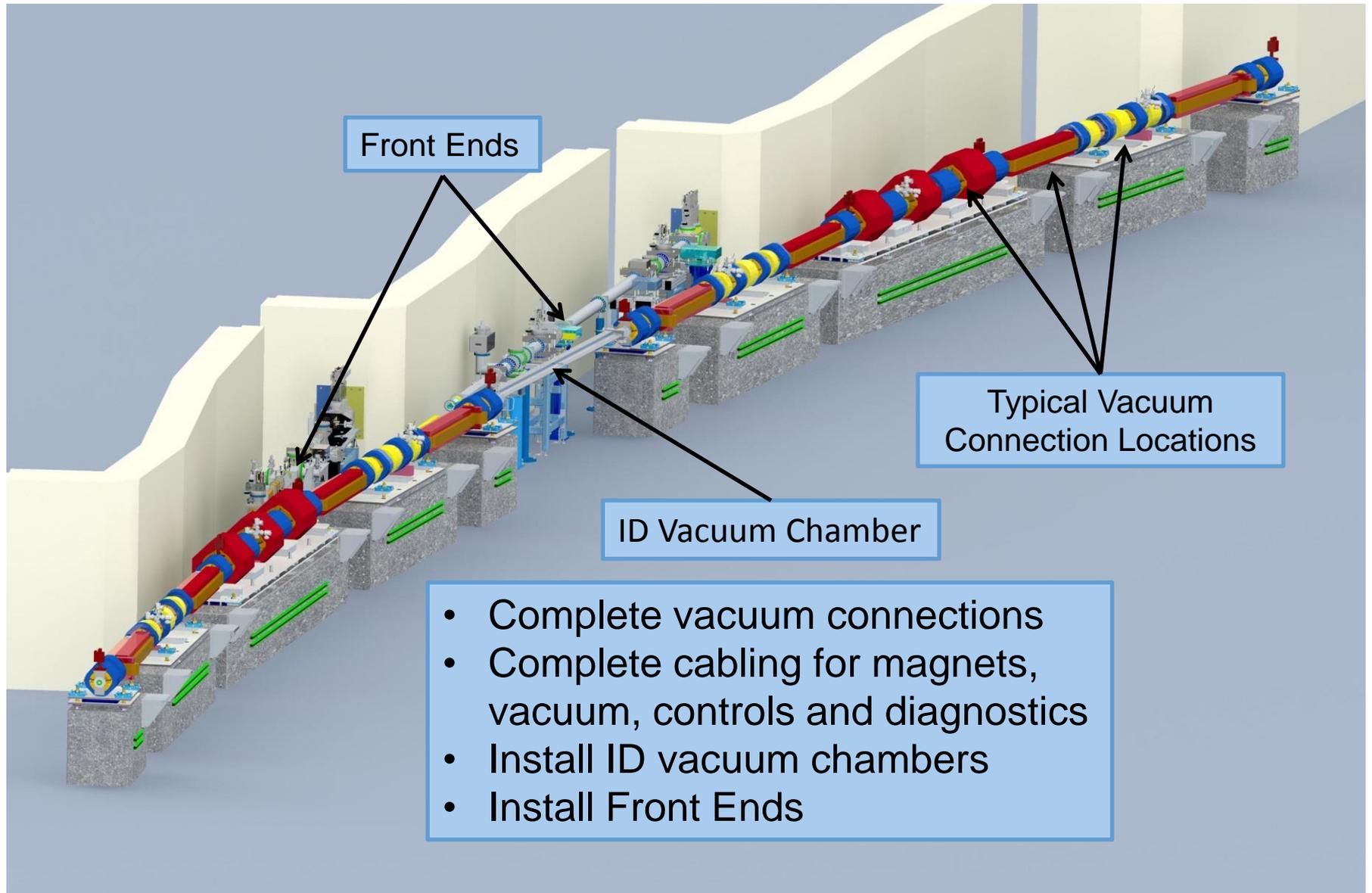
- FODO Section - Four quadrupoles, three bending magnets, total weight – 48,000 pounds
- Straight Multiplet - Four quadrupoles, three sextupoles, total weight – 26,000 pounds
- Quad Doublet - Two quadrupoles, total weight - 9600 pounds
- L-Bend (2 styles) - One bending magnet, total weight – 2,500 pounds

Magnet Assembly Installation

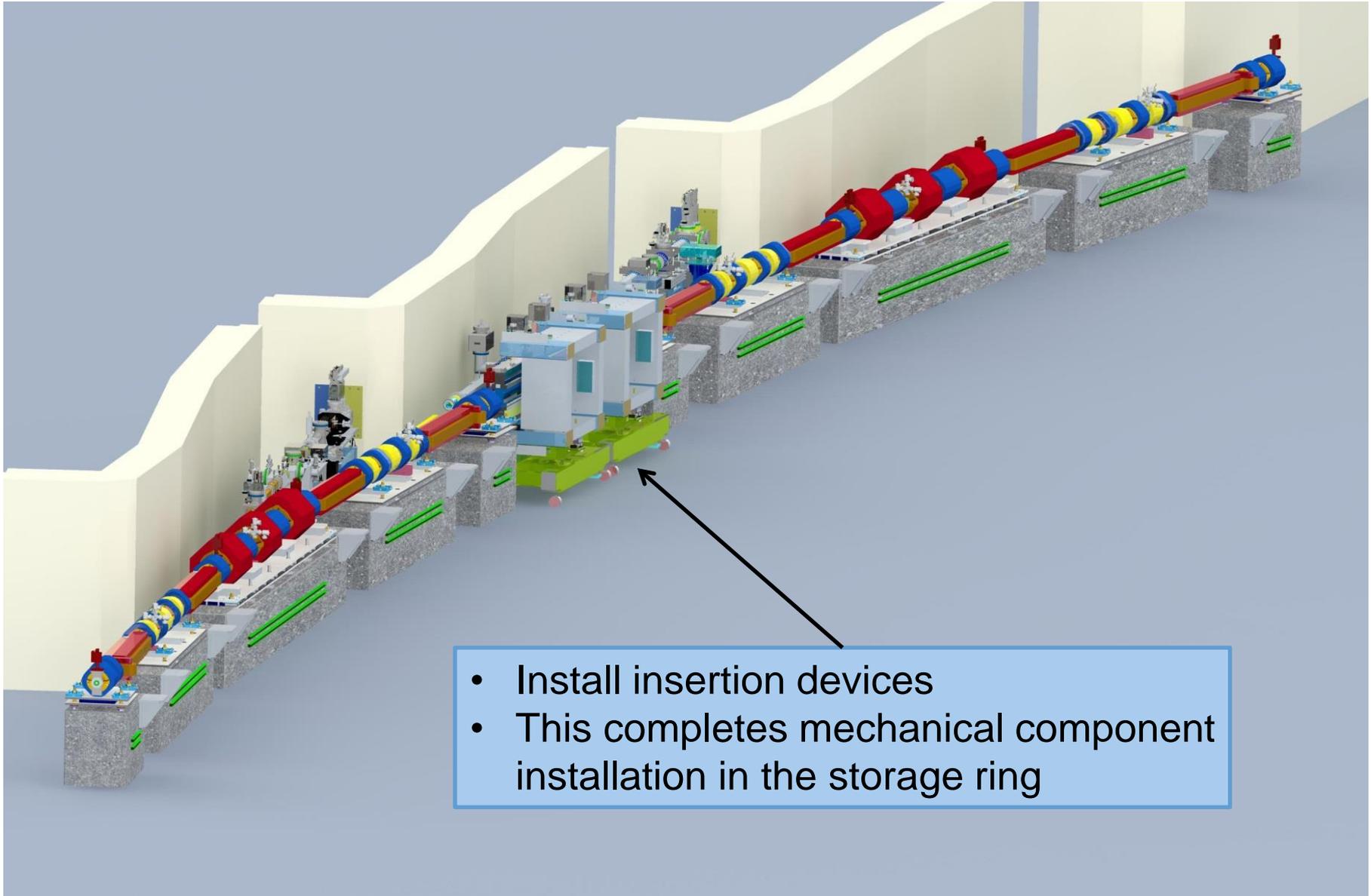


- Assemblies are fastened to the floor
- Magnet assembly fine alignment is completed
- Final alignment will occur after storage ring is closed and temperature stabilizes

Storage Ring Installation - Next Steps



Storage Ring Installation – Insertion Devices



- Install insertion devices
- This completes mechanical component installation in the storage ring

Mezzanine Installation

- Installation is a mix of new equipment in existing cabinets and completely new cabinets.
- Mezzanine installation will occur in parallel with storage ring installation.
- Generally this work will be performed by two person teams that are distributed around the mezzanine.

Installation Effort Summary

Installation Activity	Person-Hours
IDs and Front Ends	43,446
Storage Ring	69,594
Mezzanine Electronics	66,689
Integrated Testing without Beam	30,000
Total	209,729

This is roughly 100 people per shift for seven months

Typically 7 crews, 2 shifts, 5 days per week to complete installation

Summary of Space Requirements



	Disposition Facility		ID Processing Building	MRAS Building	CRATS Building
	Enclosed	Outdoor			
Square Footage	6,060 ft ²	40,550 ft ²	15,860 ft ²	55,025 ft ²	19,400 ft ²
10% un-programmed contingency space	606 ft ²	4,055 ft ²	1,586 ft ²	5,503 ft ²	1,940 ft ²
Total Square Footage	6,666 ft²	44,605 ft²	17,446 ft²	60,528 ft²	21,340 ft²

We are investigating options on site and off site to meet these needs.

Comparison to Other Storage Ring Removal and Installation Projects

Light Source	SR Circum. (m)	Remove Duration	Install Duration	Notes
SSRL/SPEAR3	234	5 weeks	27 weeks	Similar scope to APSU (1/5 length), Complete ring replacement, 1 access point
NSLS II	792	N/A	30 months	Limited by equipment availability
PETRA III	2304	~3 months	~6 months	1/8 of 2304 m ring removed and replaced (~300 m)
ESRF II	844	~12 months		Planned; 18 months stop to start for user operations
MAX IV	528	N/A	12 months	Planned
Pohang	282	3 months	3 months	Complete; 6 month commissioning
Australian Light Source	216	N/A	12 months	Complete; five 12 hour shifts/week for installation; 6 month commissioning
SIRIUS	518	N/A	14 months	Planned
APS-U	1104	2 months	7 months	Planned; 5 access points



Conclusions

- We recognize that minimizing the down time is critical to our users.
- We have assembled a plan to accomplish the removal and installation within nine months.
- We are continuing to refine the plan and to learn from others.
- We are glad that you are here!