

24.536 Reactor Experiments 407.403 Advanced Nuclear Lab

UMLRR Facility Overview and Data Acquisition Tools

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24.536 Reactor Experiments
UMLRR Facility Overview & Data Acquisition Tools

(Jan. 2018)

Discussion Outline

Introduction/Course Policy

The UMLRR -- Facility Overview

Data Acquisition Tools

UMLRR_Online Demo ([remote real-time capability](#))

[umlrr_data](#) GUI Demo ([offline data analysis tool](#))

Matlab Analysis of Reduced Data File – [A Demo](#)

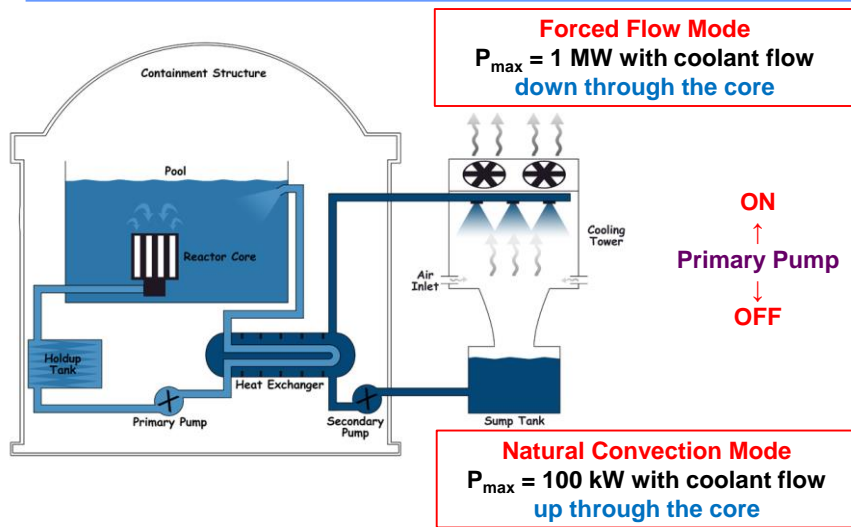
Homework #1

See details in [rexpts_hw1sp18.pdf](#)

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UML Research Reactor (UMLRR)



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UML Research Reactor (UMLRR)



1 MW swimming pool reactor with **MTR plate-type fuel**

First critical in 1974 with **HEU UAl_x -Al fuel**

Converted to **U_3Si_2 -Al LEU fuel** in 2000

Various assemblies are placed in a **9x7 grid** that includes **partial** and **full fuel elements**, a **regulating control element**, **graphite reflector elements**, **radiation baskets**, **voided lead boxes**, a **movable neutron source**, along with **four corner posts** for structural support.

The **core is suspended 24 feet (7.3 m) below the surface** of the pool (which contains about **76,000 gallons** or **288 m³ of water**).

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UMLRR (cont.)

The current LEU fuel assemblies are 3" square and 30" long and contain **16 uranium silicide fuel plates** and **2 aluminum end plates** (active fuel height is about 23.5" or 0.6 m).

Four large BORALCAN control blades (Boron Carbide in an Al metal matrix composite) provide overall reactivity control and shutdown capability.

One low-worth Boral regulating rod provides fine reactivity control (manual or auto mode with a PID controller).

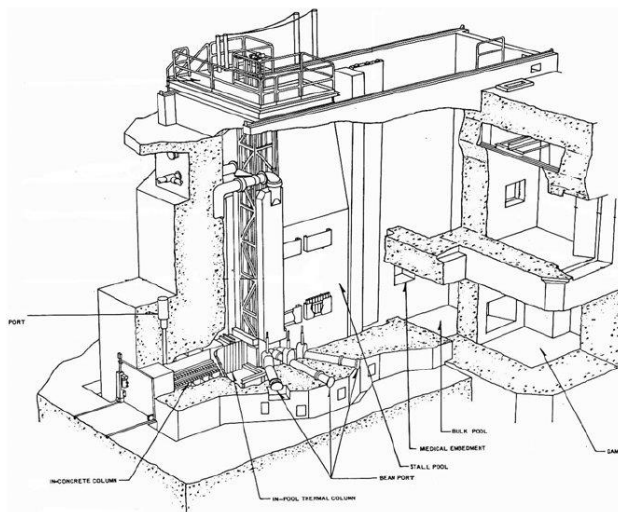
Several experimental facilities (**in-core radiation baskets**, **3 beam ports**, **thermal column**, **fast neutron irradiator**, and **pneumatic tube**)



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Cutaway of UMLRR Pool Structure



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View of Pool Surface, Support Bridge, and Upper Core Support Structure



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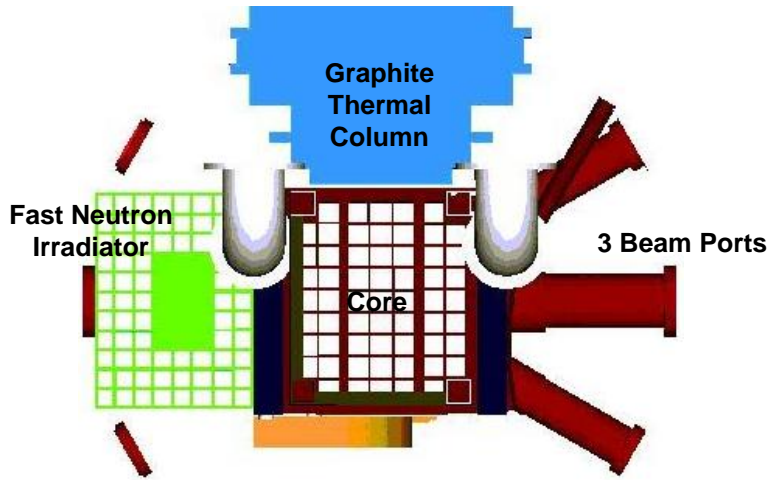
Self-Illuminated Photo of UMLRR Core and Lower Support Structure



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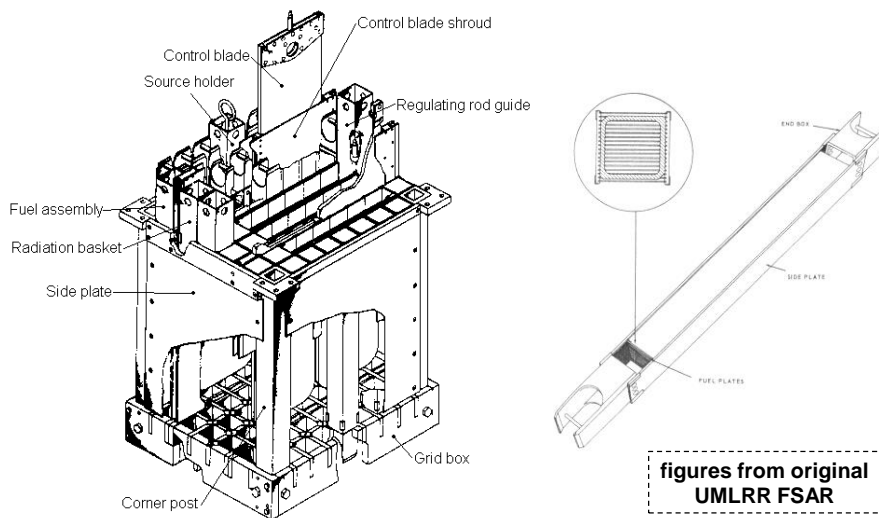
Major UMLRR Structures/Facilities



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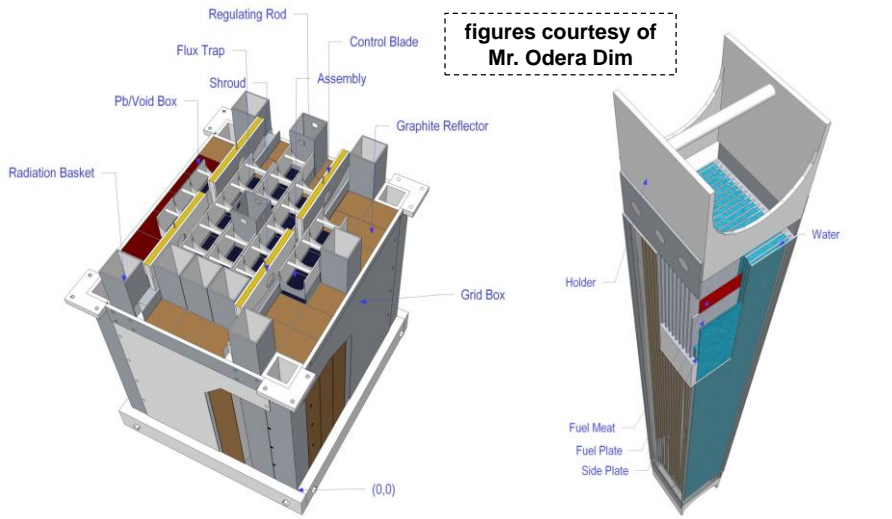
Details of the Core Structure and In-Core Components



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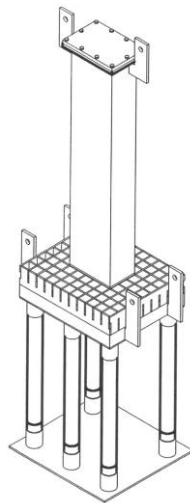
Details of the Core Structure and In-Core Components



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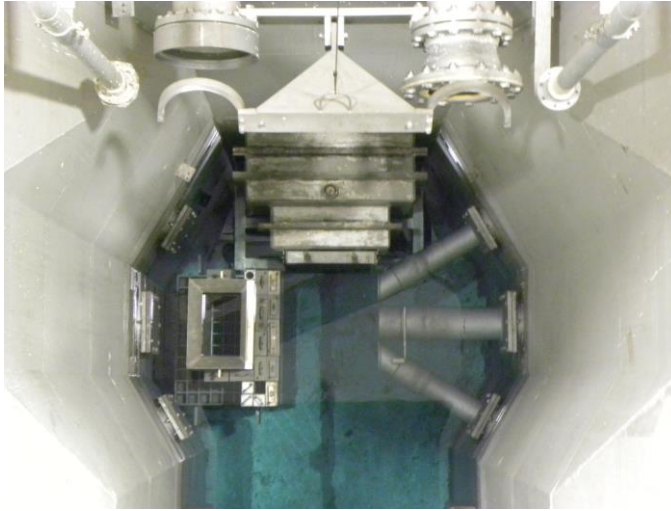
Sketch/Photo of FNI Structure (top view)



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Some Additional Photos



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Some Additional Photos



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Some Additional Photos



Learning with Purpose



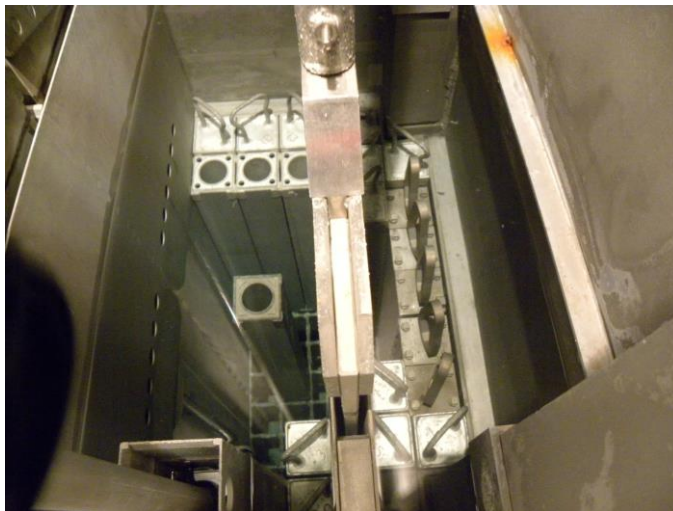
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Some Additional Photos



Learning with Purpose



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Additional Core Components

Control blade, support structure, and shroud



fuel assembly end boxes, radiation basket, and bayonet insert

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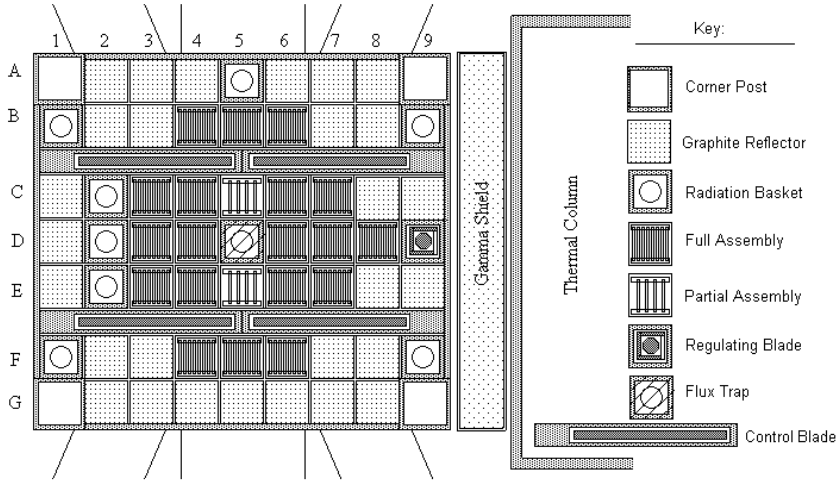
Pump Room Equipment



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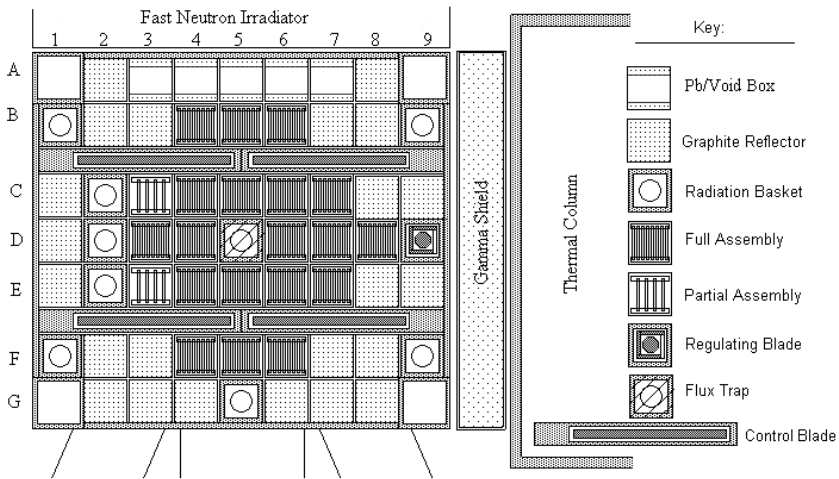
Initial LEU Core Layout (M-1-3 Core)



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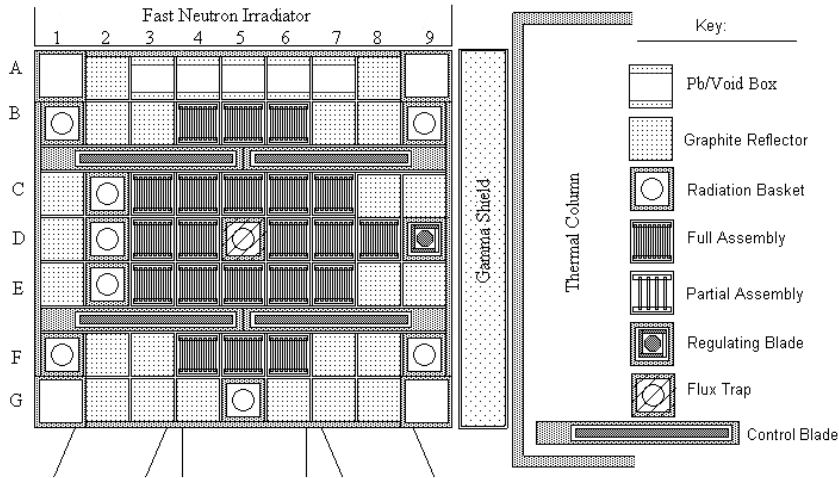
Recent LEU Core Layout (M-2-5 Core)



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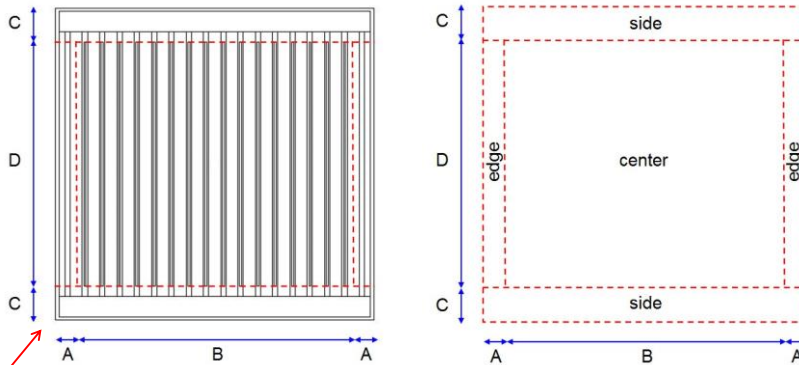
Current LEU Core Layout (M-5-8 Core)



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Detailed Fuel Assembly Geometry and 3-Zone Homogeneous Representation



**MCNP
Monte Carlo
Models**

Region Dimensions (cm)		
A = 0.4995	B = 6.7734	2A+B = 7.7724
C = 0.8437	D = 6.0850	2C+D = 7.7724

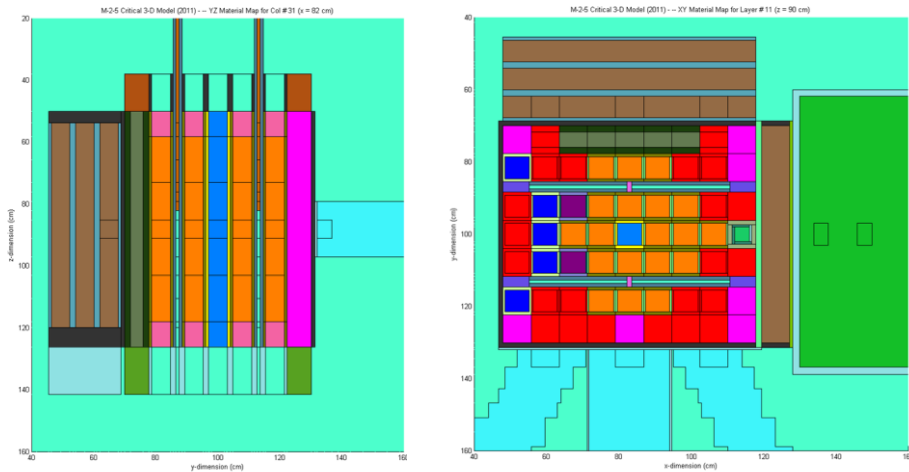
**VENTURE
Deterministic
Models**

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Modeling for Deterministic Codes

yz and xy views of the VENTURE M-2-5 core model

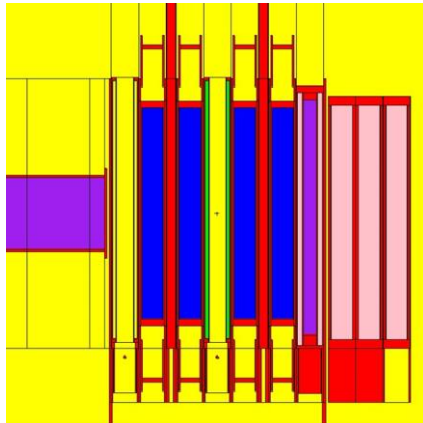


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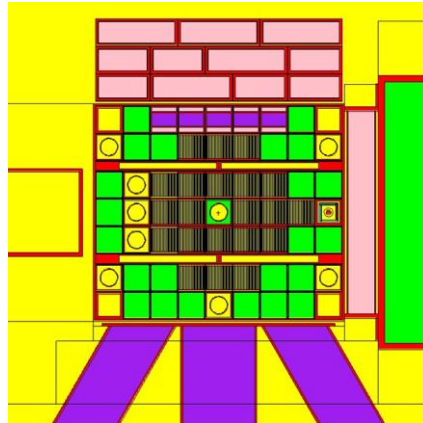
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Modeling for Monte Carlo Codes

yz-view of MCNP M-2-5 core through centerline in x-direction



xy-view MCNP M-2-5 core through centerline in z-direction



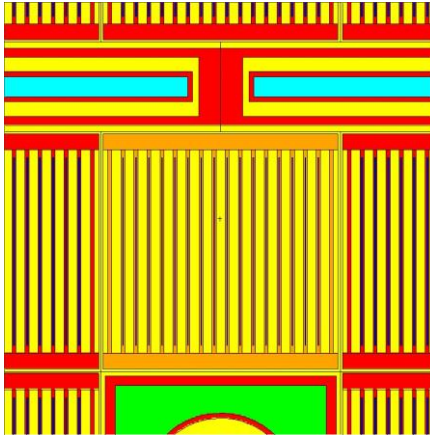
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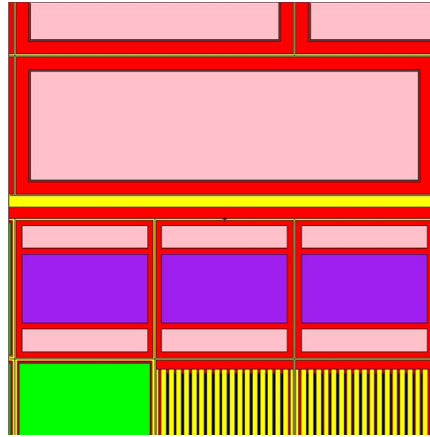
Modeling for Monte Carlo Codes



xy-view M-1-3 core in vicinity of partial fuel in C5 position



xy-view M-2-5 core in vicinity of Pb-void box in A4 position



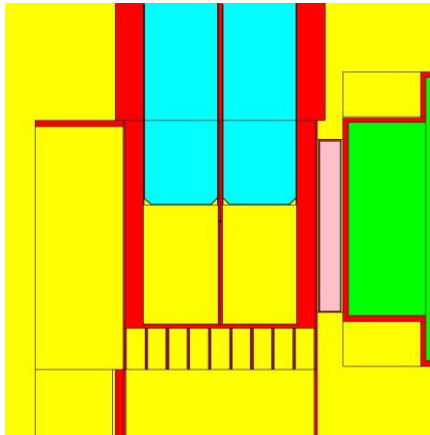
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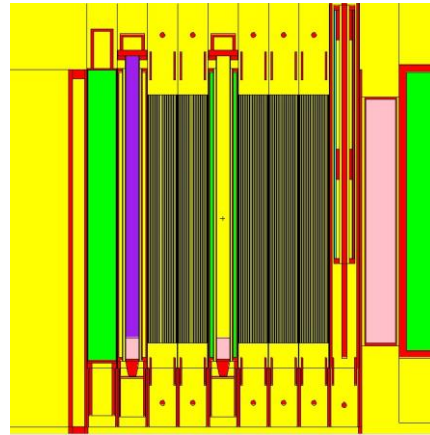
Modeling for Monte Carlo Codes



xz-view of MCNP M-1-3 core through control blades



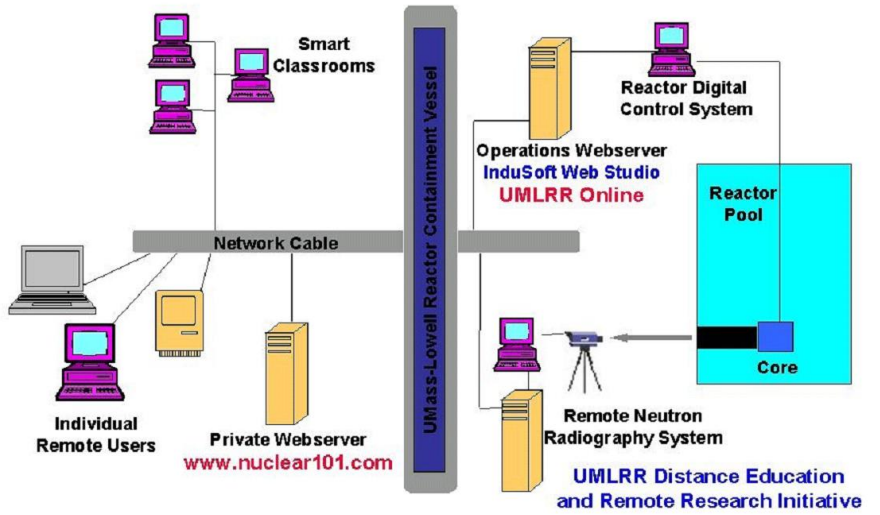
xz-view of MCNP M-1-3 core through centerline in y-direction



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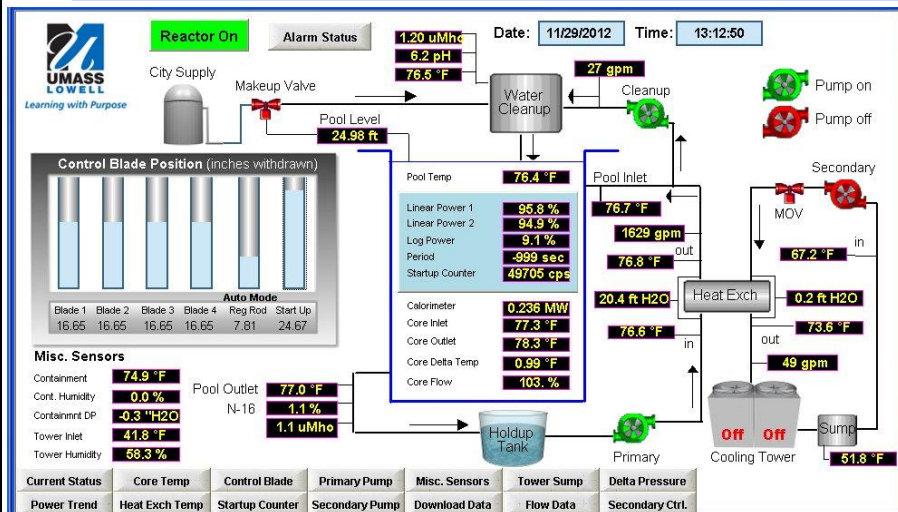
UMLRR Distance Ed System



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UMLRR Online Application GUI

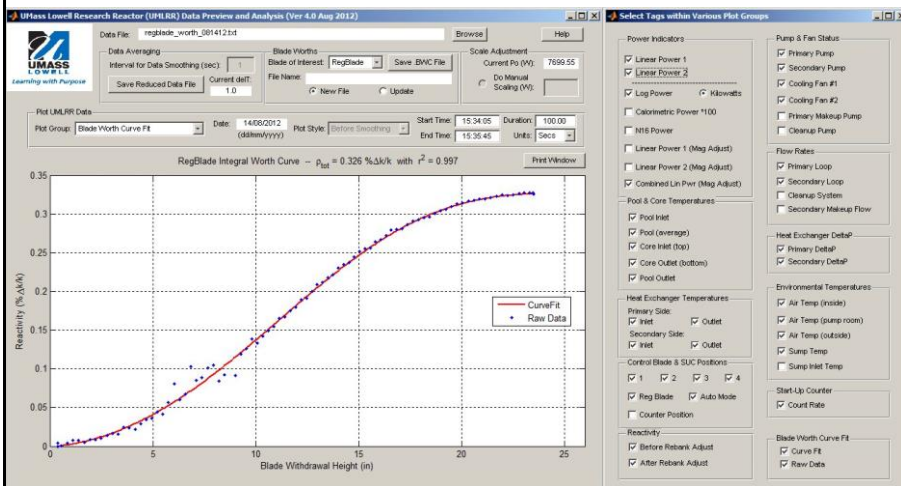


Show Live Demo

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Offline Data Processing GUI



Show Live Demo

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Steps for the `umlrr_data` GUI Demo

Run the `umlrr_data` GUI (latest edition is ver 4.1)

Open `xenon+temp_test_081612.hst` (only one time)

→ This generates `xenon+temp_test_081612.txt/hdr` and these can be used in subsequent runs

Explore the data from the experiment and **identify** the region of interest and smoothing interval

→ Here we selected the data for **4 hours** starting at **10:03 am** with the sensor values averaged over **30 seconds**

Save a **reduced data file** for subsequent processing/analysis in Matlab

→ Saved `xenon_temp_feedback_081612.dat`

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umlrr_data GUI Demo (cont.)



Write (or modify) a Matlab file to do some further analyses

→ See fdbk_rho_081612.m which reads the *.dat file, creates plots of blade position and core temperatures vs. time and, using prior blade worth information, generates a plot of feedback reactivity vs. time

This final plot of xenon and temperature feedback vs. time was the ultimate goal of this particular experiment...

You should use the above sequence as an example of the type of analyses needed for each experiment in this course...

You will get a chance to practice these steps in your Homework #1 assignment...

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Summary and Take-Aways



Good overview of UMLRR structures, control, and operation.

Understand function of major in-core elements and out-of-core energy removal components.

Explain/sketch primary & secondary coolant flow paths.

Understand basic function of various experimental regions and devices within the system.

Be familiar with the data acquisition tools available for monitoring, visualizing, and analyzing system behavior.

Be familiar with some local terminology (i.e. UMLRR, pre & post FNI, HEU vs. LEU, UMLRR Online, etc.)

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