RADIATION SHIELDING DESIGN 2010

FROM CONCEPT ...TO... REALITY

WITHOUT THE MISTAKES

ACMP 2010
SAN ANTONIO, TEXAS – MAY 23, 2010
DANIEL G. HARRELL
SHIELDING CONSTRUCTION SOLUTIONS, INC.

RADIATION SHIELDING...

...DESIGN

...MANUFACTURE

...INSTALLATION

NSS
Nuclear Shielding Supplies & Service

Providing Radiation Shielding
For Over 50 Years
Medical Nuclear Power National Labs

SCS
Shielding Construction Solutions, Inc.

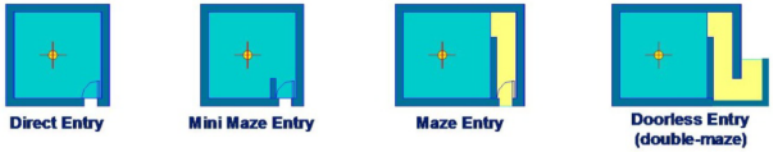
Flexible Shielding Solutions
& Turn Key Installation
For Radiation Shielding Projects.

We Can Help You

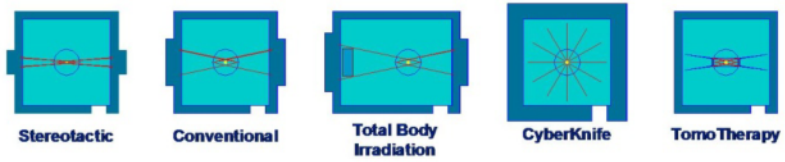
select the most efficient and cost effective shielding solution for your project

Your Choice...

Room Layout



Treatment Modality



Shielding Options, Cost & Impact

Our Solution...

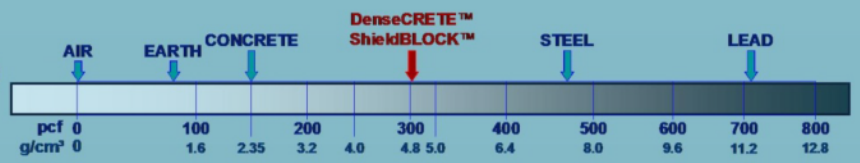
DenseCRETE™
High Density Concrete PIP
Twice the density in half the space to solve today's demanding space constraints

ShieldBLOCK™
High Density Modular Units
Factory quality with the flexibility to be installed in any configuration, anywhere at anytime

ShieldDOOR™
Radiation Shielding Door
Direct Entry Maze Entry Mini-Maze Entry
Sliding Door and Swing Type

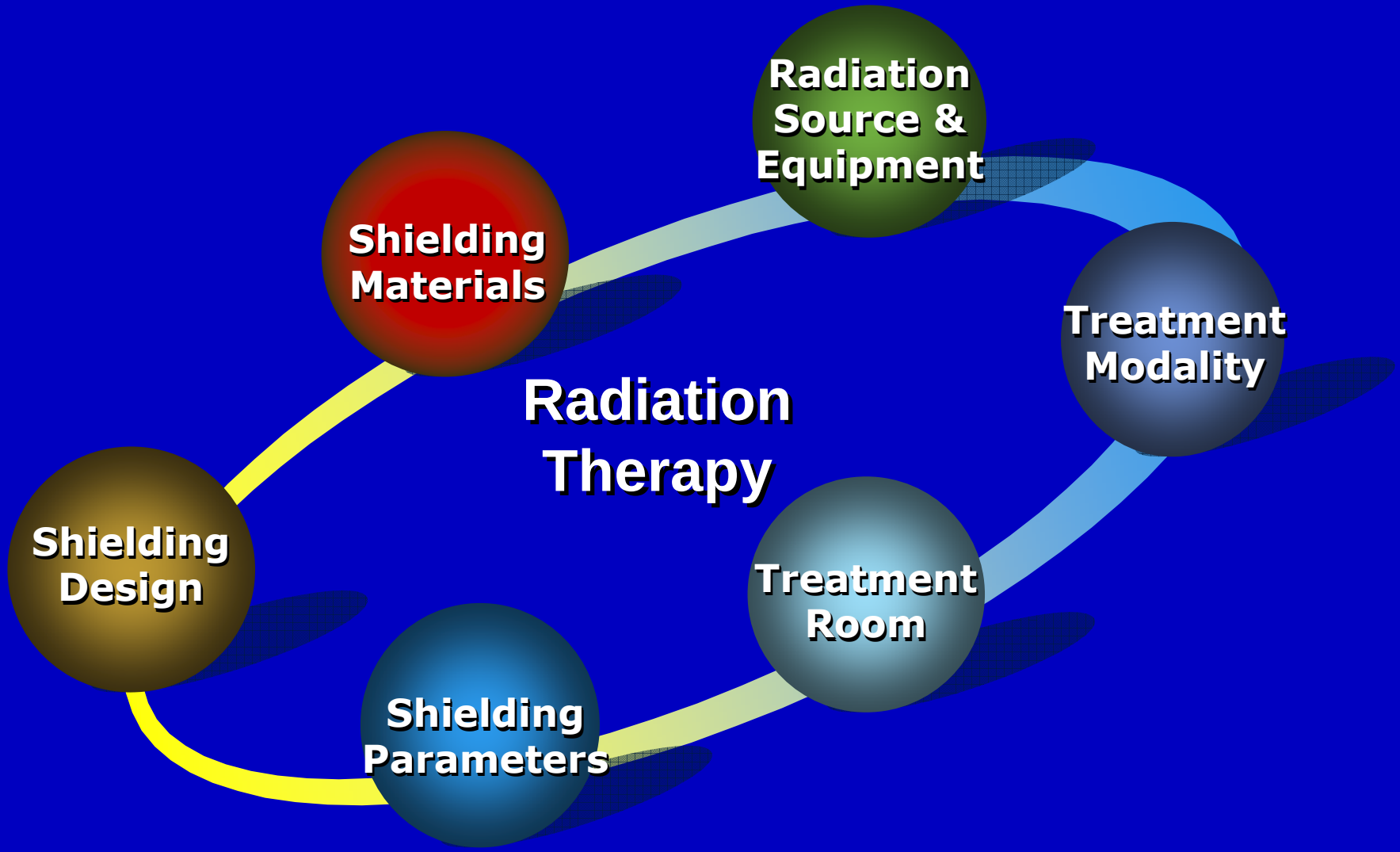
ShieldGROUT™
High Density Mortar & Grout
An equivalent density complement to ShieldBLOCK™ systems

Shielding Density



RADIATION SHIELDING
... Guaranteed for LIFE!

THE DESIGN PROCESS



COMMUNICATION

THE PLAYERS

1. The Client
   - Treatment Modality –Use and Cost
2. Equipment Vendor
   - Machine Energy - Space Requirements
3. Architect
   - Available Space - Entry type - Direct, Maze, Mini Maze, Door Free
4. Shielding Vendor
   - Material Options
5. Shielding Designer
   - Physicist of Record - Parameters – Applicable Codes

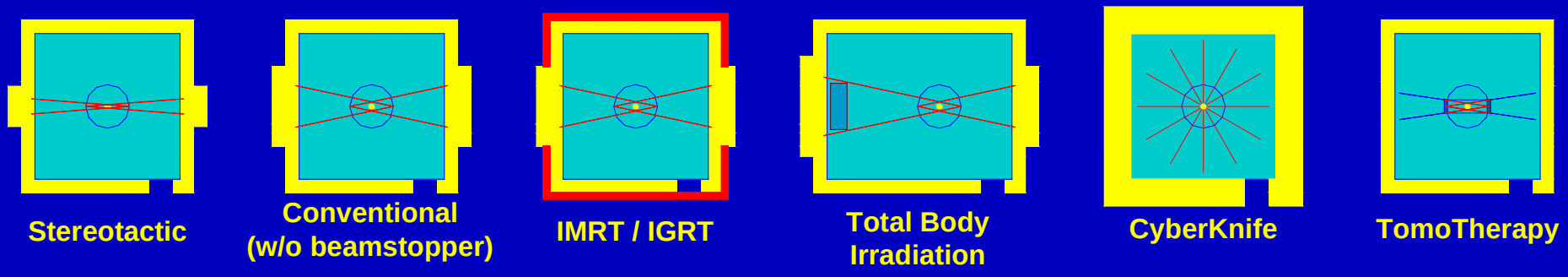
SHIELDING DESIGN

THE TREATMENT ROOM

1. Treatment Modality
   - Treatment Energy, Conventional, Stereotactic, TBI, IMRT, IGRT, etc
2. Components
   - Isocenter, Equipment, Primary and Secondary Barriers, Penetrations, Entry Type
3. Entry Types
   - Direct Entry, Maze Entry, Hybrid Mini Maze, Door Free Entry, Shield Door Type
4. Unique Conditions
   - Penetrations, Existing Shielding, Structural Obstructions, Access to Work Area
5. Shielding Parameters
   - Workload, Design Goal, Applicable Regulations, Adjacent Occupancies, Future

TREATMENT ROOM

TREATMENT MODALITY

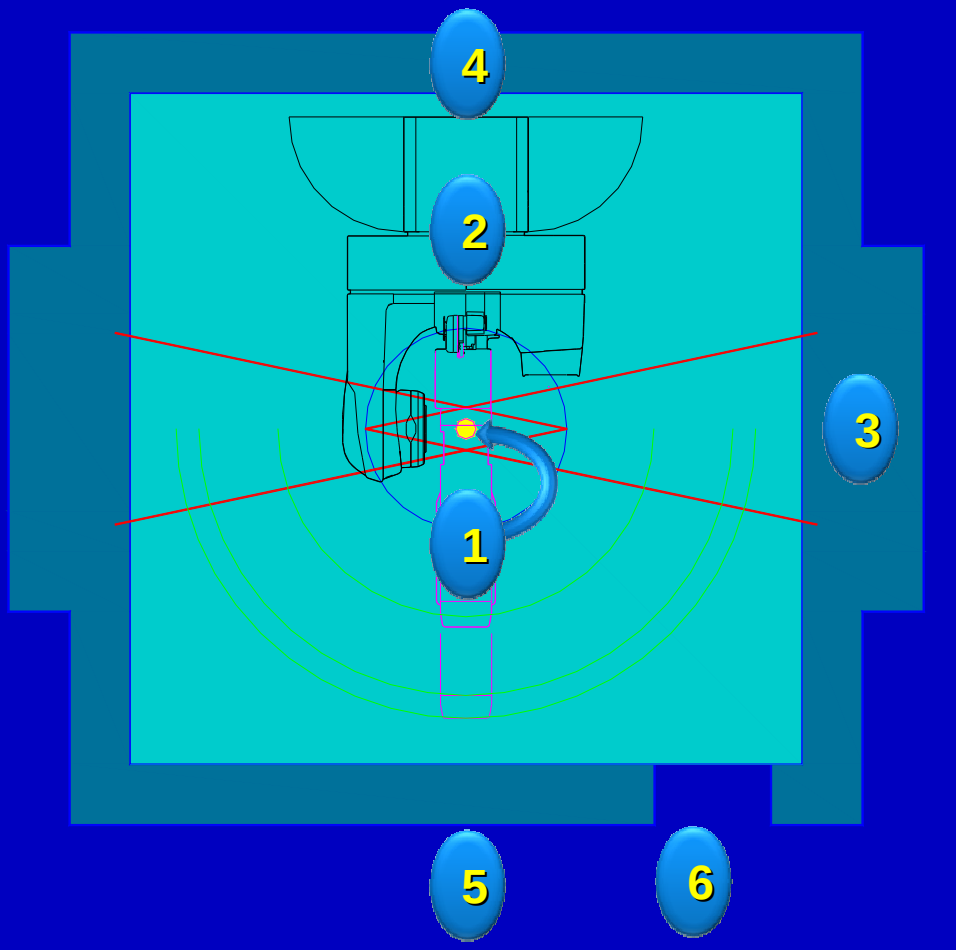


- Stereotactic
- Conventional
- IMRT / IGRT
- Total Body Irradiation
- CyberKnife
- Tomotherapy
- Brachytherapy (HDR)

TREATMENT ROOM

COMPONENTS

1. Isocenter
2. Equipment
   - (Manufacturer & Space)
3. Primary Barrier
   - (Direction & Width)
4. Secondary Barrier
5. Penetrations
   - (MEP, Door)
6. Entry Type
   - (Direct, Maze, Mini Maze, Doorless)

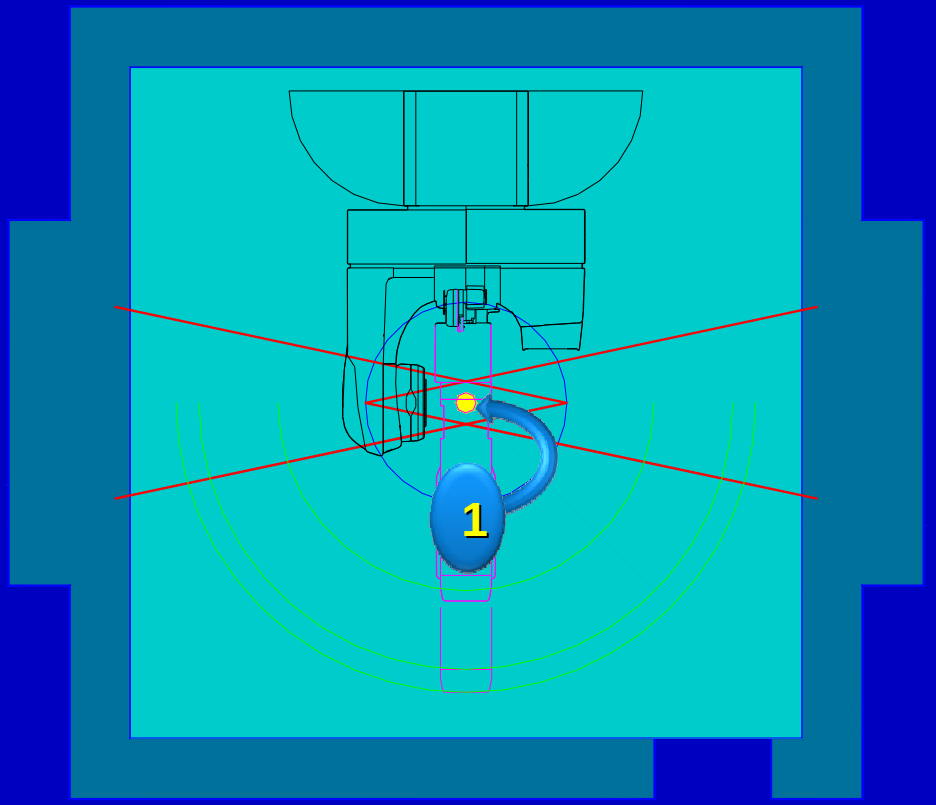


TREATMENT ROOM

COMPONENTS

1. Isocenter

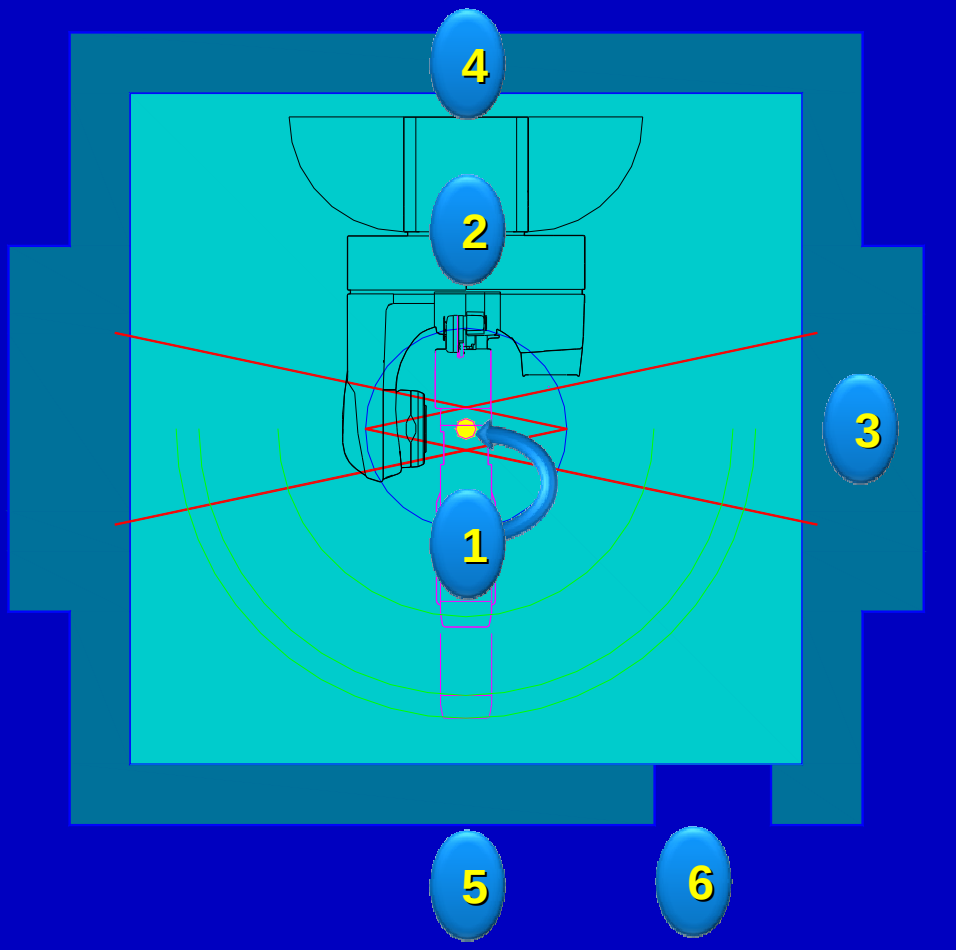
Graphic Image



TREATMENT ROOM

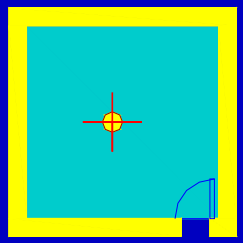
COMPONENTS

1. Isocenter
2. Equipment
   - (Manufacturer & Space)
3. Primary Barrier
   - (Direction & Width)
4. Secondary Barrier
5. Penetrations
   - (Dosimetry Passage, MEP, Door)
6. Entry Type - Layout
   - (Direct, Maze, Mini Maze, Doorless)

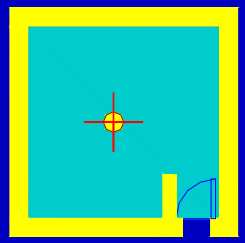


TREATMENT ROOM

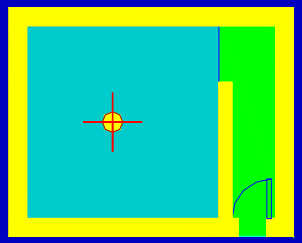
ENTRY TYPE AND LAYOUTS



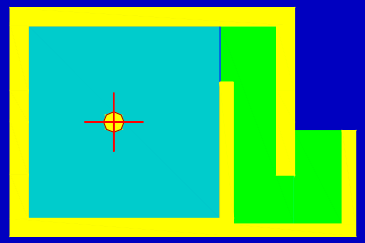
Direct Entry



Mini-Maze Entry



Maze Entry



Doorless Entry
(double-maze)

- Direct Entry
- Mini Maze Entry
- Maze Entry
- Doorless Entry
- Doors can be either Swing type or Sliding type

TREATMENT ROOM

DOOR TYPES

Sliding Door

Swing Door

TREATMENT ROOM

(OFTEN OVERLOOKED) UNIQUE CONDITIONS

1. Penetrations
   - Dosimetry Passage
   - Mechanical Openings
   - Entry way (DOOR or DOOR FREE)
   - Skylights
2. Existing Shielding
   - Concrete Density
3. Structural Obstructions
   - Columns & Beams
   - Existing Services (Communication, Gas, Electrical, etc)
4. Access, Delivery, Storage
   - Moving the material into place

TREATMENT ROOM UNIQUE CONDITIONS PENETRATIONS

1. Dosimetry Passage
   - Best Location
   - Oblique Angles
2. Mechanical Openings
   - Location
   - Shielding Around
3. Entry Way
   - Layout – protection
   - Door Opening – Head and Jambs
   - Safety devices - interlocks
4. Skylights
   - How and When
   - Adjacent Occupancies – and other Skylights

TREATMENT ROOM UNIQUE CONDITIONS PENETRATIONS

Graphic Image

TREATMENT ROOM UNIQUE CONDITIONS EXISTING SHIELDING

1. Existing Concrete
   - When was it placed?
   - What Density is it?
   - How to Verify
2. Earth Backed Walls
   - Which Walls have EARTH?
   - How high does it go?
3. Occupancy
   - Adjacent to the shielding walls
   - What about Beyond? Nearest full occupancy

TREATMENT ROOM UNIQUE CONDITIONS
EXISTING SHIELDING

Graphic Image

TREATMENT ROOM UNIQUE CONDITIONS
STRUCTURAL OBSTRUCTIONS

1. Columns
   - Where are they? What are they made of?
   - How do we shield around these?
2. Beams
   - Where are they? What are they made of?
   - How do we shield around these?
3. Communication or Electrical Services
   - Could require costly interruption and rerouting
   - Shielding around an existing service
4. Special (HIDDEN) Occupancies
   - Service Tunnels
   - Crawl Spaces

TREATMENT ROOM UNIQUE CONDITIONS

STRUCTURAL OBSTRUCTIONS

Graphic Image

TREATMENT ROOM UNIQUE CONDITIONS
ACCESS TO THE WORK AREA

1. Where is the Proposed Treatment Room?
   - All New construction with Full Access
   - Attached to the outside of an existing building
   - Trapped in a courtyard
   - Up on a Second Story
2. Material Delivery
   - PIP – Trucks, Conveyors, cranes
   - Modular – Pallets, Forklifts, Pallet Jacks
3. Storage
   - Fresh (Wet) Concrete can not be stored
   - Pre-Cast modular Shield Block can be stored
   - Weather Conditions – working in the COLD and WET

TREATMENT ROOM UNIQUE CONDITIONS

ACCESS TO THE WORK AREA

Graphic Image

SHIELDING RADIATION

1. Radiation Therapy → Radiation Shielding
   - We are treating patients with radiation therapy . . .
   - and we are protecting people with shielding . . .

2. The Sources Radiation & Equipment
   - Internal Radiation Therapy (Brachytherapy, LDR, HDR, Perm Implant)
   - External Beam Radiation Therapy
     - Linear (Cobalt, Gamma Knife)
     - Linear Accelerators (linacs)

       (Varian, Elekta, Siemens, TomoTherapy, Accuray CyberKnife, Novalis, etc.)
     - Circular Accelerators & Particle Therapy

       (Proton, Carbon, Cyclotron, Synchrotron)

SHIELDING PARAMETERS

1. How Much Radiation Shielding? . . . the TVL

The required amount of Radiation Shielding is a direct result of your calculations for TVL of attenuation based on:

- Source Energy and Quality (primary, leakage, scatter)
- Patient Workload
- Distance from Isocenter to the Adjacent Areas (point of survey)
- Occupancy (Time) of Adjacent Areas (control, office, parking, etc.)
- Permissible Exposure Levels (NCRP, state and local requirements)

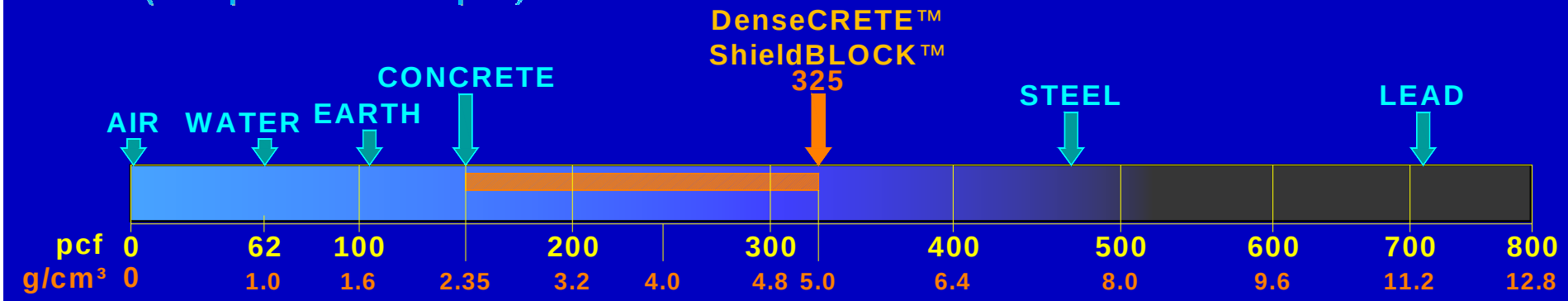
2. Selection of Radiation Shielding Material

- Best match to Satisfy the TVL requirement (space, cost, availability)
- Photons and/or Neutrons
- Future plans (upgrades, removability)

SHIELDING MATERIAL OPTIONS

DENSITY MATTERS

- Air (0.075 pcf)
- Earth (100 pcf)
- Concrete (147 pcf)
- Steel (480 pcf)
- Lead (710 pcf)
- High Density Concrete (PIP & Modular Shield Block) (145pcf to 325 pcf)



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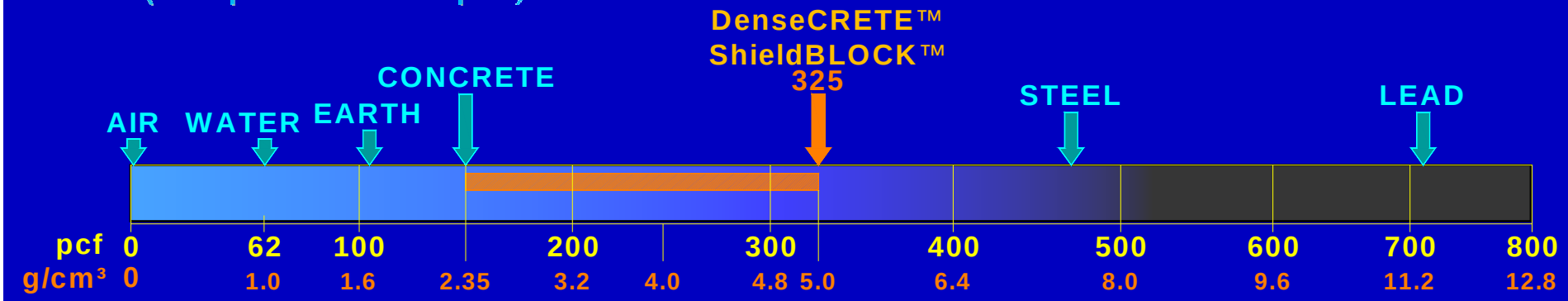
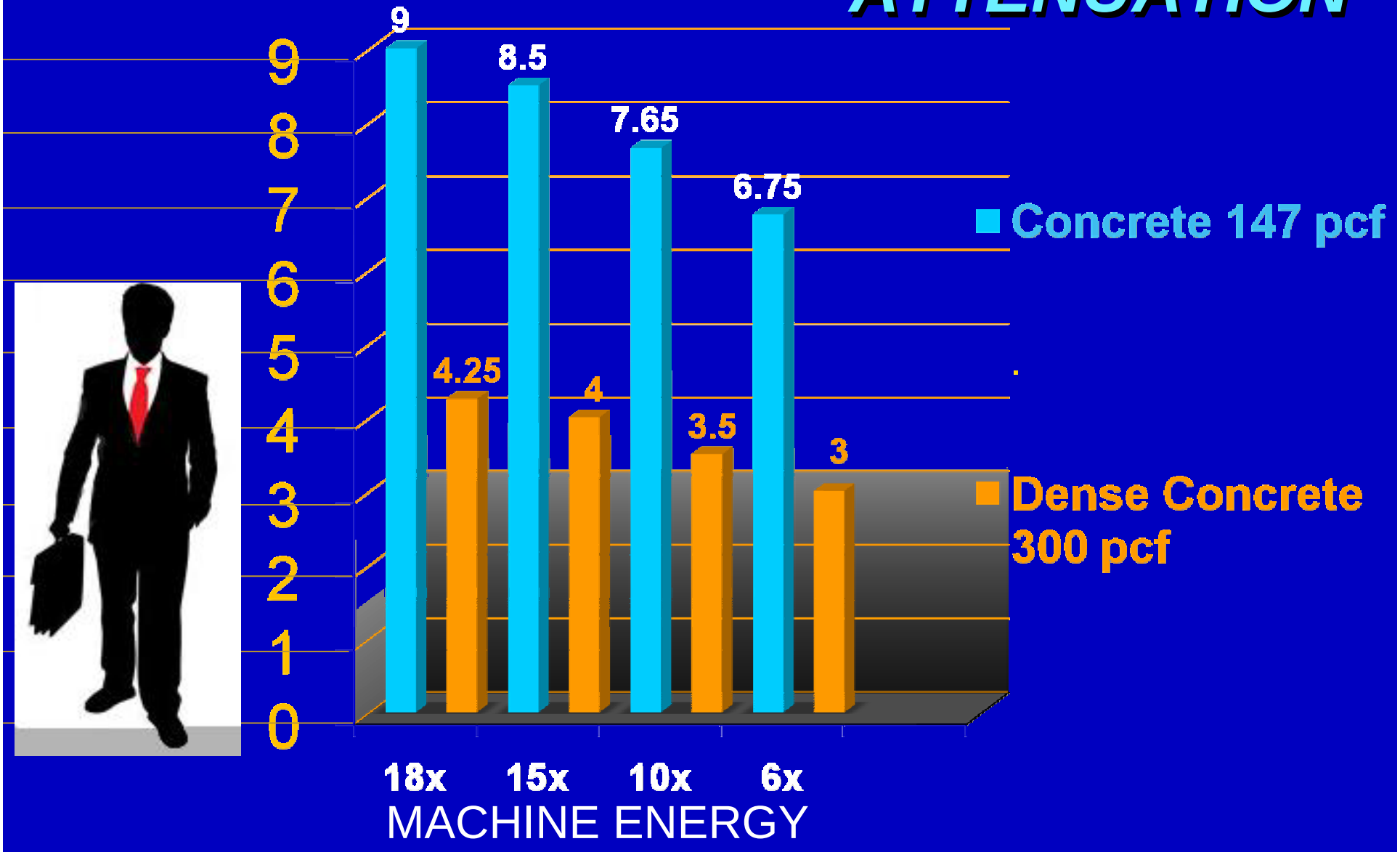


SHIELDING THICKNESS FOR 6TVL ATTENUATION



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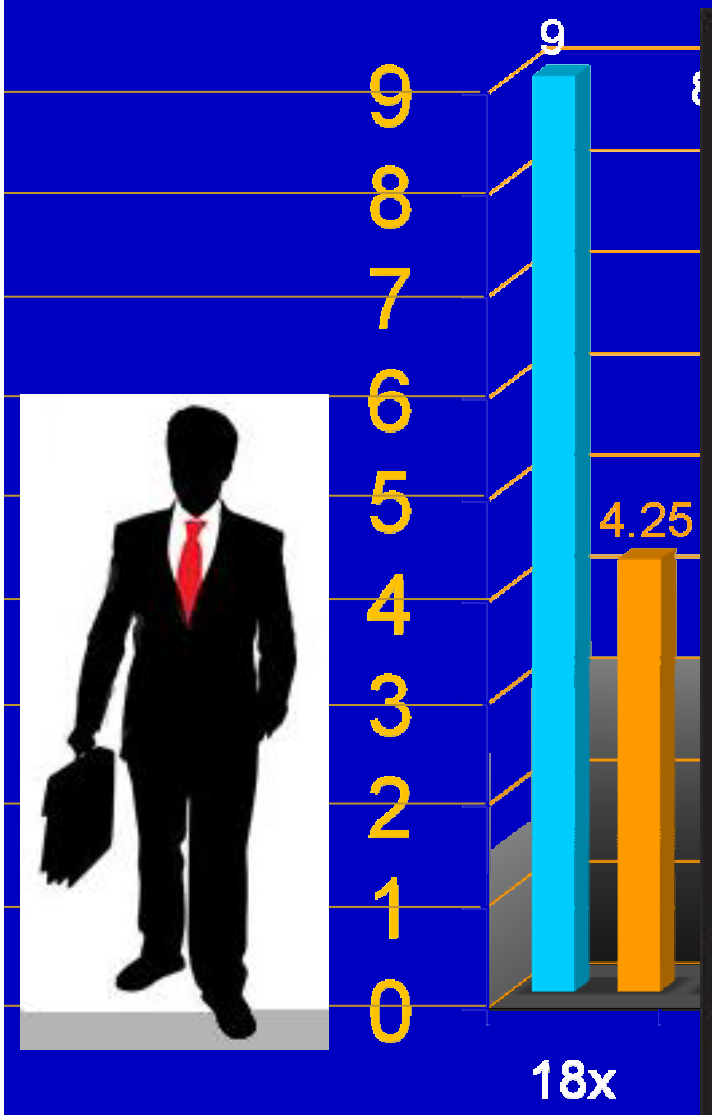

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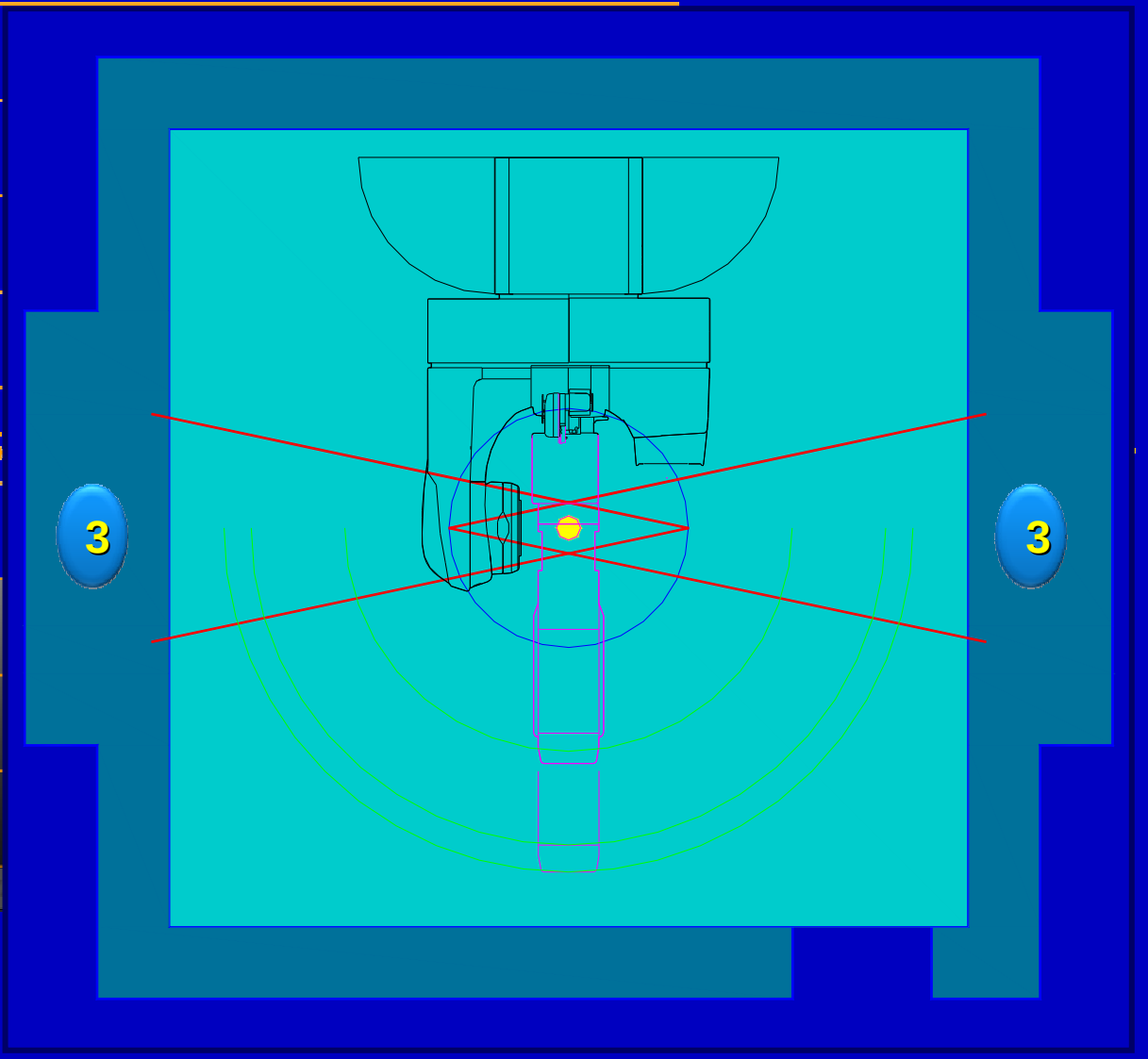

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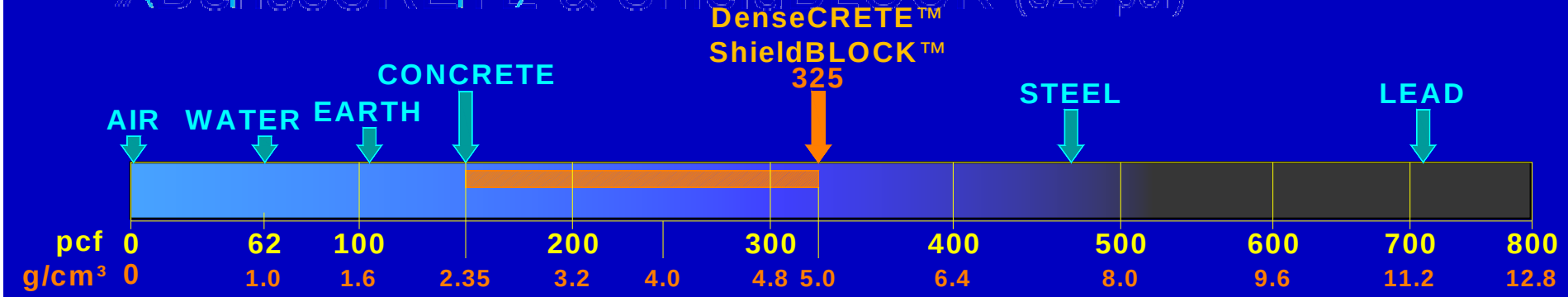
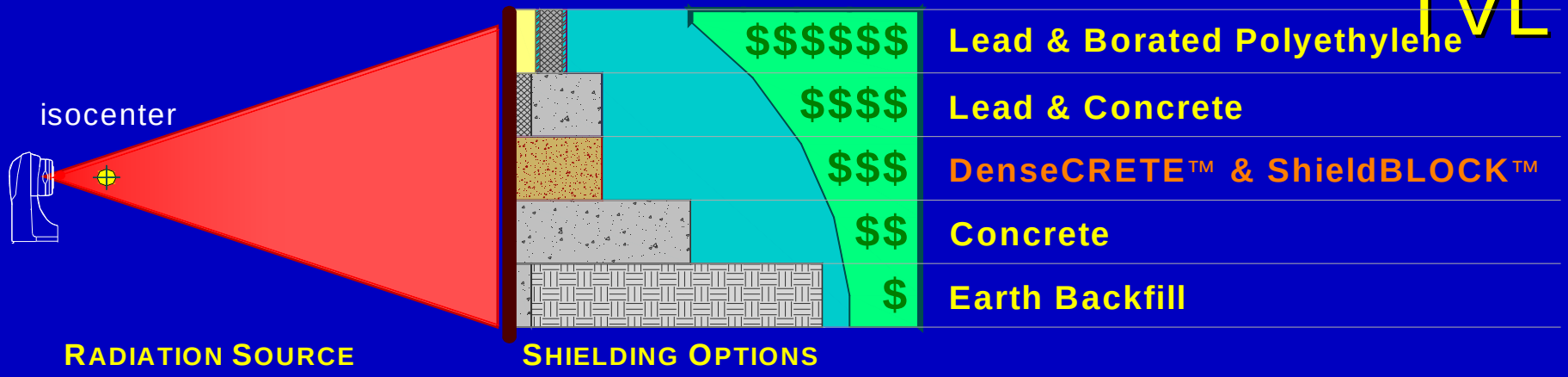


RADIATION SHIELDING

MATERIAL SELECTION : BEFORE THE TVL



- Required Shielding Attenuation [W & d = TVL]
- Each Material has its own TVL
- Twice the density means half the thickness
- Cost of Shielding Materials (Installed)

SHIELDING DESIGN WORKSHEETS

Material Data

- Densities
- Tenth Value Layers

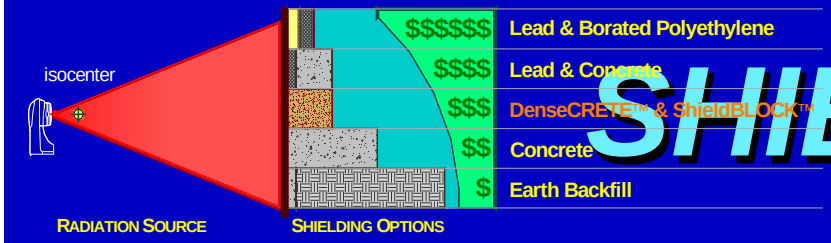
Design Sketches

- Parameters
- Distances

Worksheets

- Summary of Data
- TVL Requirements

Graphic Image



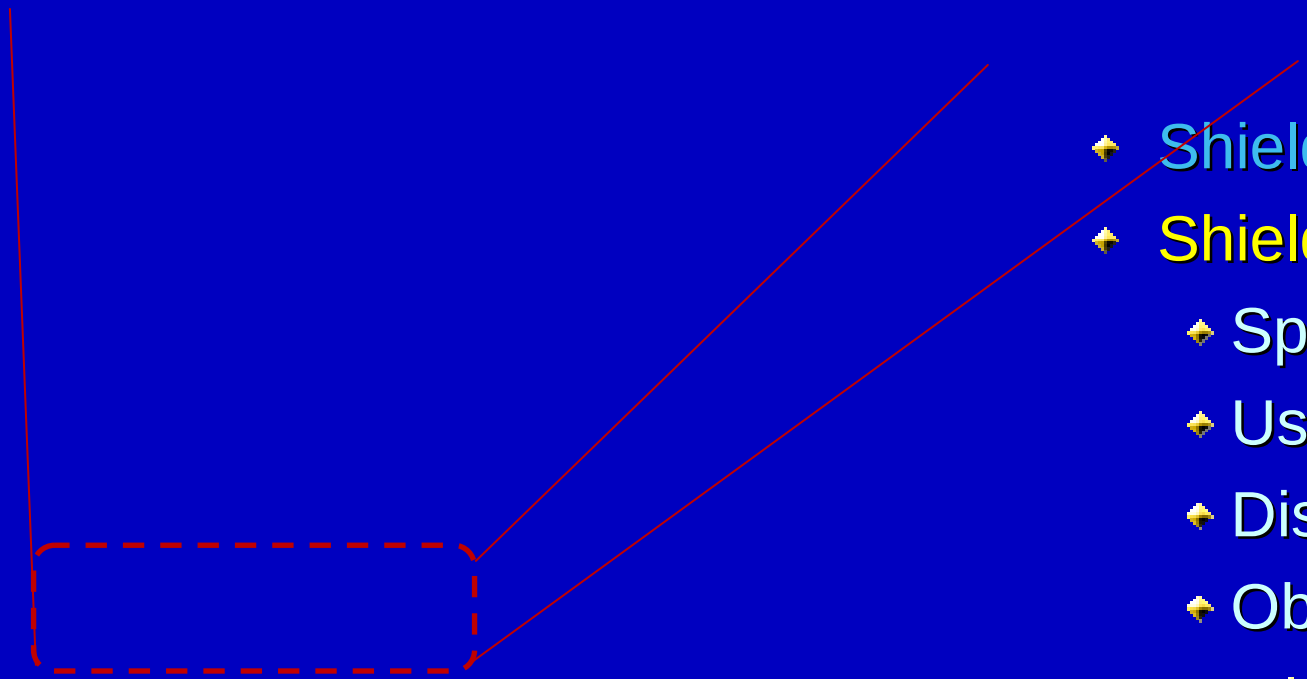
SHIELDING DESIGN

KNOW YOUR TVLS

Graphic Image

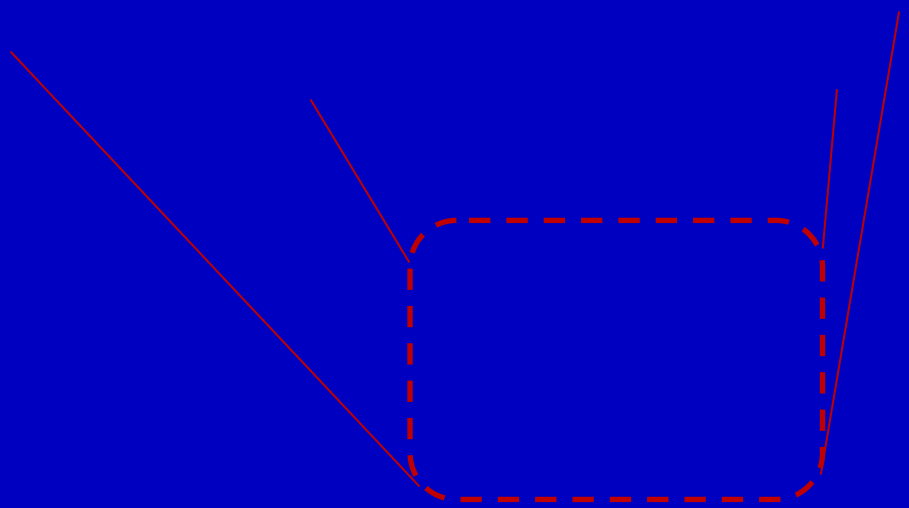
- Shielding Material Data
  - Attenuation TVL
  - Material Options
  - Barrier Thickness
  - Custom Systems
    - Combination
    - Special Density
- Shielding Design Sketch
- Shielding Worksheets

DESIGN



- Shielding Material Data
- Shielding Design Sketch
  - Specific Points
  - Use & Occupancy
  - Distance
  - Obliquity
    - Effective Thickness
    - Unusual Conditions
- Shielding Worksheets

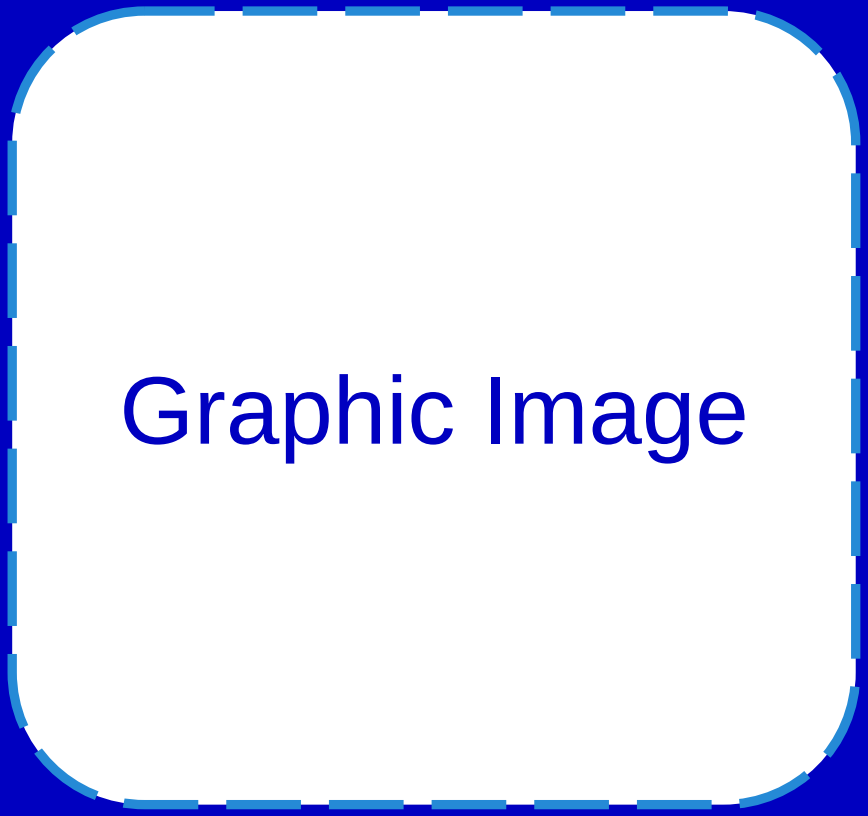
DESIGN



- Shielding Material Data
- Shielding Design Sketch
  - Specific Points
  - Use & Occupancy
  - Distance
  - Unusual Conditions
    - Beams & Columns
    - Penetrations
    - Effective Thickness
- Shielding Worksheets

DESIGN

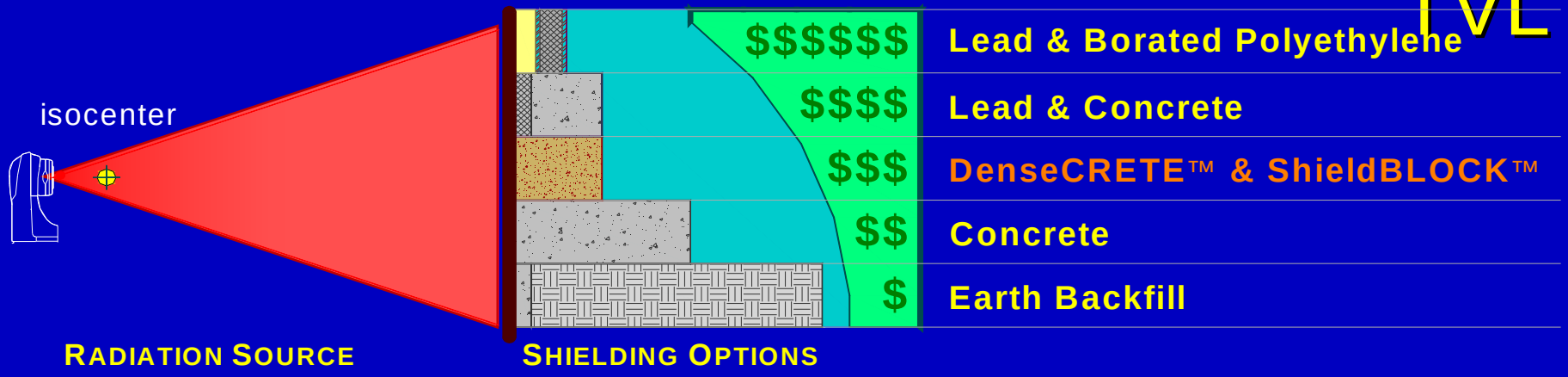
ATTENUATION (TVLS)



- Shielding Material Data
- Shielding Design Sketch
- Shielding Worksheets
  - Location
    - Description
    - Beam Quality
  - Parameters
    - W + U + T +α +P + *d*
  - TVL's REQUIRED
    - Photon
    - Neutron

RADIATION SHIELDING

MATERIAL SELECTION : AFTER THE TVL



- Attenuation → Thickness can be determined
- IMPACT can be reviewed with the Architect
- Single material vs combination of materials
- Method of installation can be reviewed (PIP vs Modular)

RADIATION SHIELDING

OTHER CONSIDERATIONS

- The Total Cost of the Shielding includes:
  Foundations, Installation, Finishes, Service Contracts
- System of Installation
  - Modular vs. PIP (pumped, conveyed or craned)
  - Manufacture (On-site vs. Pre Fabricated)
  - Delivery & Storage
- Accelerated Depreciation Savings (possible)
- The Value of the Space (Savings) $300-$500/sq ft

RADIATION SHIELDING DESIGN

MISTAKES 2010 HAPPEN …

BUT THEY NEED NOT HAPPEN TO YOU!

- UNDERSTAND THE PROCESS
- KNOW YOUR OPTIONS
- UNDERSTAND THEIR IMPACT
- DESIGN THE BEST RADIATION SHIELDING SOLUTION FOR YOUR CLIENT …NOW AND INTO THE FUTURE.

RADIATION SHIELDING DESIGN 2010

FROM CONCEPT ...TO... REALITY

WITHOUT THE MISTAKES

QUESTIONS?