**Engineering, Design and Manufacturing** 

### Investigation of Modern Self-Contained, Dry-Storage Irradiators

Spencer Mickum, Zach Hope, Robert Rushton, Ryan Howell Council on Ionizing Radiation Measurements and Standards April 16, 2018

### Focus

# HDI is repositioning to offer a cost-effective replacement to the legacy Gammacell 220 irradiator.

Hopewell Designs Inc. Model GR420 Research Irradiator



### Outline

- Design and Comparison
- How to treat the transition dose?
- Uniformity within the chamber
- Source Loading
- Additions
- Conclusions



### **Design – Overview**

#### Gammacell 220



#### **Hopewell GR420**





### Design – GR420 KPPs

- Integrated Shielding
- Improved Operator Interaction
- Sample Rotation
- Increased Chamber Size
- Simplified Source Loading



### Design – GR420 KPPs



GR420 Shield Overview



#### GR420 Cross section



#### Example Touchscreen Controller



### Design – GR420 KPPs



#### **GR420** Chamber Section



#### GR420 Source Loading 7

### **Comparison – Overview**

Irradiator	GR420	Gammacell 220
Floor footprint	13950 cm <sup>2</sup>	17,710 cm <sup>2</sup>
Weight	~15,000 lbs	~10,000 lbs
Max. Co-60 Activity [Ci]	24,000	24,000
External Dose Rate	<20 uSv/hr * (<2 mrem/hr )	>300 uSv/hr * (>30 mrem/hr )
External Transition Dose Rate	<50 uSv/hr * (<5 mrem/hr )	>1000 uSv/hr  * (>100 mrem/hr )
Source loading	On-site transfer shield	Ship entire irradiator

\* Determined at 5 cm from external surface, for full 24kCi loading

### **Comparison – Overview**

Irradiator	GR420	Gammacell 220
Available Source Slots	24	48
Chamber size [L]	5.3	3.8
Center Doserate [Gy/min]	200	270
Dose Uniformity Ratio	1.90±31%	1.81 ±29%
<b>Transition Dose [Gy]</b>	3.1%	3.8%

### Outline

- Focus
- Comparison
- How to treat the transition dose?
- Uniformity within the chamber
- Source Loading
- Additions
- Conclusions



### **Gammacell 420 – Transition**



11

### **Gammacell 420 – Transition (external)**



### Gammacell 420 – Transition (internal)

- Transition Dose to Center of Chamber
- Dose Rate
   202.7 Gy/min
- Transition
   Dose of
   6.28 Gy
- 3.1% of Centerline dose rate



### Outline

- Focus
- Comparison
- How to treat the transition dose?
- Uniformity within the chamber
- Source Loading
- Additions
- Conclusions

### Gammacell 420 – Uniformity

• DUR: 1.90 • Centerdose: **202 Gy/min** • DUR XY: 1.37 • DUR YZ: 1.88



### Gammacell 420 – Uniformity, Rotation

- DUR:
   1.74 (10%)
- Centerdose:
   202 Gy/min
- DUR XY:
  1.28 (7%)
- DUR YZ:
   1.71 (10%)



### Outline

- Focus
- Comparison
- How to treat the transition dose?
- Uniformity within the chamber
- Source Loading
- Additions
- Conclusions

### Gammacell 420 – Source Loading

- All source loading of the GR420 is done on-site.
- Transfer shields are specifically designed to integrate with the GR420 system to move fresh sources from the Shipping Cask to the Irradiator.





### Gammacell 420 – Source Loading

# Initial Loading: o Eight C-198 sources, 3 kCi each





### Gammacell 420 – Source Loading

## <u>Subsequent</u> Loadings: o Four C-198 sources, 3 kCi each







### Gammacell 420 – Source Loading

Equilibrium:
 0 23.625 kCi Total Loading each reload







### Outline

- Focus
- Comparison
- How to treat the transition dose?
- Uniformity within the chamber
- Reloading
- Additions
- Conclusions

### Gammacell 420 – Additions







### Gammacell 420 – Additions



- <u>Temperature control</u>
- Thermo Jet ES
   Precision
   Temperature Cycling
   System
- (- 80°C to + 225°C) ± 1°C
- Temperature transition in less than 15 seconds.

http://www.spscientific.com/Products/Thermal\_Products/FTS\_Systems/ Air\_Stream/ThermoJet\_ES\_Precision\_Temperature\_Cycling\_System/

### Conclusions

- The GR420 addresses the need for:

   Operator Safety (Radiation Shielding)
   Ease of Operation (Computer Control)
   Dose Uniformity (Rotation)
   Reduced Downtime (On-site source loading)
- The Hopewell Designs GR420 is a great option for a modern, high dose-rate irradiator.



### **Thank You**

**Questions?** 

#### Ryan Howell Ryan.Howell@HopewellDesigns.com

Hopewell Designs, Inc. 5940 Gateway Dr. Alpharetta GA, 30004 P: +1 (770) 667-5770 F: +1 (770) 667-7539 www.HopewellDesigns.com