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Title: New Qt Plotter in Development / Redesigning The MCNP Plotter

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# New Qt Plotter in Development / Redesigning The MCNP Plotter

*The 70s were so last millennium...*



**Sriram Swaminarayan**

**Joel Kulesza**

MCNP User Symposium

July 15, 2021



Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

# Why update the plotter?

## Current interface uses a basic layout

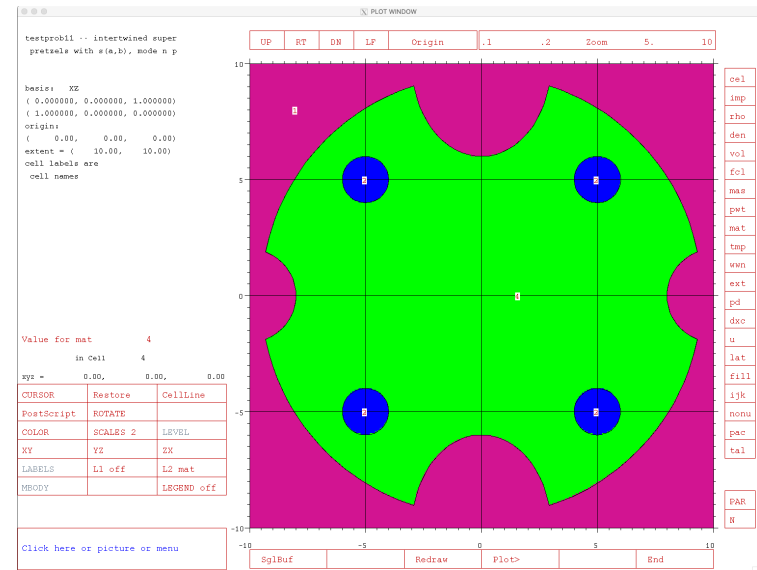
- Interface elements are text drawn on a window
- Button clicks are interpreted using mouse coordinates
- No functionality offloaded to a framework such as Qt
- Interaction with interface doesn't provide a modern look-and-feel e.g. label selection requires multiple clicks

## Performance is less than optimal

- No platform specific optimizations
- Host code runs the main event loop

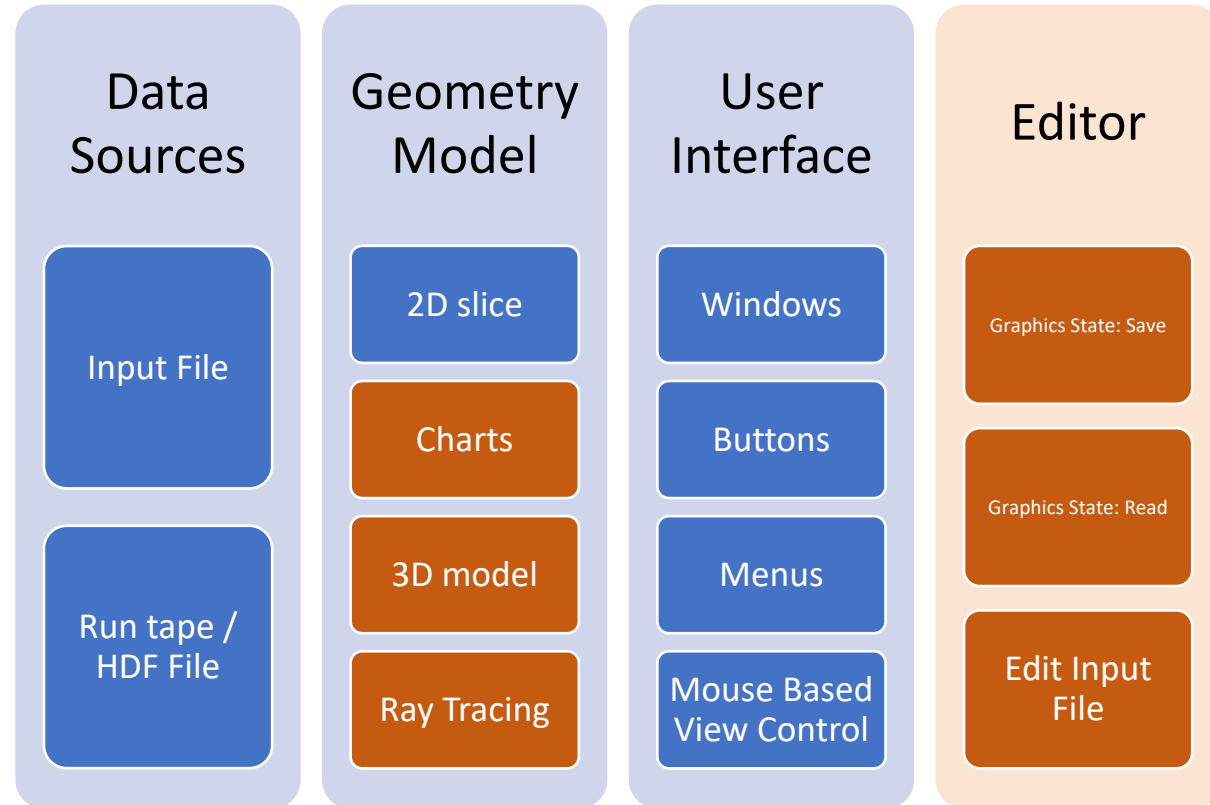
## Extension to 3D modes is not easy

- Host code calculates the 2D projection
- No easy way to calculate 3D geometry or to hand it off to something like OpenGL



# Guiding Principles for Interface Redesign

- Provide functionality similar to current interface
  - Start with Geometry
  - Provide other capabilities later
- “Modernize” the interface using button and menu elements
- Better command processing
- Use a cross-platform graphics layer

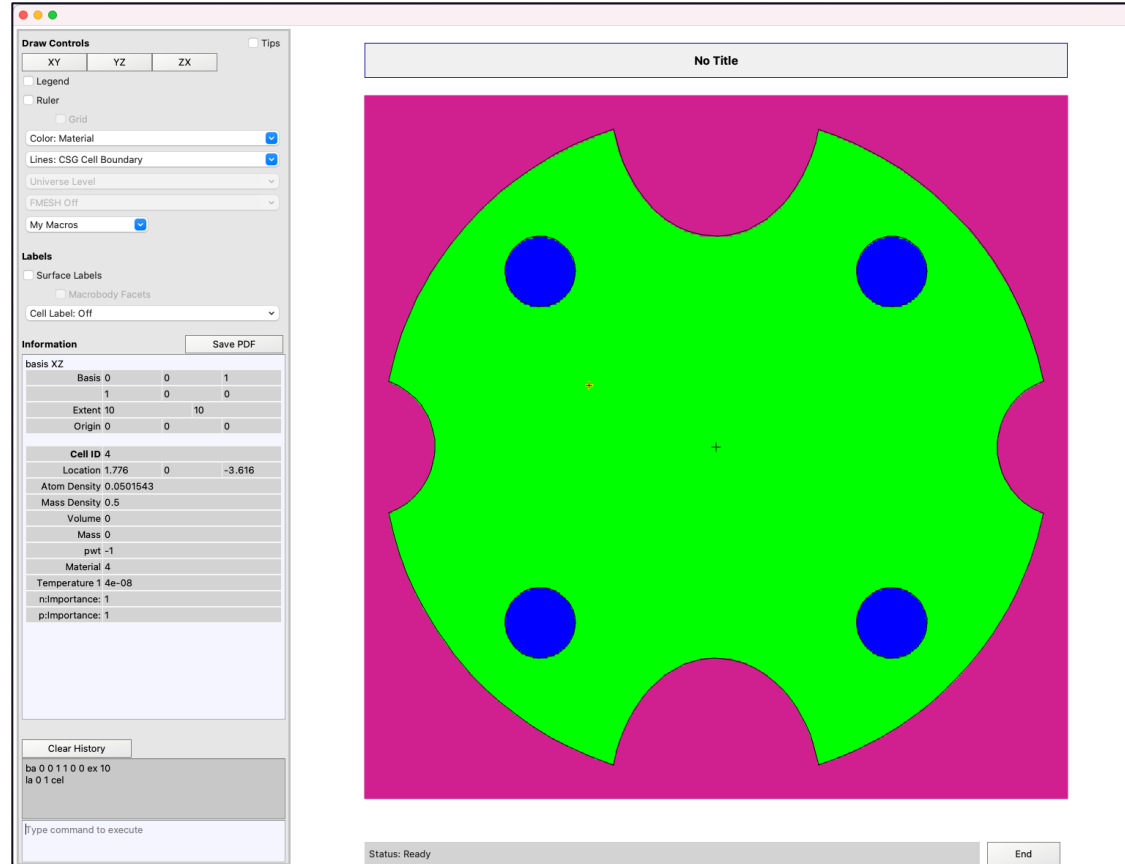


# Decision Made To Use Qt As Infrastructure

- Cross-platform framework provides portability
- Per-platform optimizations provided by Qt, reducing the effort on part of the host code
- User interface events handled by Qt for interface elements such as buttons, menus, and text
- Window manager interface handled by Qt
- LGPL license for Qt allows for distribution
- Long term support provided by Qt, so new platforms will be supported
- Open source of Qt allows us to compile on platforms where it is not available

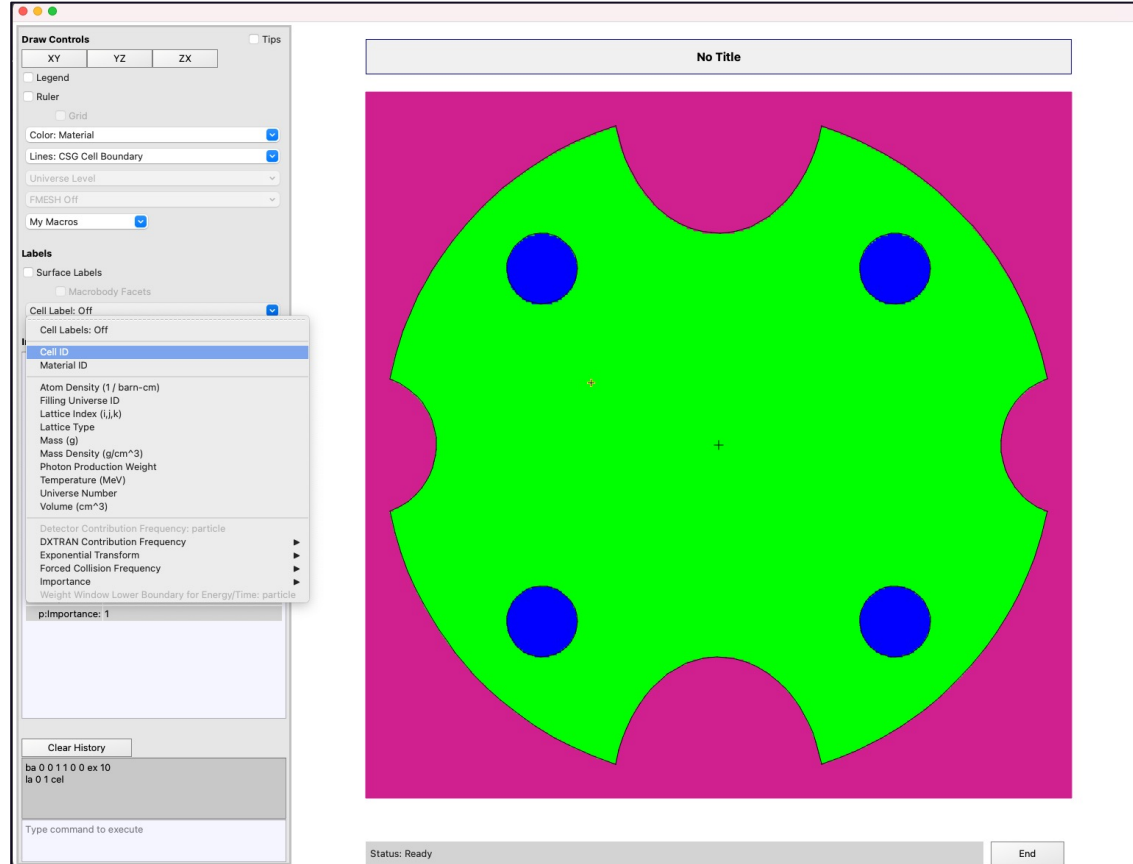
# New interface is menu driven but retains command line

- Cross platform graphical interface provided by Qt
- Menu driven interface with logical nesting
- Deeper information at cell level
- Direct save to PDF
- Command line input retained



# New interface is menu driven but retains command line

- Cross platform graphical interface provided by Qt
- Menu driven interface with logical nesting
- Deeper information at cell level
- Direct save to PDF
- Command line input retained
- Will be released beside version 6.3
- User experience input requested





# Goal Was To Reproduce Geometry Drawing In Qt

## Status:

- Geometry drawn correctly
- Geometry drawn *faster*
- Mouse based interaction for translation and zoom
- Buttons / Menus for common tasks
- Nested menus for particle types
- User defined “My Macros” menu
- More natural mouse interaction
- Direct save to PDF
- Better cell information on click
- Command line input retained

# Live Demo



# Recapping The Primary Interface Elements

- Interface is designed to include familiar elements
- Command line input with history
- Mouse click for cell information / rotation
- Mouse drag for translation and zoom
- Logically nested menus
- Direct save to PDF

**Draw Controls**  Tips

XY YZ ZX

Legend

Ruler

Grid

Color: Material

Lines: CSG Cell Boundary

Universe Level: All

FMESH Off

My Macros

**Labels**

Surface Labels

Macrobody Facets

Cell Label: Off

**Information**

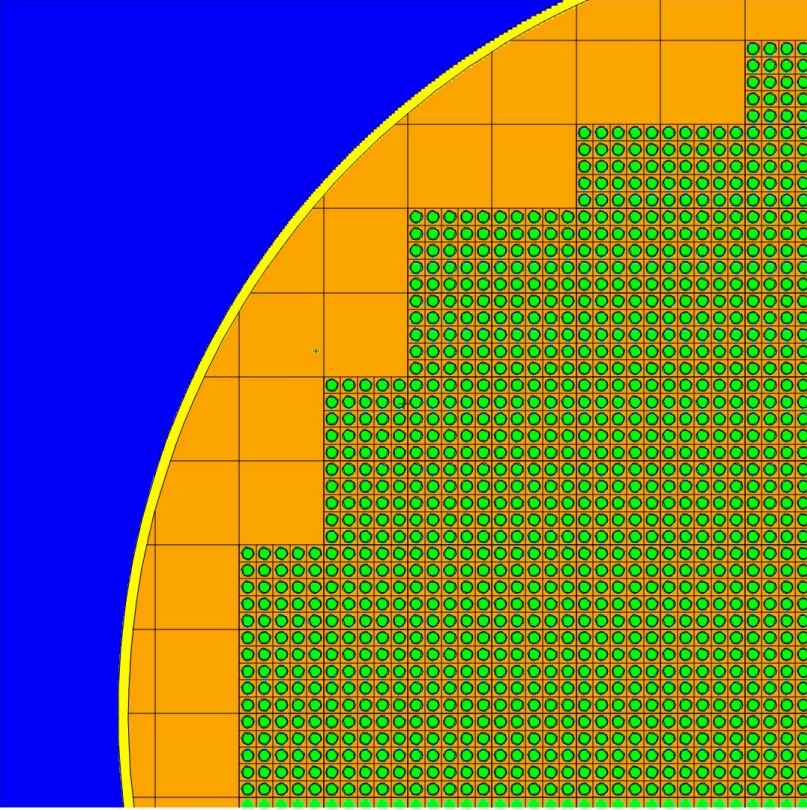
basis XY

Basis 1	0	0
0	1	0
Extent 39.2341	39.2341	
Origin -449.432	30.1183	5

Your command history will show up here.  
You can clear it by clicking 'Clear History' button above

Type command to execute

Storage Facility + Critical Assembly



Status: Ready

# Recapping The Primary Interface Elements

**Draw Controls**  Tips

XY  YZ  ZX

Legend

Ruler

Grid

Color: Material   
Lines: CSG Cell Boundary   
Universe Level: All   
FMESH Off   
My Macros

**Labels**

Surface Labels

Macrobody Facets

Cell Label: Off

**Information**

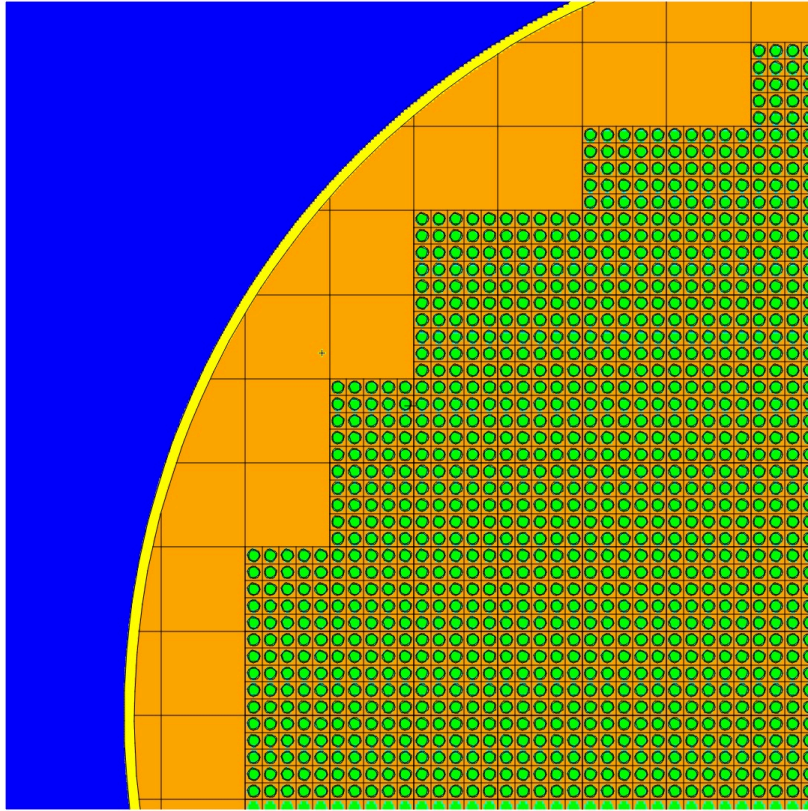
basis XY		
Basis 1	0	0
0	1	0
Extent 39.2341		39.2341
Origin -449.432	30.1183	5

Your command history will show up here.  
You can clear it by clicking 'Clear History' button above

Type command to execute

Direct command line  
input with history

**Storage Facility + Critical Assembly**



Status: Ready

# Recapping The Primary Interface Elements

Direct access  
to common  
basis functions

Draw Object  Tips

**XY** YZ ZX

Ruler

Grid

Color: Material

Lines: CSG Cell Boundary

Universe Level: All

FMESH Off

My Macros

**Labels**

Surface Labels

Macrobody Facets

Cell Label: Off

**Information**

basis XY

Basis 1	0	0
0	1	0
Extent 39.2341		39.2341
Origin -449.432	30.1183	5

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Type command to execute

Storage Facility + Critical Assembly

Status: Ready

# Recapping The Primary Interface Elements

**Draw Controls**  Tips

XY  YZ  ZX

Legend

Ruler

Grid

Color: Material

Lines: CSG Cell Boundary

Universe Level: All

FMesh Off

My Macros

**Labels**

Surface Labels

Macrobody Facets

Cell Label: Off

**Information**

basis XY		
Basis 1	0	0
	0	1
Extent	39.2341	39.2341
Origin	-449.432	30.1183
		5

Your command history will show up here.  
You can clear it by clicking 'Clear History' button above

Type command to execute

Menus /  
checkboxes for  
common tasks

**Storage Facility + Critical Assembly**

Status: Ready

# Recapping The Primary Interface Elements

Save to PDF

**Draw Controls**  Tips

XY  YZ  ZX

Legend

Ruler

Grid

Color: Material

Lines: CSG Cell Boundary

Universe Level: All

FMESH Off

My Macros

**Labels**

Surface Labels

Macrobody Facets

Cell Label: Off

**Information**

basis XY		
Basis 1	0	0
0	1	0
Extent	39.2341	39.2341
Origin	-449.432	30.1183
		5

Your command history will show up here.  
You can clear it by clicking 'Clear History' button above

Type command to execute

**Storage Facility + Critical Assembly**

Status: Ready

# Recapping The Primary Interface Elements

Pop-up tool tips available

**Draw Controls**

**Tips**

XY YZ ZX

Legend

Draw

Grid

Color: Material

Lines: CSG Cell Boundary

Universe Level: All

FMesh Off

My Macros

**Labels**

Surface Labels

Macrobody Facets

Cell Label: Off

**Information**

basis XY		
Basis 1	0	0
0	1	0
Extent 39.2341	39.2341	
Origin -449.432	30.1183	5

Your command history will show up here.  
You can clear it by clicking 'Clear History' button above

Type command to execute

**Storage Facility + Critical Assembly**

Status: Ready



# Recap: Menus Are Nested With Relevant Information

The screenshot displays a software interface for a simulation. On the left, the 'Draw Controls' panel includes options for XY, YZ, and ZX views, Legend, Ruler, Grid, Color: Material, Lines: CSG Cell Boundary, Universe Level: All, FMESH Off, and My Macros. Below this is the 'Labels' section, which is currently expanded to show a nested menu for 'Weight Window Lower Boundary for Energy/Time'. This menu lists various parameters such as Cell Label, Cell Labels, Cell ID, Material ID, Atom Density, Filling Universe ID, Lattice Index, Lattice Type, Mass, Mass Density, Photon Production Weight, Temperature, Universe Number, Volume, and a list of Weight Windows (WWN 1 n through WWN 27 n). A 'Clear History' button and a text input field are also visible at the bottom of the panel. On the right, a 3D visualization titled 'Storage Facility + Critical Assembly' shows a complex, curved structure with a blue outer shell, an orange inner shell, and a green grid-like interior. The status bar at the bottom indicates 'Status: Ready' and 'End'.

Nested Menus are determined by features active in simulation

# Recap: Information Pane With Current View & Extensive Cell Information

Information Pane  
With Extensive Cell  
Information

**Draw Controls**  Tips

XY YZ ZX

Legend  
 Ruler  
 Grid

Color: Material

Lines: CSG Cell Boundary

Universe Level: All

FMesh Off

My Macros

**Labels**

Surface Labels  
 Microbody Facets

Cell Label: Off

**Information**

basis XY

Basis 1	0	0
0	1	0
Extent 39.2341	39.2341	
Origin -449.432	30.1183	5

**Cell ID 450**

Location 4.96818	3.98115	5
------------------	---------	---

Universe 7

Lattice 1

Fill Universe -1

ijk 9	-3	0
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Atom Density 0.10019

Mass Density 0.999528

Volume 0

Mass 0

Material 8

Temperature 1 2.53e-08

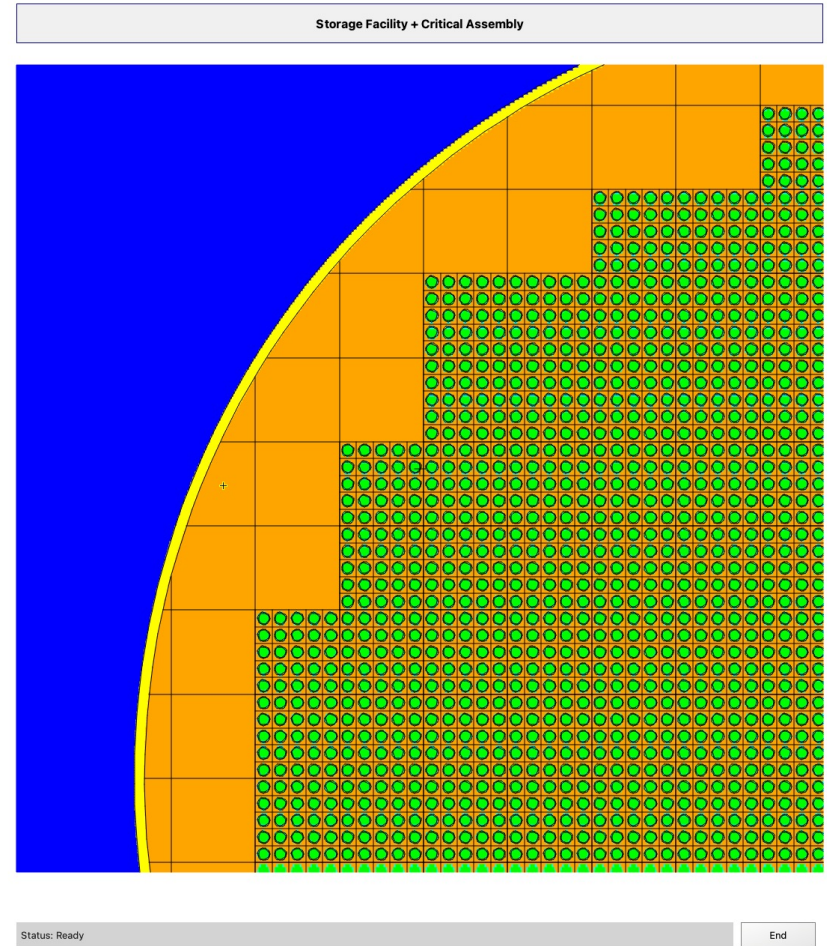
nonu -1

n:importance: 1

n: WWN 1-2 806.22	365.462
n: WWN 3-4 241.605	192.329
n: WWN 5-6 148.541	124.581
n: WWN 7-8 112.575	97.2746
n: WWN 9-10 88.0022	83.9231
n: WWN 11-12 80.9634	75.6298
n: WWN 13-14 68.0223	54.4334
n: WWN 15-16 42.6555	32.9136

ex 39.2341  
ex 39.2341  
or -449.432 30.1183 5

Type command to execute



# Recap: My Macros Menu With User Defined Views

Quick access to user defined views with My Macros menu

**Draw Controls**  Tips

XY YZ ZX

Legend

Ruler

Grid

Color: Material

Lines: CSG Cell Boundary

Universe Level: All

FMESH Off

**My Macros**

- pz close up
- pz no number
- pz with numbers
- pz close up
- View 5

Add Current View

Help  Save PDF

Load

Save

Basis 1	0	0
	1	0
Ext 39.2341		39.2341
Origin -449.432	30.1183	5

Clear History

ex 39.2341  
ex 39.2341  
or -449.432 30.1183 5

Type command to execute

Storage Facility + Critical Assembly

Status: Ready

# Next Steps

- Internal cleanup
- Scroll View for 'Z-surfing' to allow for translation normal to view axis
- Multiple Viewports
- Ray Tracing for 3D rendering
- Edit & Relaunch capability for interactive geometry building

# Questions?

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