Shown below is a preliminary plan for the first floor of a new radiation therapy clinic, which is to be built adjacent to an existing hospital. The clinic is two stories tall; the second floor has the same footprint as the first floor, *except* that it does *not* extend over the linac vaults. The second floor contains administrative offices, physician and staff offices, conference rooms, and related functions.

The facility includes two accelerator vaults, a PET-CT suite, and a radiography unit in the special procedures room, all of which need shielding. Machine-specific parameters, estimated from utilization at a similar established facility, are provided below. Other than specifying the locations and maximum footprints of these areas, the architect has left it to the Qualified Expert to determine the room layouts and shielding requirements. (*In fact, if rearranging rooms on the first floor can lead to a "better" shielding design, then the architect is willing to consider it. However, any rearranged facility must be equivalent in terms of numbers/sizes of offices, work areas, etc.*) Also, the dashed lines on the plan show the approximate locations of the vault doors; specify the final door locations as part of the shielding design. Consult the chief physicist and architect for additional information or drawings, as deemed necessary.

Some specific design features are requested by the facility staff and the architect/contractor. Vaults will have 14 feet of interior floor-to-ceiling clearance, while all other facility areas are 10 feet in height; a drop ceiling will be located 20" below each ceiling, with ducts/conduits running above the drop ceiling. Per local codes, hallways should be a minimum of 8 feet wide; doors to vaults and imaging rooms must be 6 feet wide. The floor between 1st and 2nd stories is 8" light-weight concrete on 1/16" corrugated metal panels, but standard density concrete can be specified for localized areas. Cable chases can be located in floors or walls, or placed above the drop ceiling. A QA access port (3" diameter minimum) must be provided near the treatment console. Concrete vault walls will be covered by a false wall (4" deep) to accommodate light switches, electrical outlets, laser mounts, etc. Each vault and the PET/CT room must have sufficient space for cabinets along interior walls and a sink. Per code, a window must allow imaging system operators to view the patient at all times.

External to the facility, a sidewalk surrounds the building on three sides. Immediately adjacent to the north is the 4-story (60 feet) tall hospital building. East of the facility is a parking lot. West of the facility is a service drive and ambulance staging area; beyond this is undeveloped land reserved for future hospital expansion. South of the facility is a lawn with seating.

The Report Document (read this carefully! Also see the Grading Criteria document)

Your report must contain information necessary for an external reviewer (e.g., State regulatory agency) to assess your design. The report must be clearly organized and with no extraneous information, Specific components of your report include:

a) annotated drawings of the facility, showing expected total dose equivalents *from all sources at points throughout the facility*, as well as controlled designations and occupancy limits;
b) detail views of vaults and shielded rooms to document the shielding design (including barrier dimensions, placement and composition; and equipment siting); and
c) summary of equipment utilization and siting, design assumptions, and reference documents.

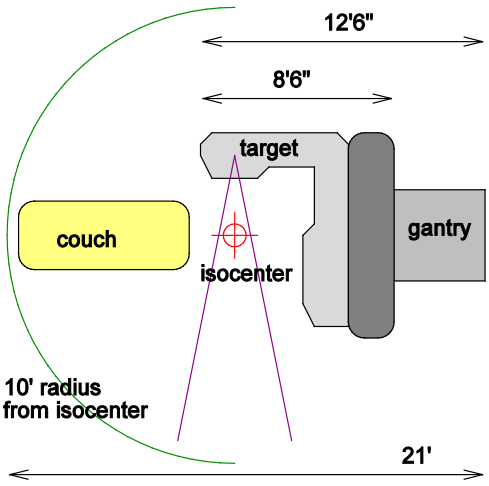
Your shielding calculations must be attached as an appendix, but are not part of the report itself.

Considering costs/budget is not a specific requirement of this project, but do not be wasteful! Reasonable conservative choices (to meet goals while minimizing materials and costs) are expected. Choices that require excessive time, money, or complexity without improving safety are not acceptable. *You should specify layout and supplemental shielding for ducts and large conduit/pipe; you don't need to show small conduit/pipe, electrical outlets, light switches, laser boxes, etc.*

Equipment parameters and maximum usage

1) *Varian 21EX (LINAC VAULT 1)
   - Delivers conventional and IMRT treatments
   - Conventional workload
     i. 100 Gy/wk @ 6 MV, 250 Gy/wk @ 18 MV
   - IMRT/VMAT workload, $C_{IMRT} = 4.5$
     i. 400 Gy/wk @ 6 MV only
   - IMRT/VMAT QA: 20 Gy/wk, $C_{IMRT} = 4.5$
   - Footprint as shown, w/ isocenter located 4'3" above floor
   - 1-m target-to-isocenter distance
   - Max. field size of 40x40-cm^2

Top view 1

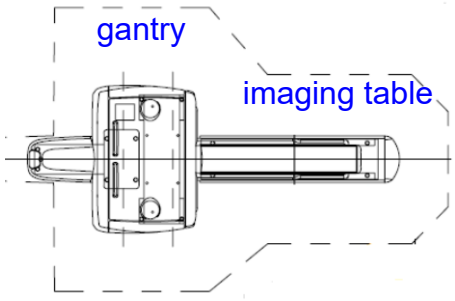


2) *Novalis Varian 600N (LINAC VAULT 2)
   - Delivers stereotactic radiotherapy (SRT) and stereotactic radiosurgery (SRS) treatments
   - SRT: 200 Gy/wk
   - SRS: 90 Gy/wk
   - 100% IMRT @ 6MV only, IMRT factor 4.5
     i. QA: 10% of workload, QA factor 4.5
   - Footprint as shown, w/ isocenter located 4'3" above floor
   - 1-m target-to-isocenter distance
   - Max. field size of 20x20-cm^2

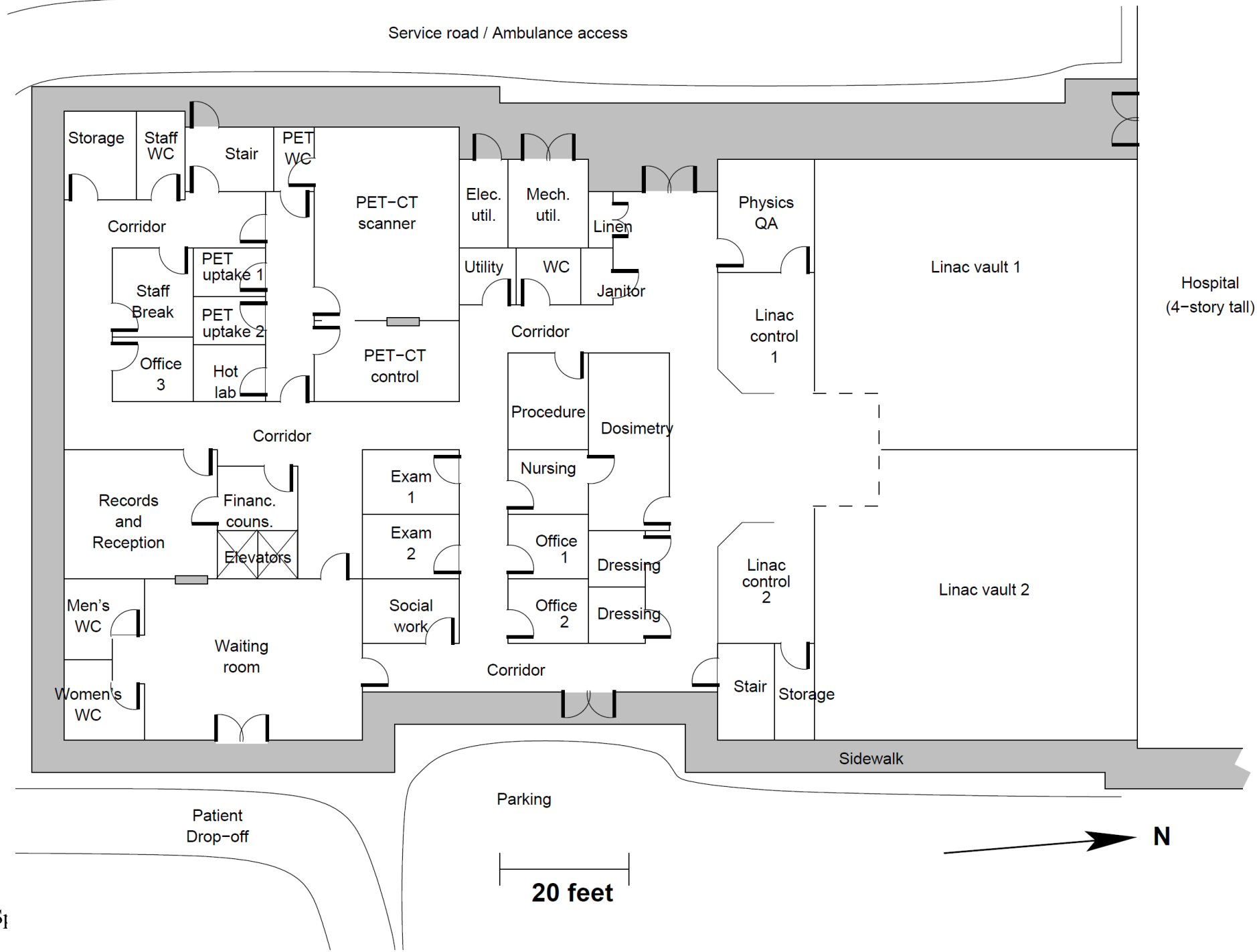
** Vault layout including door positions to be determined as part of shielding design*

3) PET/CT suite (PET-CT SCANNER and Uptake rooms)
   - GE Discovery ST, w/ Lightspeed 16 CT
   - 10 PET/CT scans per day
     i. 10 mCi F-18 FDG per patient
     ii. 60-min uptake, 25-min imaging
     iii. Two available uptake rooms
     iv. Transmission body CT: 120 kV, p=1.2, 200 mAs
   - RTP CT scans per day
     i. Typical: 120 kV, 380 mAs max., 1 sec rotation
     ii. Scan types:
     5 head (p=0.9, L=20cm);
     8 body (p=0.9, L= 20cm);
     12 body (p=1.2, L=50cm)
   - Scanner footprint as shown (overall footprint: 20'x14')
     i. Gantry: 8' wide, 8' tall, 5' deep; gantry axis at 3.25' above floor
     ii. Imaging table: 30" wide; front: 8' max. extension, back: 3' max extension (from gantry faces)
     iii. Clearance on sides (~3') shown as dashed line in drawing
     iv. Alignment lasers identical to linac vaults

Top view 2



4) R&F room (PROCEDURE)
   - Table footprint is 30"x80" with minimum of 15" clearance around it
   - Wall bucky is 30" wide, extends 12" from wall, and requires 7' clearance in front
   - Anticipated usage:
     i. Radiography: 20 patients per week
     ii. Fluoroscopy: 10 patients per week


Service road / Ambulance access
Storage
Staff WC
Stair
PET WC
PET–CT scanner
Elec. util.
Mech. util.
Linen
Physics QA
Linac vault 1
Hospital (4–story tall)
Corridor
PET uptake 1
Staff Break
PET uptake 2
Office 3
Hot lab
PET–CT control
Utility
WC
Janitor
Corridor
Linac control 1
Procedure
Dosimetry
Corridor
Nursing
Exam 1
Records and Reception
Financ. couns.
Elevators
Exam 2
Office 1
Dressing
Linac control 2
Linac vault 2
Men's WC
Social work
Office 2
Dressing
Waiting room
Women's WC
Corridor
Stair
Storage
Sidewalk
Parking
Patient Drop–off
N
20 feet

SI