

MR Linac on ACB 1.1209

Test Fit and Infrastructure report

June 13, 2012

THE UNIVERSITY OF TEXAS

MD Anderson
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For

Feasibility Study – Test Fit

HOK Project #12.10011.00

As Prepared By:

Hellmuth, Obata + Kassabaum

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GENERAL

1. Report -8 pages

2. Supplemental Drawings:

6 sheets (11"x17")

Existing floor plan - A001

Existing reflected ceiling plan - A002

Proposed schematic demolition floor plan - A003

Proposed schematic demolition reflected ceiling plan - A004

Proposed schematic equipment floor plan - A005

Vault section - A006

3. Exhibits

Exhibit A- Elekta's proposed test fit in room ABC1.1209, dated 05.07.12 - 2 pages

MEMO

To: Tom Branch
Senior Project Manager
The University of Texas MD Anderson
Cancer Center
Patient Care and Prevention Facilities

Date: June 13, 2012

From: Richard Leyendecker, AIA
Vice President
HOK

Copies To: Paula Gaviria, HOK
Muhammad Cheema, WPM
Margaret Stever, E&C

Client: The University of Texas MD Anderson
Cancer Center

Project: Test Fit for MRI Linac on ACB 1.1209

Project #: 12.10011.00

Notes:

Tom,

Per the proposal submitted on May 8, 2012, HOK is pleased to submit Phase 2 of the Feasibility study, for your review.

Phase 2 of the Feasibility study completes the test fit and assessment of the MEP and Structural infrastructure study to determine if a new Elekta Linac/Philips MRI combination machine can be placed in an existing concrete shell vault room in ACB1.1209. This study is based on responses provided by Elekta to the Phase 1 report submitted on 03.20.12.

Project Scope:

The primary goal is to provide a feasibility study evaluating the ability of the existing room, ACB 1.1209, to accommodate a new Elekta Linac/Philips MRI combination machine. The space is an existing concrete vault, originally design to receive a Linear Accelerator machine which is currently a shell space.

Existing Conditions:

The existing conditions of Room 1.1209 were reviewed during a site visit on June 4th, 2012. Field measurements were taken, confirming clear dimensions in the room; current location of existing lead brick shielding and steel plates in the room, (used as supplemental radiation shielding), existing equipment pit slab depression, and the proposed pathway for the machine delivery.

See attachments A001 and A002 for this information.

ATTACHMENT I

Test Fit:

To help determine if the existing space is able to accommodate the combination MRI-Linac, the following information was referenced:

- The existing conditions w/respect to Architectural, Structural and MEP systems.
- MRL Draft planning guide –Version 0.8 from Elekta, dated 20 February 2012.
- Standard referenced drawings from Philips for the MRI-Ingenia 1.5T
- MRL Draft planning guide – Version 0.9 from Elekta, dated 29 February 2012.
- Responses from Elekta, dated 04.17.12, to Phase 1 report, dated 03.20.12.
- Responses from Elekta dated 05.07.12, to comments from HOK and WPM, dated 04.22.12

Findings:

Architectural

- Equipment delivery path:
 - a. Due to the size of the opening required to deliver the MRI magnet (8.2 ft. wide x 8.2 ft. tall), the existing window and a section of the existing exterior wall, will require removal and reinstallation. This will require removal of some of the existing exterior stone cladding and reinstallation to allow for future magnet removal.
 - b. The existing lay-in ceiling, grid and lighting fixtures adjacent to this opening, will need to be temporarily removed as indicated on the section in attachment A004, to allow for the clear height requirements along the pathway.
 - c. The existing door opening for the vault is 4'-2" wide, which is not wide enough to allow the magnet to be brought directly into the room. A new opening of approx. 8.2 ft. wide x 8.2 ft. tall is required in the east wall of the existing vault room. An 8'-3" wide clear corridor leading to this opening is required. In order to accomplish these items, the following is required:
 - 1. The existing Office 1.1201 needs to be removed and relocated. New location to be determined.
 - 2. The existing work engineering 1.1205 needs to be relocated. A new location to be determined. This involves relocating equipment, a work bench and high density shelving.
 - 3. The existing east concrete vault wall will require partial demolition to provide a new opening for installation of the LINAC.
 - 4. The existing steel plate and lead bricks inside the vault along the east wall will require removal and replacement once the machine has been placed in the room.
 - 5. Once the magnet is delivered into the room, the opening in the wall will need to be built back with a system that will allow for removal for future requirements. This system will require ease of installation, allow for future removal and will need to provide the required level of radiation shielding for the room.

ATTACHMENT I

- Space Requirements:
 - a. Overall dimensions of the vault room are adequate for equipment MR-Linac combination, allowing for normal clinical functionality.
 - b. A Control room is proposed to be located in the existing room 1.1211, designed originally to be the control room for the Linac vault. This room will require new cabinetry, equipment, and any additional MEP requirements.
 - c. A Technical room, use primarily as the MRI equipment room will need to be provided. Based on the existing space available, this room is proposed to be located east of the existing vault at the north end of the building. This room is proposed to be approximately 193 s.f. and will be required to accommodate all of the typical equipment for the MRI, including some computers for the Linear accelerator. Please note that connectivity between the equipment room and vault room may be required and will require additional input from equipment vendors, for sleeve locations and coring thru existing concrete vault wall which will impact shielding.
- Vault 1.1209:
 - a. Based on the proposed layout of the equipment in the vault room, provided by Elekta, (refer to Exhibit A), the orientation of the Linac will be rotated 90 degrees, which will reposition the location of the primary beam in the room in the east/west direction, in lieu of the original north/south orientation. Physicist input is required to address the radiation shielding requirements because of this repositioning. Some repositioning or additional lead brick shielding may be required.
 - b. Per Elekta's equipment layout the required thickness of the concrete walls based on an 8MV machine differ from the thickness of the existing concrete walls. A Physicist input is required to determine if the quantity of lead bricks in the walls is adequate to supplement the concrete vault walls.
 - c. The use of steel plates to hold the existing lead bricks will require additional study with respect to proximity and compatibility with MRI magnet. A different support system may be required.
 - d. The new MR-Linac requires a minimum pit depth of 3.2 ft. In order to meet this requirement, the existing 13" topping slab will need to be removed and a new topping slab placed over the existing 43" slab. This will result in a raised finished floor elevation of 2'-2". The difference in floor elevation will need to be addressed at the new opening of the maze wall of the room. (See item 2 below)
 - 1. Due to existing space constraints an ADA compliant ramp cannot be provided. (An ADA compliant ramp would require 26'-0" of ramp with a 5'-0" landing at the top and bottom of the ramp). As a result, a portable transfer wheelchair lift for patient/staff, and a non-compliant ramp for general access and patient transport in a stretcher is proposed, as indicated in attachment A005. - Please note that the use of the wheelchair transfer lift will require a variance approval from TDLR.
 - 2. Because the machine is introduced on the finished floor level at a different elevation than the floor level in the vault room, a fixed crane or other method of

ATTACHMENT I

lifting the machine will need to be provided on the east side of the removable opening in the east concrete wall to lift/raise the equipment 2'-2" to the same level as that of the vault floor.

3. The required height clearance of 13.1 ft. in the vault will still be met, raising the floor 2'-2", allowing for a clearance of 16'-1" from finish floor to underside of the existing concrete slab above.
- e. The existing slab depression for the equipment pit will need to be filled-in since the location of the new pit will be relocated more towards the north end of the room, as indicated on attachment A005. The new Isocenter will be located at 10'-10" from gridline A, as opposed to 13'-1" for the original machine, and at 6'-3" from gridline 13, as opposed to 8'-10" for the original machine.
- f. A new gyp. board furred wall will be provided over the existing vault walls, to cover the concrete and the lead bricks. This wall will be used as the parent wall for the R/F enclosure as required for the MRI. Refer to attachment A005, for layout of the R/F enclosure. A removable portion of the R/F enclosure needs to be provided at location of removable wall for magnet removal.
- g. New R/F doors to be provided at entry of R/F enclosure and at any other location in the R/F enclosure as indicated for service access.
- h. Storage cabinetry for the room will need to be determined/verified. Lower and upper cabinets will need to be provided inside the room, as indicated in attachment A005. Additional storage space for immobilization devices could be accommodated in space east of the access corridor, as indicated in the schematic layout.
- i. As stated above, a Physicist's investigation/report of the existing shielding is required for compliance of the new machine shielding requirements. This is vital to determining the ability of the existing vault/shielding to be able to be modified/supplemented to meet those requirements. Following this is the ability to access the new floor level in the vault for ADA compliant and non-compliant access and access into the room floor level from the main building access floor level.

E&C Engineers & Consultants Inc.

MEP Analysis:

Mechanical Systems

- Remove existing 12" round exhaust serving existing Work Engineering 1.1205. Exhaust shall be removed back to Level 3.
- Temperature set point within vault shall be designed for 70 deg F at 50% relative humidity.
- Balance existing Double Duct terminal unit to 1,700 CFM and sequence it so that supply air temperature is not below 60 deg F (or 10 degrees below room set point).
- 3,000 CFM chilled water air handling unit shall provide supplemental cooling to Vault. Unit shall be ducted for supply and return air. Proposed location for unit is above the ceiling in the Corridor East of the Vault. AHU shall be sequenced so that supply air temperature is not below 60 deg F (or 10 degrees below room set point).

ATTACHMENT I

- New openings on East end on Vault will be required for the new AHU ductwork. Supply duct will be approximately 24x20 and return approximately 32x24.
- New Computer Room Air Conditioning Unit shall be provided in Technical Room 1.1207 for supplemental cooling.
- Chilled water supply/return shall be routed from Level 3 to serve the new AHU, new Computer Room Air Conditioning Unit in Technical Room, and the new MRI equipment requiring chilled water cooling. Piping shall hot tap the existing 10" CHS/R near column 9-C and be routed down the adjacent chase to Level 1.
- Existing closed loop process chilled water routed to Vault is adequate to serve new Linear Accelerator.
- Existing HVAC equipment serving Proposed Control Room is adequate.
- Helium quench pipe shall be routed East and terminate out East wall of building.
- All building automation system controls shall be an extension of the existing BAS within the facility

Electrical Systems

- All conduit and junction boxes with-in the MRI shall be routed in non-ferrous conduit and shall be non-ferrous boxes.
- Route all electrical cabling for the MRI through the system filter box.
- Install a 60A/3P, 208/120V, 30 Circuit panel in the control room to serve the low voltage equipment with-in the vault and the control room, feed from a new 60A/3P breaker mounted in distribution panel LA.DPL2, located in ACB1.1334
- Power to the cryogenic pump will be served from a spare 20A/1P breaker in emergency power panel 1N.EEL located in ACB1.1791.
- Provide power to the MRI MDU cabinet from a new 100A/3P circuit breaker in panel 1N.DPN2 located in ACB1.1334. Extend the circuiting to the MDU cabinet location; provide a 100A/3P non-fused disconnect switch with-in sight of the cabinet.
- Provide power to the MRI Chiller from an existing spare 60A/3P circuit breaker in 1N.DPN2, located in ACB1.1334. Extend the circuiting to the chiller location; provide a 60A/3P non-fused disconnect with-in sight of the chiller location.
- Provide power to the Elekta Generator from a new 50A/3P circuit breaker in panel 1N.DPN2 located in ACB1.1334. Extend the circuiting to the Elekta Generator location; provide a 60A/3P non-fused disconnect switch with-in sight of the generator cabinet.
- Provide quartz halogen lighting with-in the MRI Cage. Provide a quartz halogen spotlight above the patient with a separate switch specifically for doctor intervention.
- Provide an incandescent service light with switch above the ceiling.
- Route cabling to the linear accelerator through existing trench and existing conduit with-in the trench, coordinate with Philips. These conduits may need to be changed to non-ferrous, additional input from the Physicist is required.
- Lighting in the control room will be MDA dimmable fluorescent down lights.
- Lighting in the equipment area of the vault will be from MDA standard linear fluorescent fixtures.

ATTACHMENT I

Plumbing Systems

- Extend the existing gases to the face of the wall; provide new gas outlets to match MDA standards.
- Provide plumbing to the sink located in the vault using non-ferrous piping materials.

Walter P. Moore

Structural Analysis:

A. Purpose of study

- The purpose of this study was to confirm if the existing vault was structurally acceptable for new proposed Elekta MR Linear Accelerator. The feasibility study is complete and it is determined that the existing vault is adequate for the new equipment. A brief summary of the study is described below.

B. Existing Structure

- The existing vault is located at level 1 (elevation 50.00) on the north east corner of Mays Clinic (formally ACB). The vault is located south of gridline A and between gridlines 12 and 13.7. Refer to architectural sheet A001 for existing conditions.
- The existing structural system of level 1 consists of cast in place 43" thick concrete slab supported by concrete columns. The walls around the perimeter of this vault are cast in place normal weight concrete walls designed for shielding the linear accelerator at the time building was designed in 2000.
- In addition to the thicker concrete walls, the lead bricks were also used on the face of the walls at several locations to increase the effectiveness of the wall against shielding. The lead bricks were held in place by using steel framing which was attached to the wall. Refer to architectural sheet A001.
- The concrete walls are supported on level 1 and laterally braced at level 2. Those walls are non-load bearing and do not support any floor loading from level 2.
- The existing level 1 slab was depressed 13" inside the vaults and was poured back with topping slab. The purpose of this depression was to give contractor the flexibility of locating the equipment at the correct location when equipment comes to the site.
- Under the equipment inside the vault, there was a 13" depression inside the 43" structural slab. The depression was filled with lead bricks and concrete topping to increase the shielding capacity as required by the equipment supplier and the owner's shielding consultant.

ATTACHMENT I

- The roof over the existing vault consists of 51" thick normal weight concrete slab. This slab had also depressions at level 2 which were filled with lead bricks as well as concrete topping to increase the shielding properties over the equipment.

C. Structural Capacity

- The existing structure inside the vault area was designed for a live load of 325 psf in addition to the self-weight of the structure, concrete walls, lead bricks and the topping slabs. The existing structure is adequate for the new loading.

D. Transportation Path

- The structural slab north of the gridline C and south of vaults was designed for the equipment transportation loads and will be adequate for the new equipment.

E. Control Room

- The new control room is located south of the vault and is indicated on the architectural sheet A005 and is numbered as 1.1211.
- The existing structure is adequate for the loading inside the control room.

F. New Opening thru Existing Concrete Wall

- A new 8 feet wide opening is needed thru the existing east wall for the transportation of the equipment to the vault. Refer to architectural sheet A003 for the location of the opening.

G. Conclusions and Recommendations

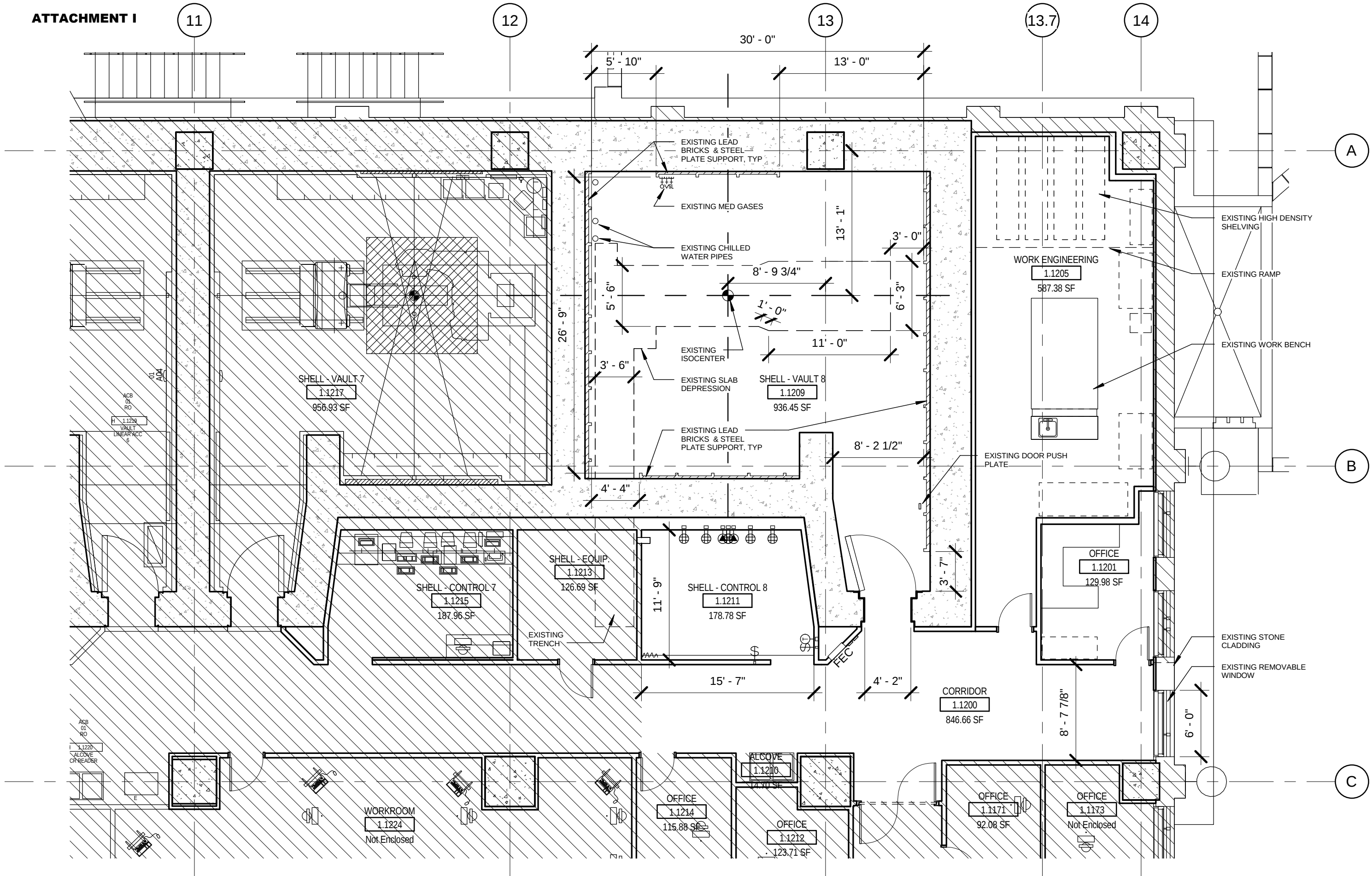
- The existing structure is adequate for the new equipment loading.
- The new equipment required a pit which is 39" (about 1.0 meter) deep.
- The magnet specs also indicate that no reinforcement is desired within 39" of the center of the magnet.
- It is not structurally desirable to cut into the existing structural slab of level 1. Therefore it is proposed that the magnet is placed on raised flooring. It is anticipated that the floor will be raised 26" above finish level 1. This will make it possible to create a 39" deep pit after removing the existing 13" topping under the magnet without jeopardizing the structural integrity of the level 1 slab.
- The new opening thru the existing wall will not be a structural issue because the existing wall is not a load bearing wall. However a suitable solution should be determined to fill in the hole after equipment is in place and that solution should provide:
 - a. The Shielding requirements of the equipment

ATTACHMENT I

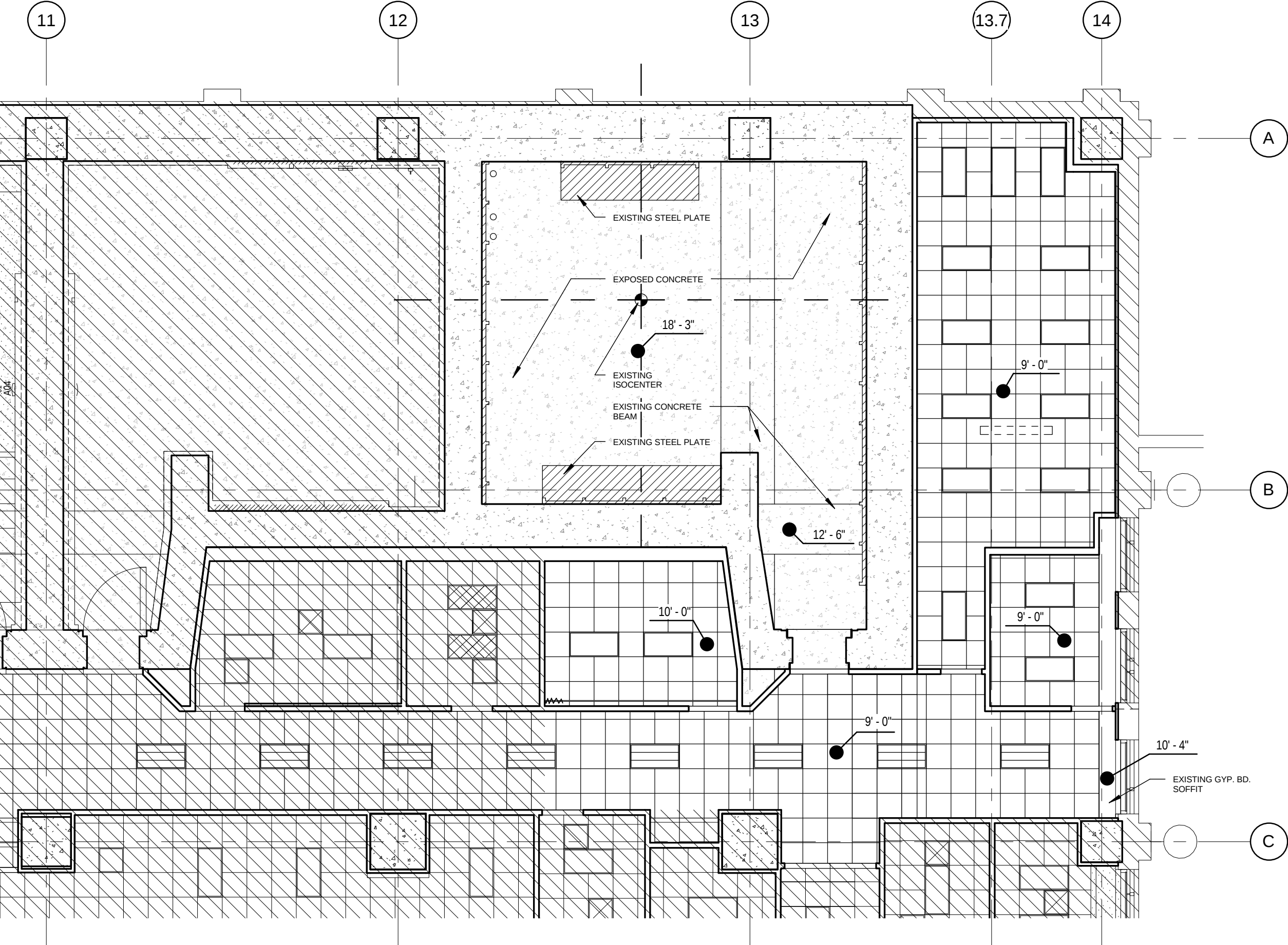
- b. Flexibility of opening and closing the hole in future
 - The existing floor depressions could be filled by using a combination of structural Styrofoam and the topping slab. However under the equipment, depressions will be filled with solid topping.
 - The existing lead bricks on the face of the walls may need to be relocated where additional shielding will be required.
 - The existing structure is adequate for the equipment transportation. No shoring below the floor will be required. However we recommend that the rigging contractor place something on the floor slab to avoid any damage to the slab during rigging operations.
 - The exterior curtain wall as well as precast/granite will be required to be removed and replaced after equipment is inside the building.

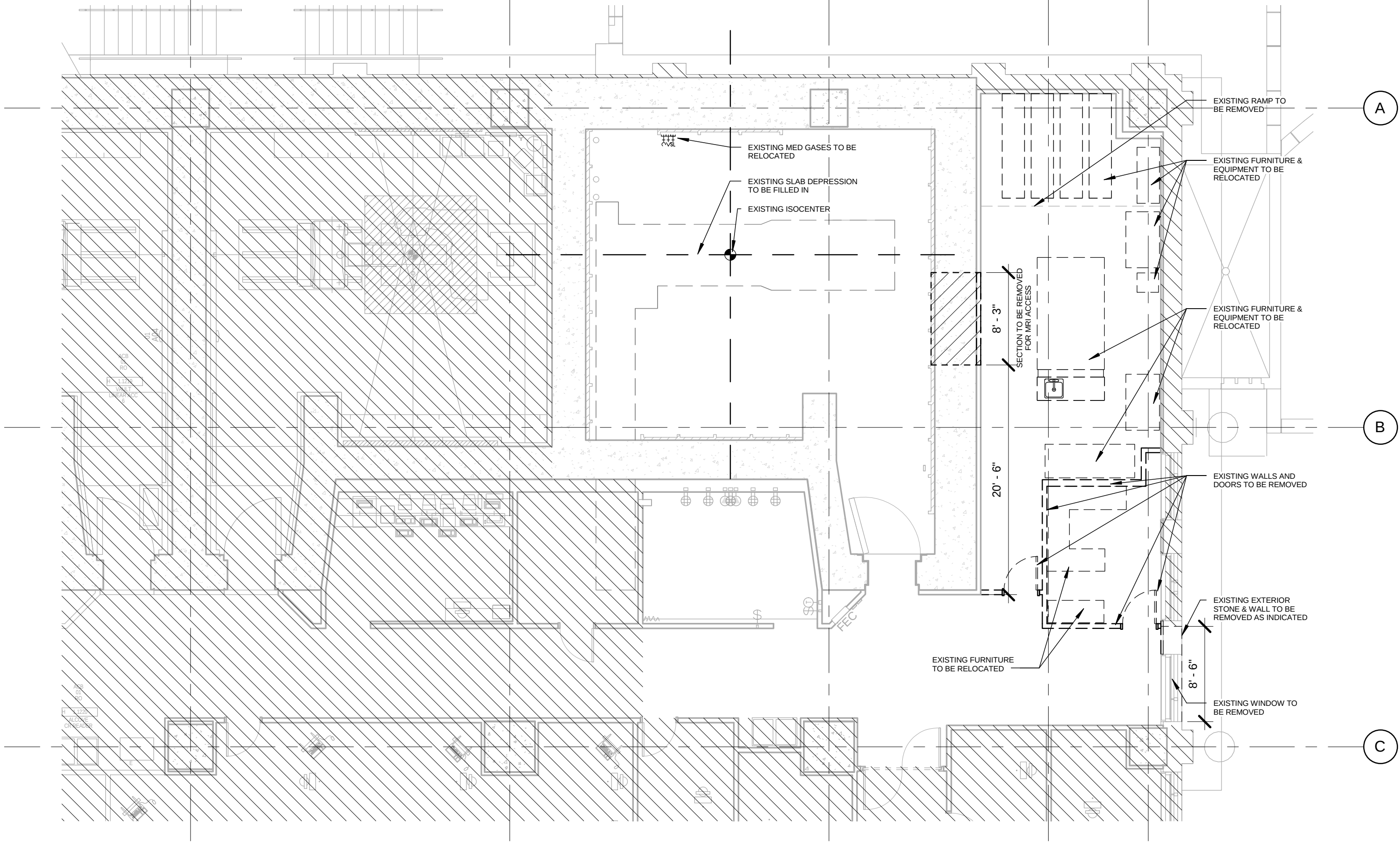
Next Steps

- Analysis of primary beam and shielding requirements by MDACC's Physicist.
- Review of equipment rigging by equipment vendors.

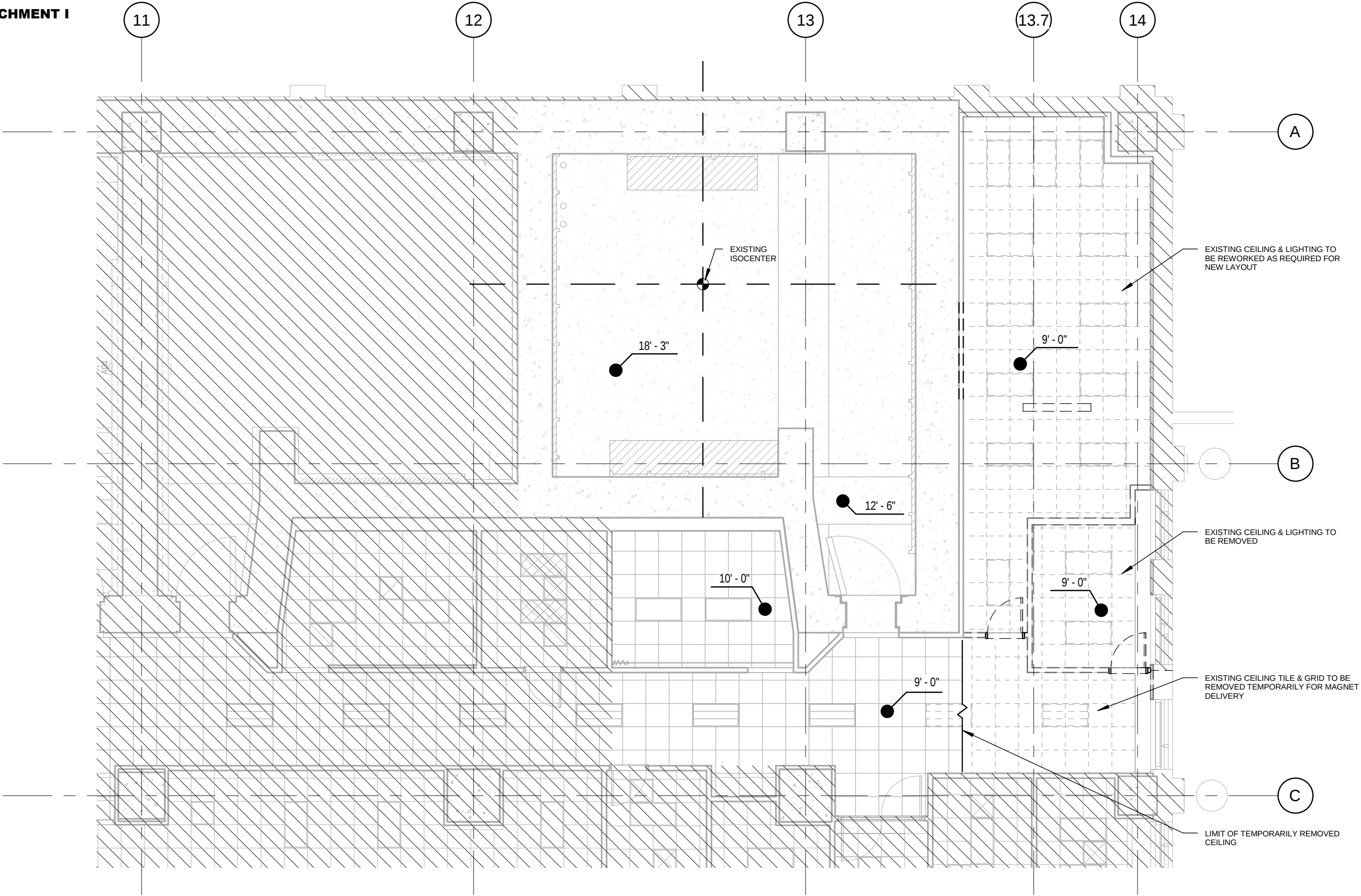


MR-LINAC at 1.1209 - Existing Floor Plan

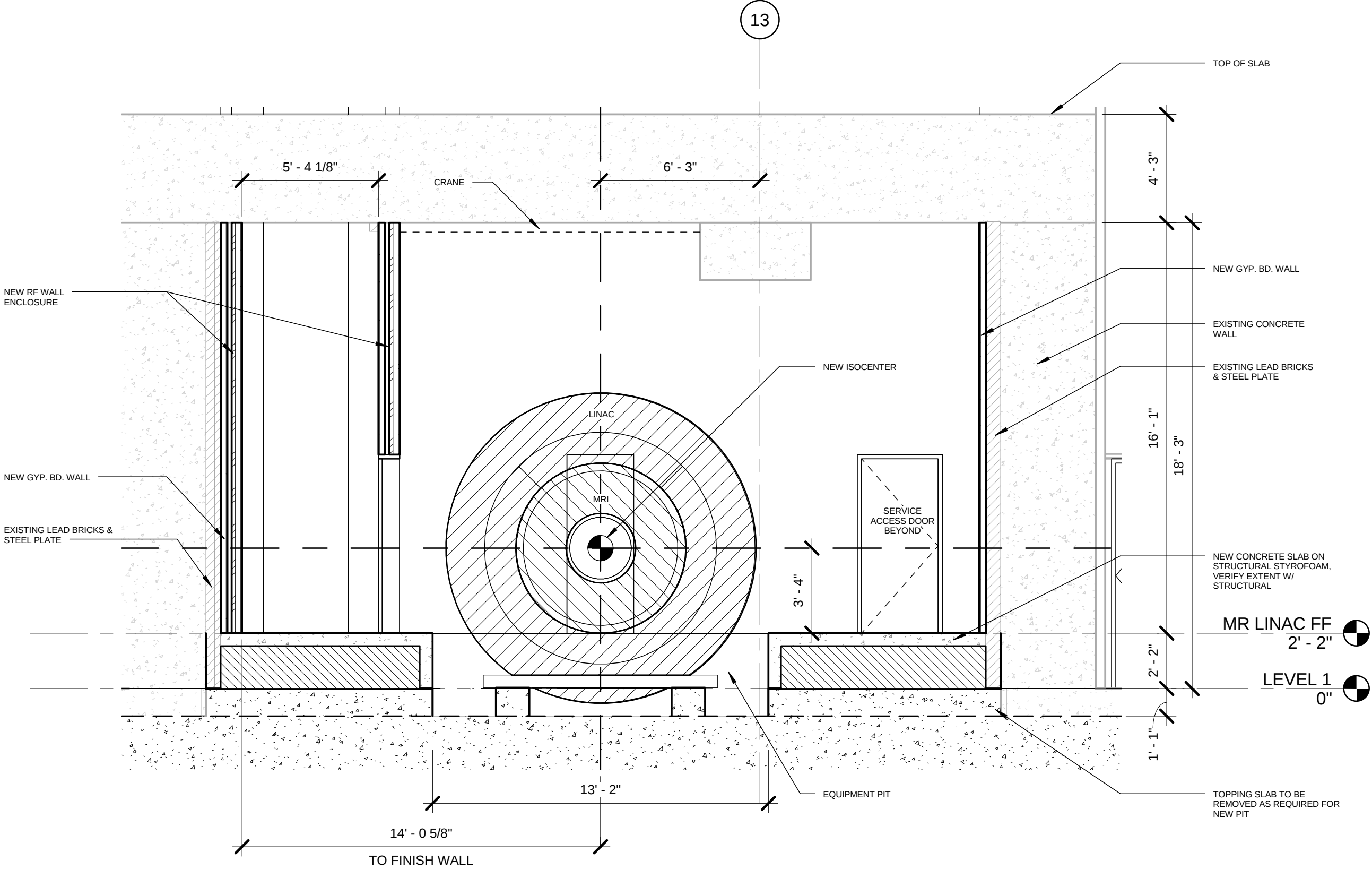




MR-LINAC at 1.1209 - Demolition Floor Plan





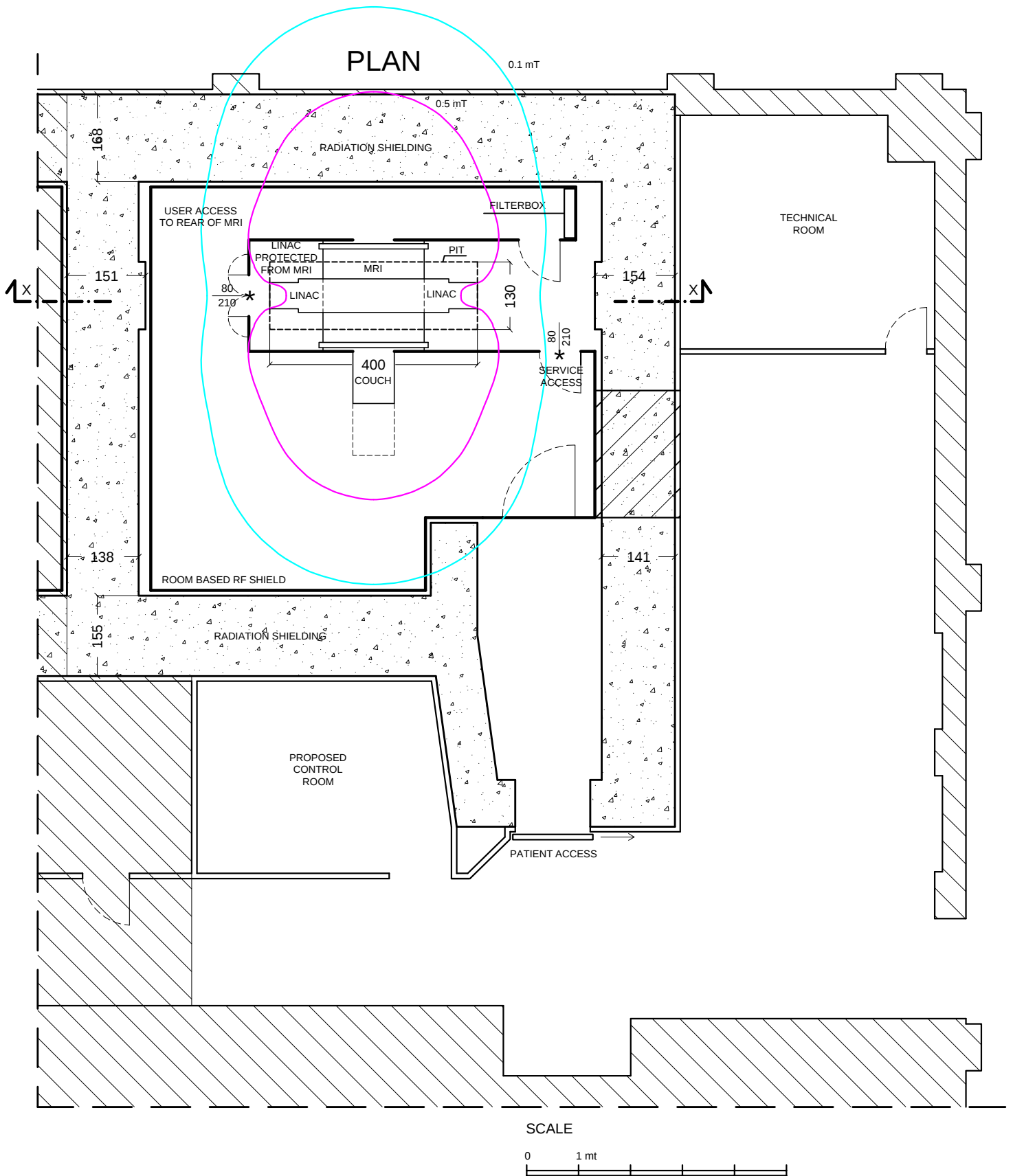


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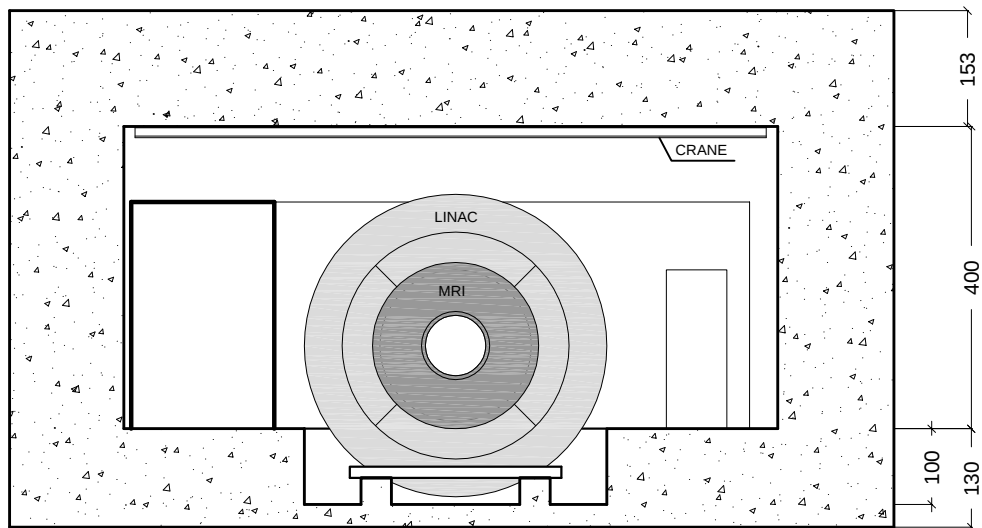
EXHIBIT A

ATTACHMENT I

PLAN



SECTION X-X



SCALE

