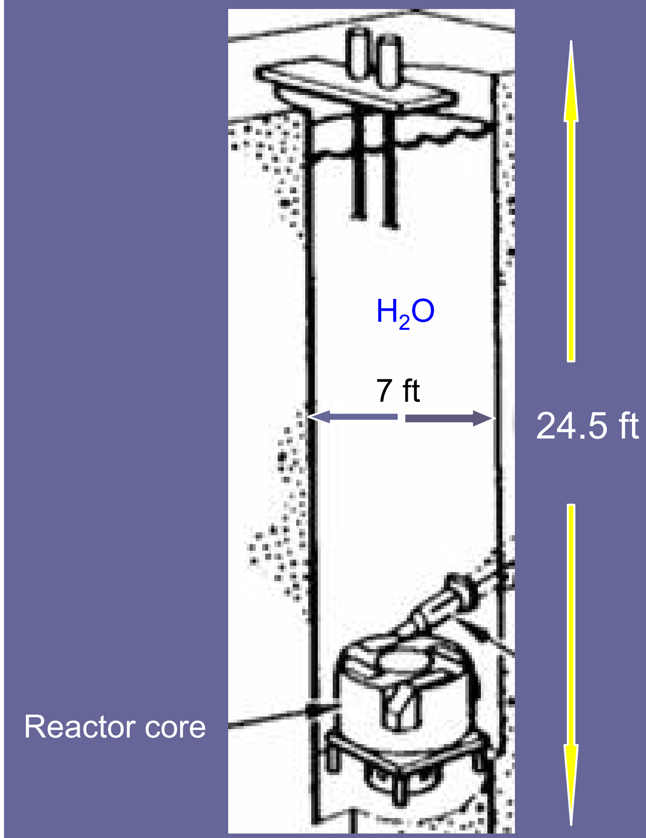
UC DAVIS MNRC

McCLELLAN NUCLEAR RADIATION CENTER

# Radiation Hardness Testing of Materials at MNRC

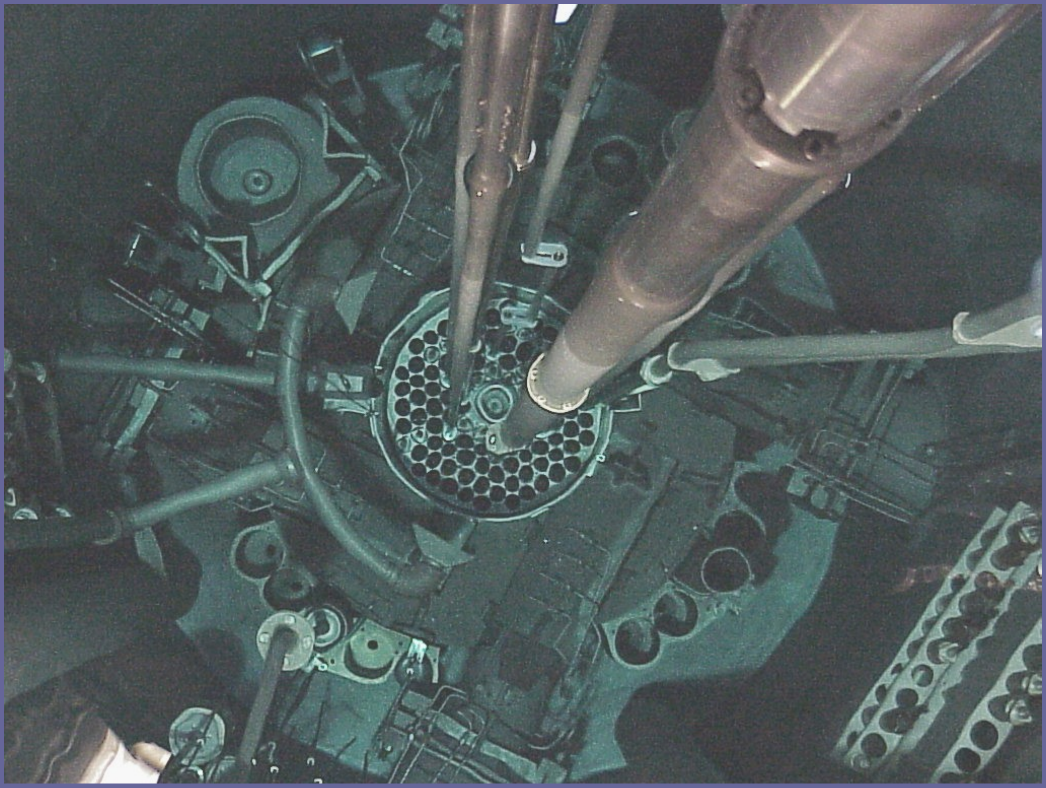
*M. Boussoufi, W. Steingass, R. Shiraki, H. Liu and R. Flocchini*

- The UCD/ MNRC research reactor of the TRIGA type is designed to be operated at a nominal 2 .0 MW steady state power as well as pulse and square wave operation. It is cooled and moderated by light water and reflected by graphite.

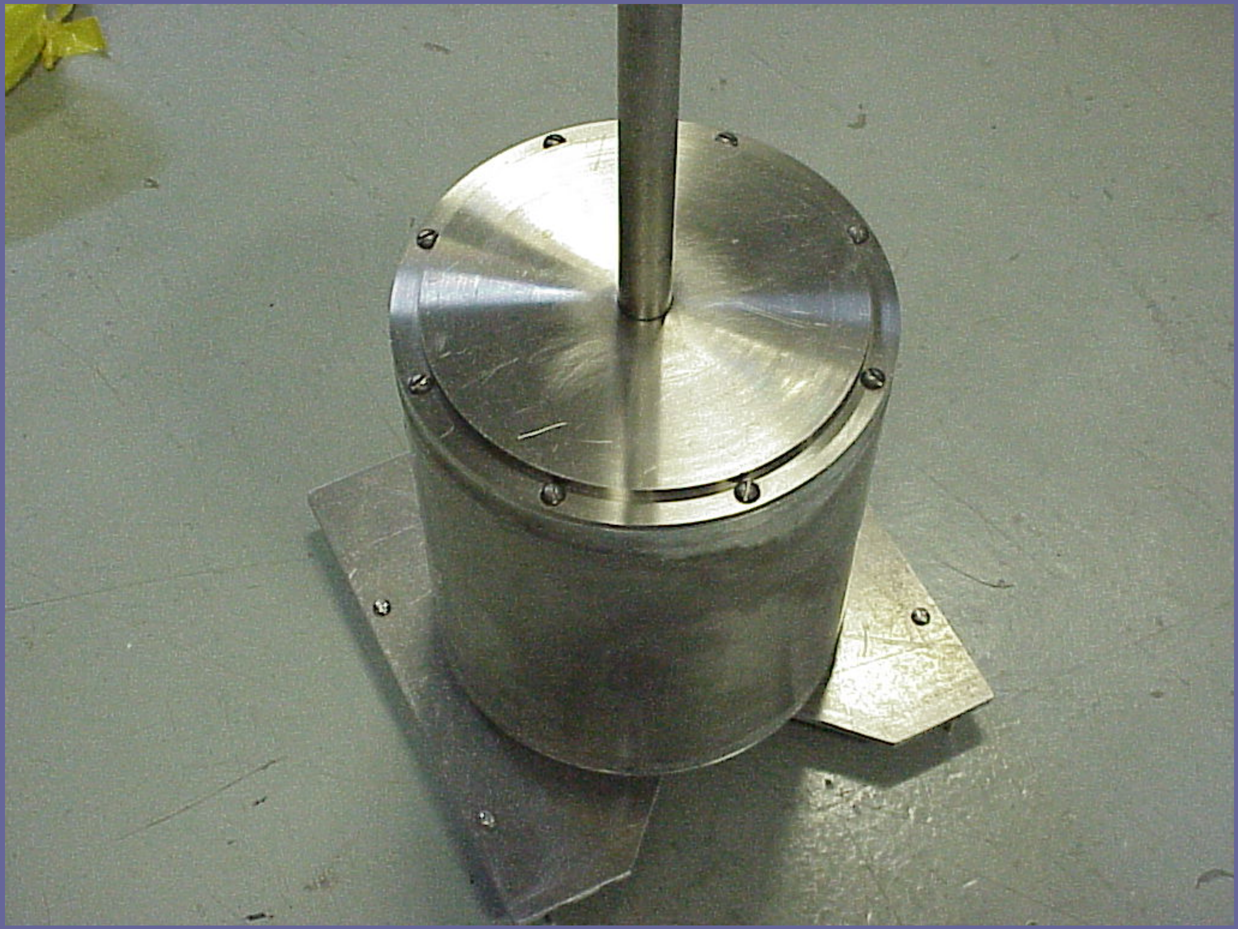



- The reactor core is located near the bottom of a water-filled aluminum vessel 7.0 ft in diameter and 24.5 ft in height.

- It went first critical in 1990 and has since become the highest power TRIGA reactor in the U.S.



- Radiation Hardness testing of materials is possible through a so-called “NEUTRON IRRADIATOR” facility (NIF for short)



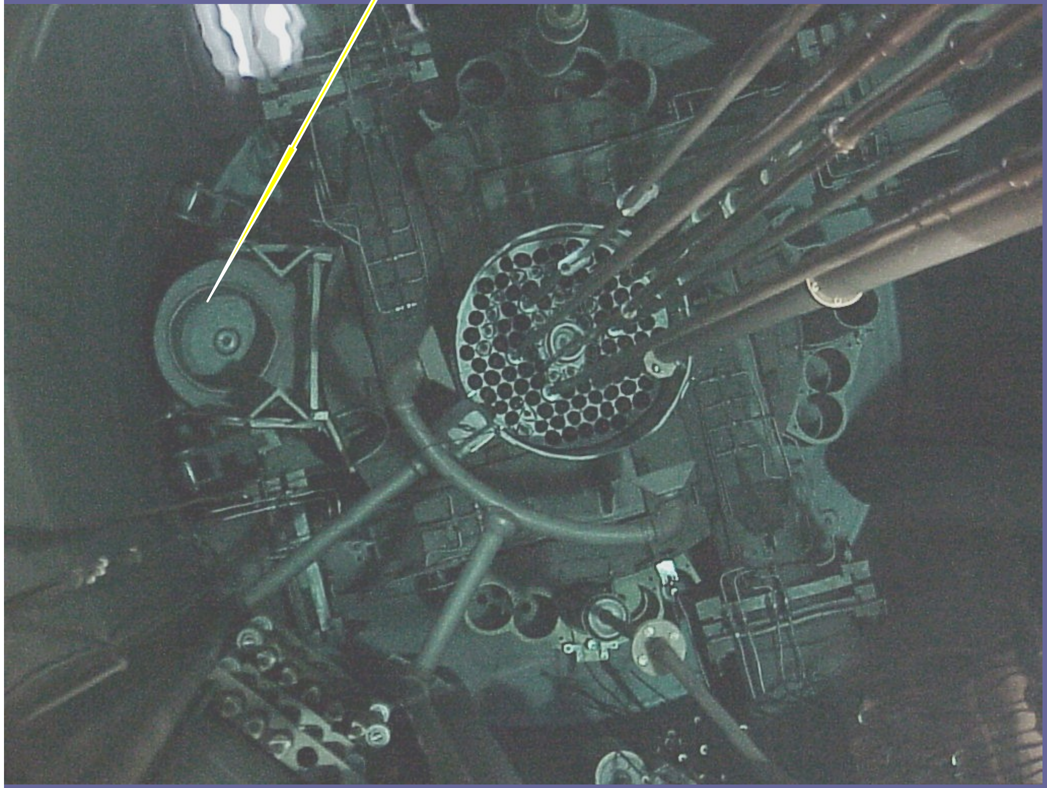
- It provides fast neutron exposure to samples with minimal contamination from thermal neutrons and γ rays (<1%).

• This neutron irradiator has three primary components:

** Exposure vessel*

** Detachable upper shield* for the exposure vessel

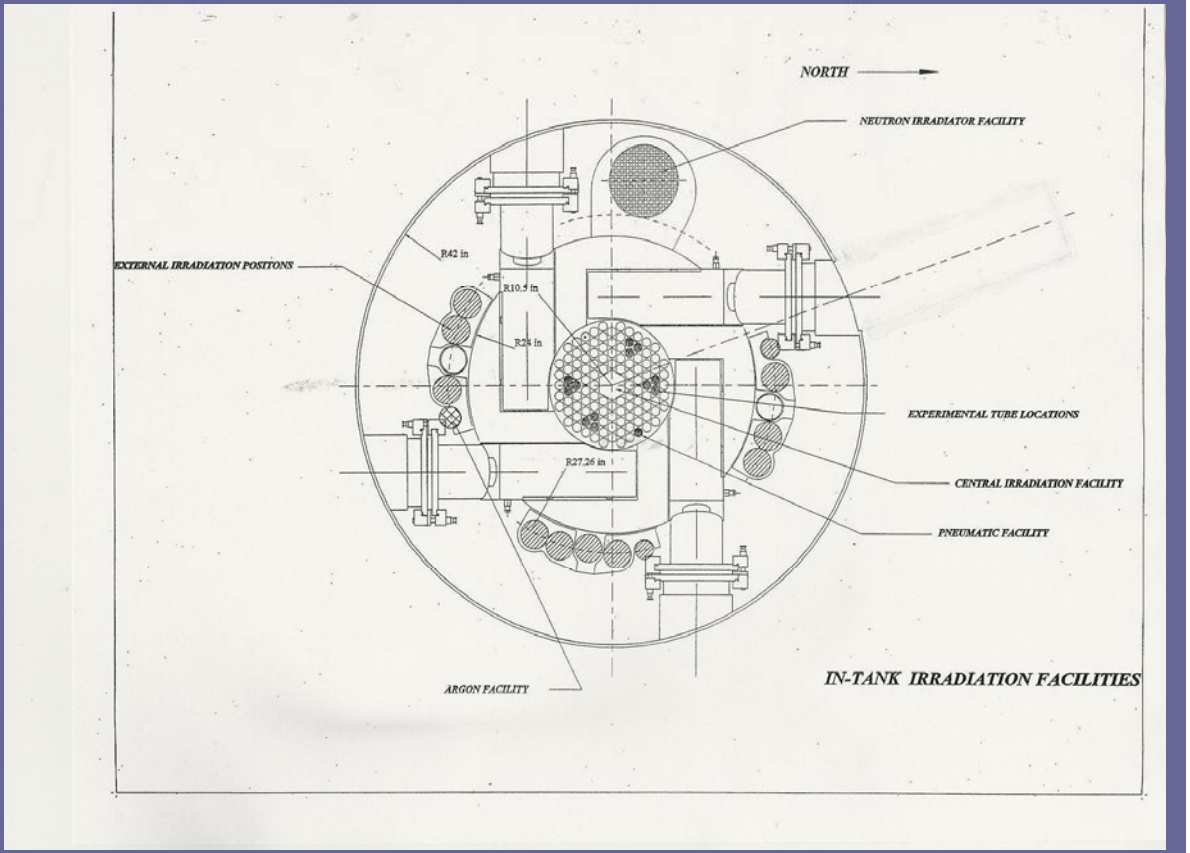
** Conditioning well*




CONDITIONING WELL….

- The *conditioning well* is installed adjacent to the annular graphite reflector inside the reactor tank.
- It is held vertically in place and rests at the bottom of the tank.

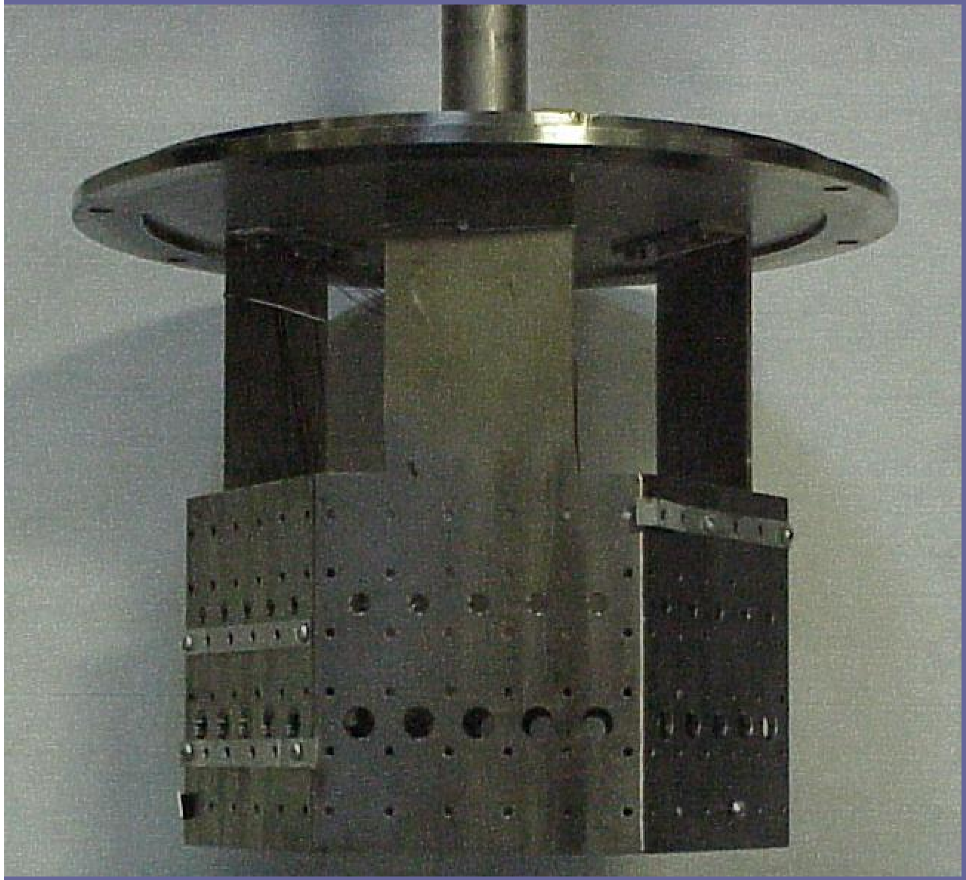
- The well-structure is shielded with sufficient boron nitride and lead encased in aluminum to remove thermal neutron and gamma rays, respectively

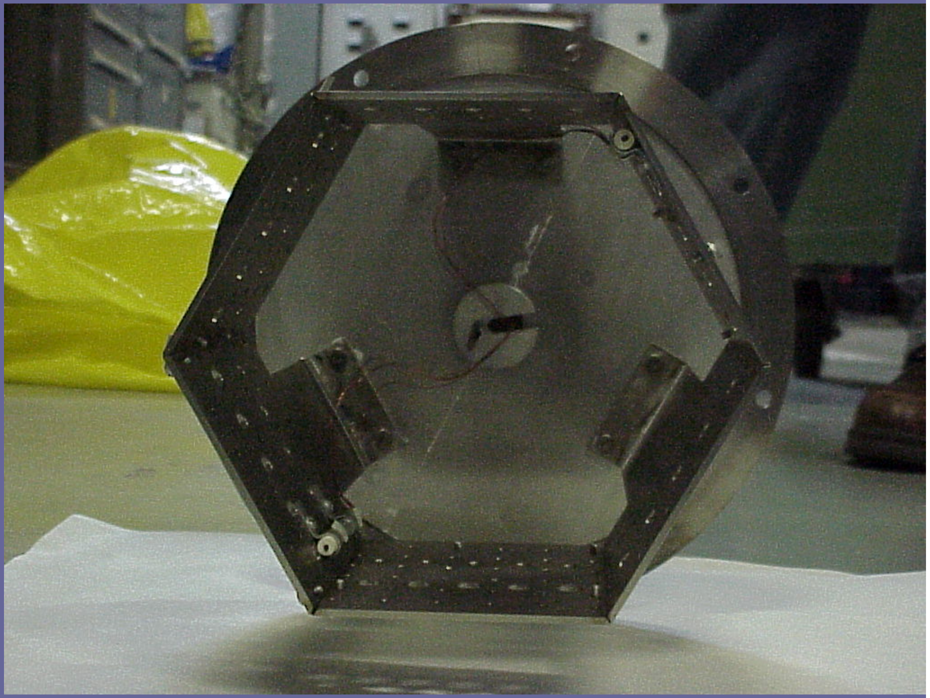


EXPOSURE VESSEL……

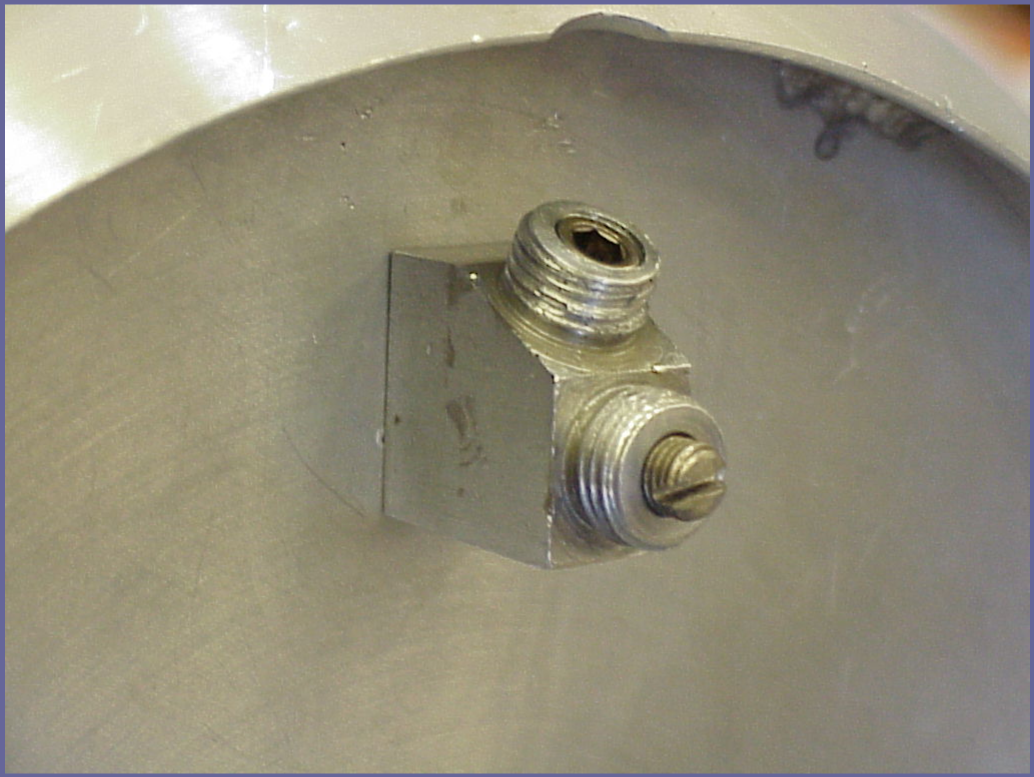
- The removable and water-tight *exposure vessel* has a usable inner space of approximately 7” in diameter and 9” in height.

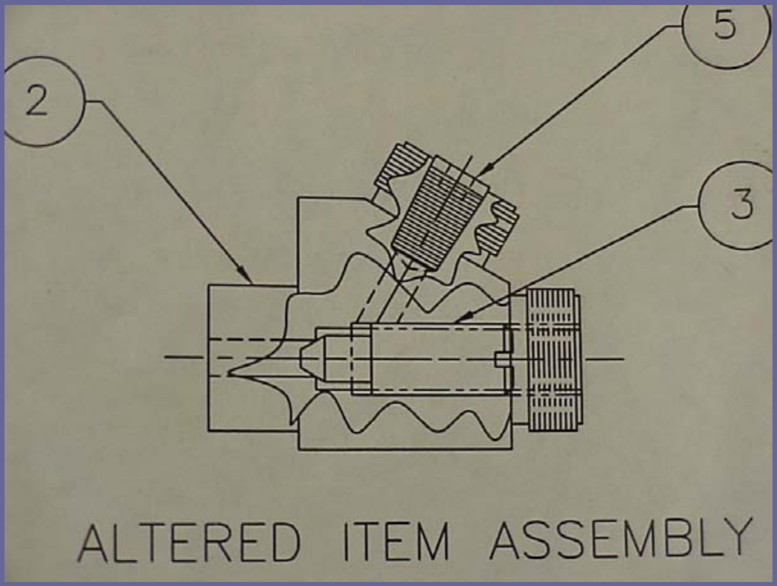
• There are six removable titanium plates with holes arranged in a hexagonal shape which can hold the components to be irradiated.





- It also contains a valve at the bottom to purge and pressurize an assembled unit with helium in order to reduce Argon-41 production during irradiation and to create a positive pressure which forbids in-leakage of water .



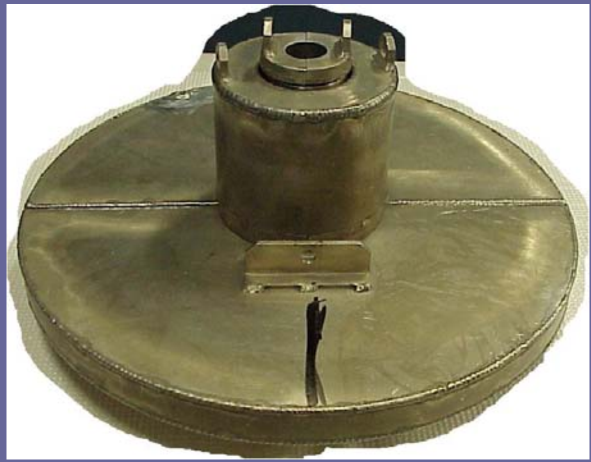



- The exposure vessel is lined with boral and gadolinium paint to insure minimal leakage of thermal neutrons

DETACHABLE UPPER SHIELD.....

• The *detachable upper shield* is made up of 5 pieces containing boron nitride and lead encased in aluminum.

• After assembly, it completes the upper shield for the exposure vessel before it is lowered into the conditioning well for irradiation.



- Monte Carlo code simulation has been benchmarked with multiple threshold neutron flux measurements. The converted 1 MeV equivalent silicon neutron flux at 1.0 MW operating power is:

$$\varphi \approx 1.5 \text{ x } 10^{10} \text{ n/cm}^2\text{.sec}$$

# IN CONCLUSION

- UCD/ MNRC is committed to offering state-of-the-art fast neutron testing for research and applications.

- Our unique capabilities enable us to provide effective solutions to the customer's needs.

- A few of many services rendered are:

*# Providing fast neutron tolerance to electronic components.*
*# Providing fast neutron-induced genes alteration for mutagenesis seeds.*
*# Examine fast neutron damage to corrosion-resistant coating.*

If you need more information visit our website at:

# http://mnrc.ucdavis.edu/

or send me an email at mboussoufi@ucdavis.edu