Title
Non-Destructive Testing with Neutron Radiography at the UC Davis/ McClellan Nuclear Radiation Center

Authors
Boussoufi, M.
Steingass, W.
Egbert, H.
et al.

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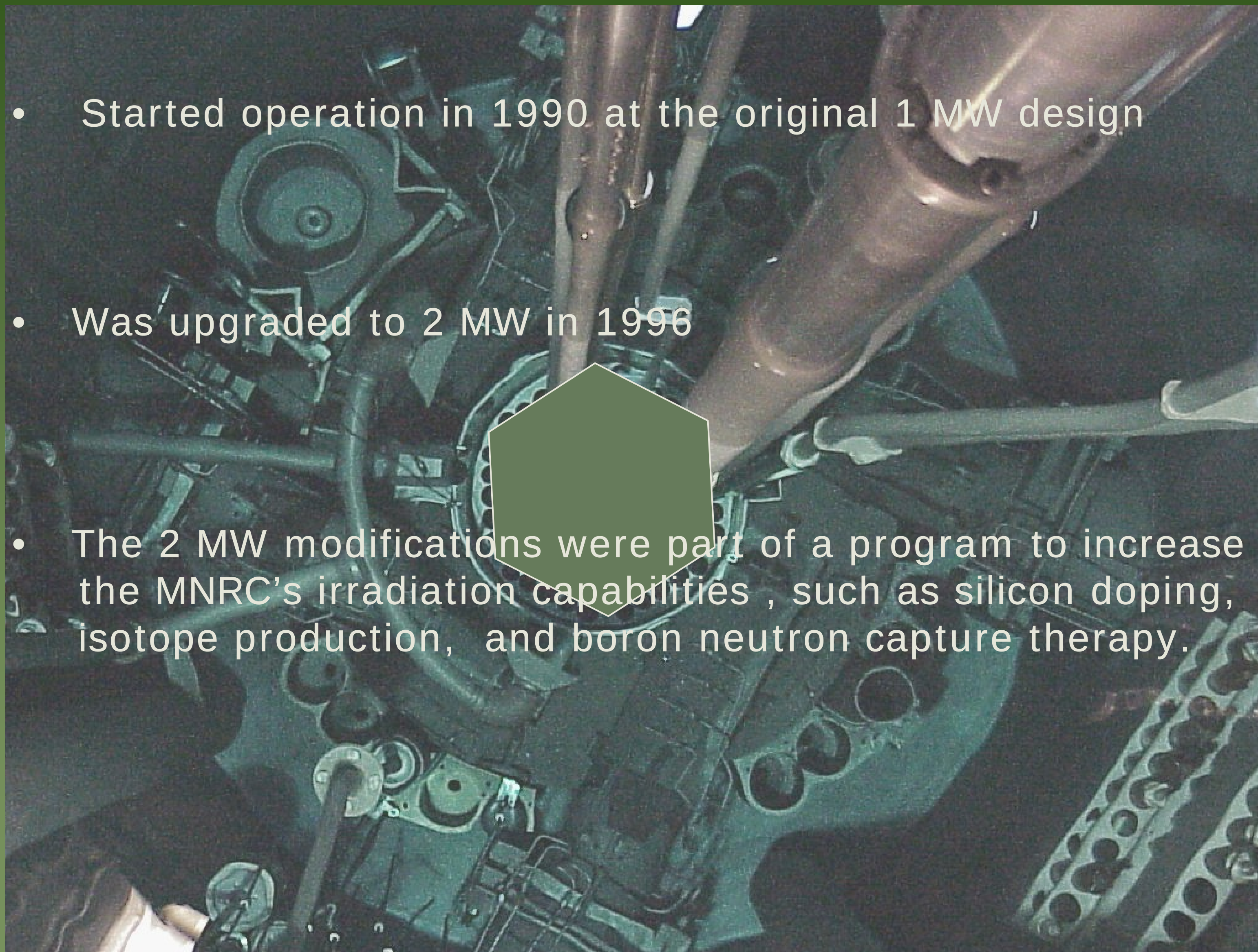
Non-Destructive Testing with Neutron Radiography

M. Boussoufi, W. Steingass, H. Egbert, H. Liu and R. Flocchini

- The UCD/ MNRC (mainly a research facility) inherited NDT capabilities from the US Air Force

- The UCD MNRC was originally developed by the US Air Force to detect low-level corrosion and hidden defects in aircraft structures using neutron radiography

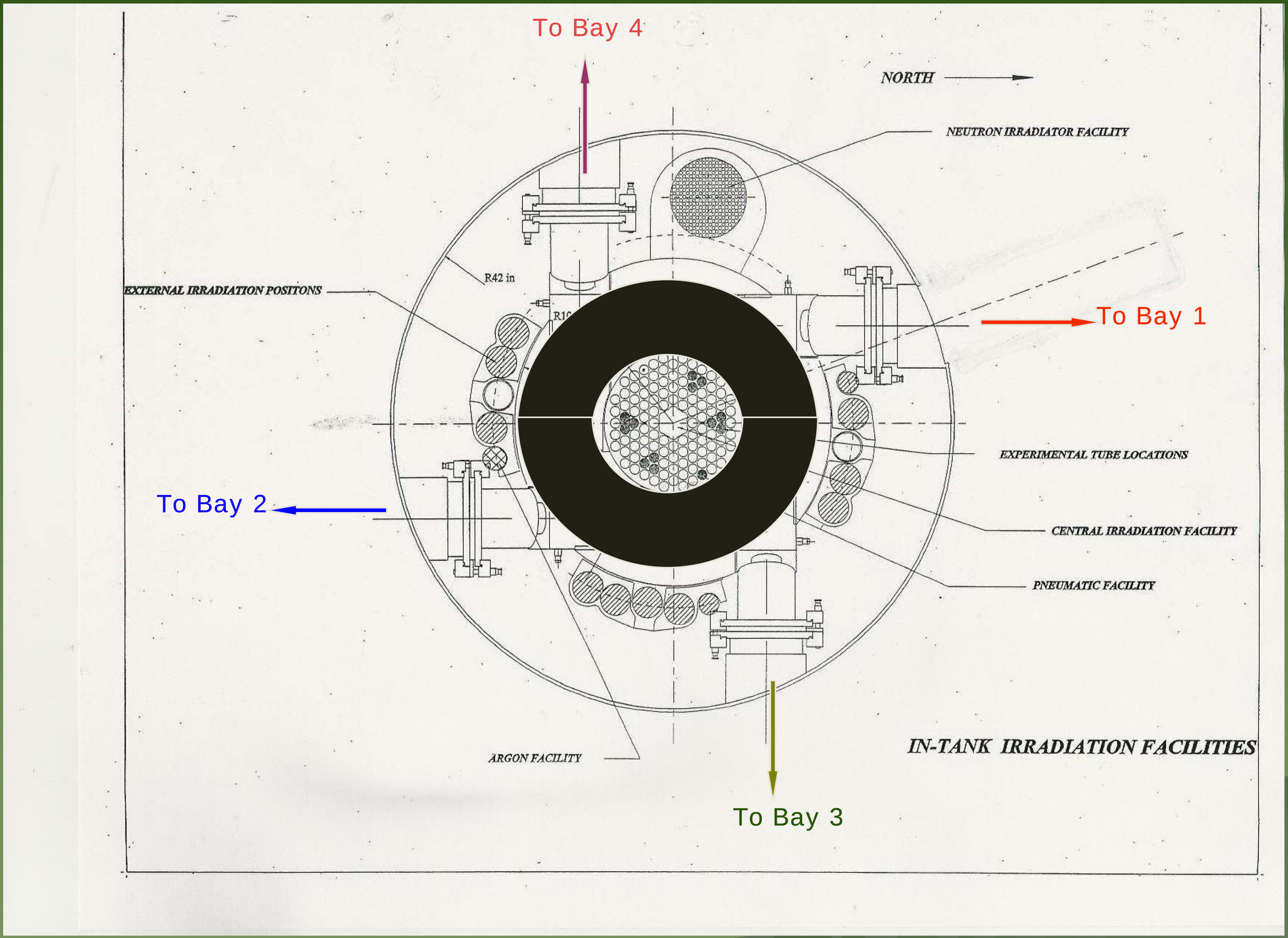
- The UCD/MNRC facility is equipped with a hexagonal grid, natural convection water cooled TRIGA reactor designed to operate at a nominal 2 .0 MW steady state power as well as in pulse and square wave mode.



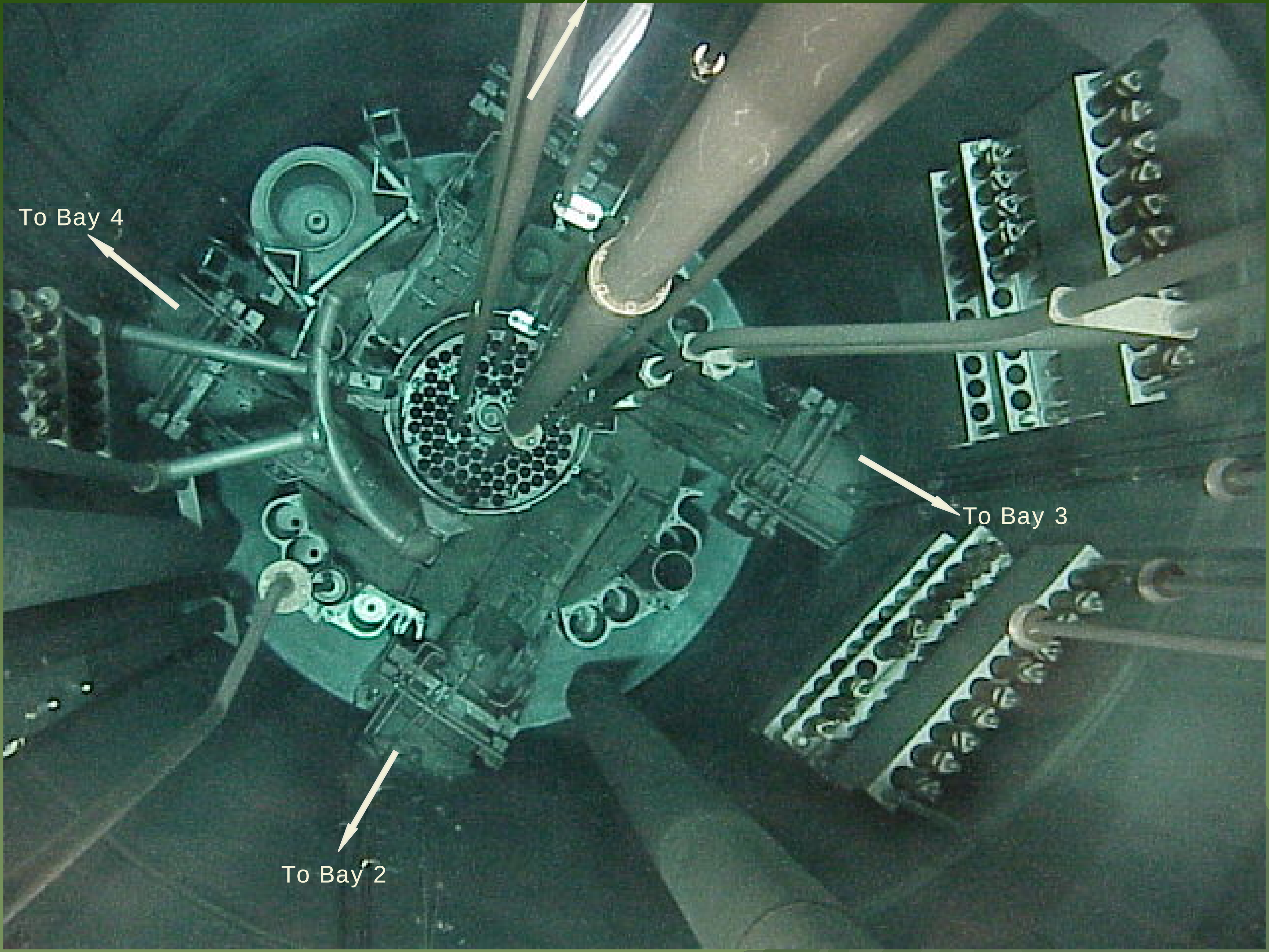
- Started operation in 1990 at the original 1 MW design
- Was upgraded to 2 MW in 1996
- The 2 MW modifications were part of a program to increase the MNRC's irradiation capabilities , such as silicon doping, isotope production, and boron neutron capture therapy.

- The reactor utilizes a specially designed annular graphite reflector accommodating four removable units to accept four separate source ends of beam tubes

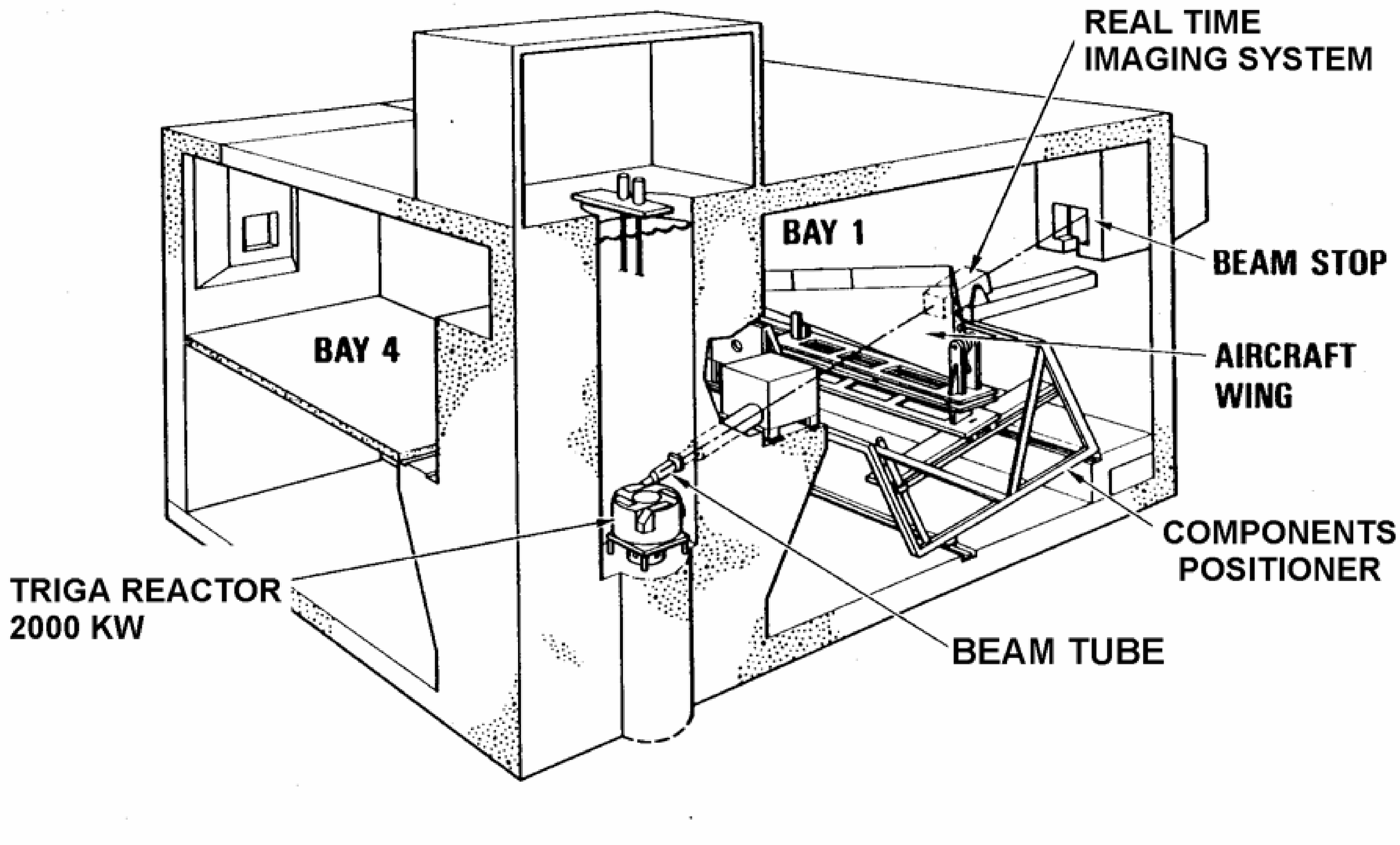
- These tangential beam tubes lead to four large investigation bays with neutron radiography capability.



- A live picture of the 4 beam inserts

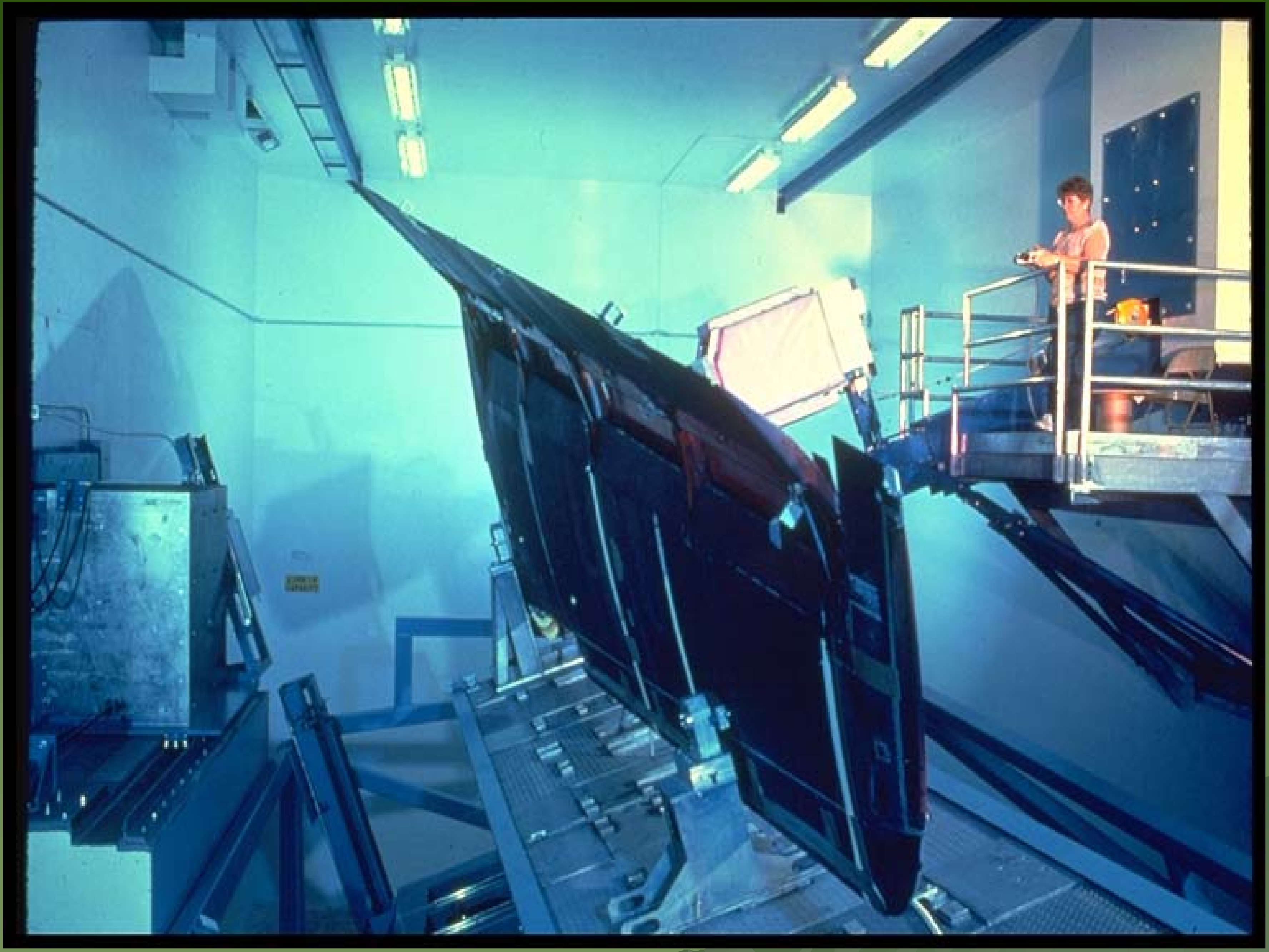


- The design basis for these beam tubes is to provide a path for primary thermal neutrons with minimum scattering and attenuation between the reflector inserts and radiography bays.

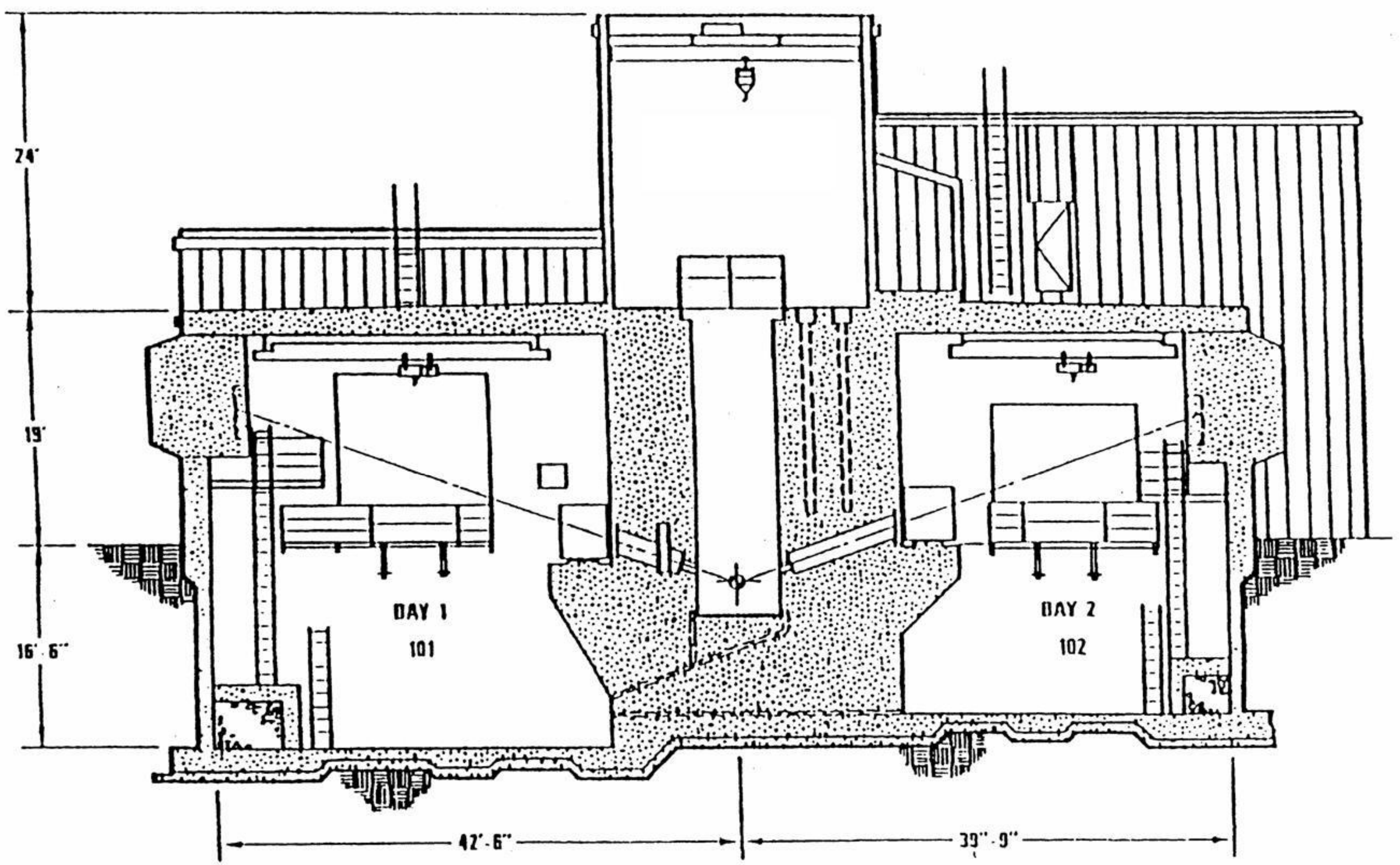


- Bay 1

• Bay 1 with an aircraft wing



- A cross-sectional view of 2 of the bays



UCD/MNRC ELEVATION SECTION B-B

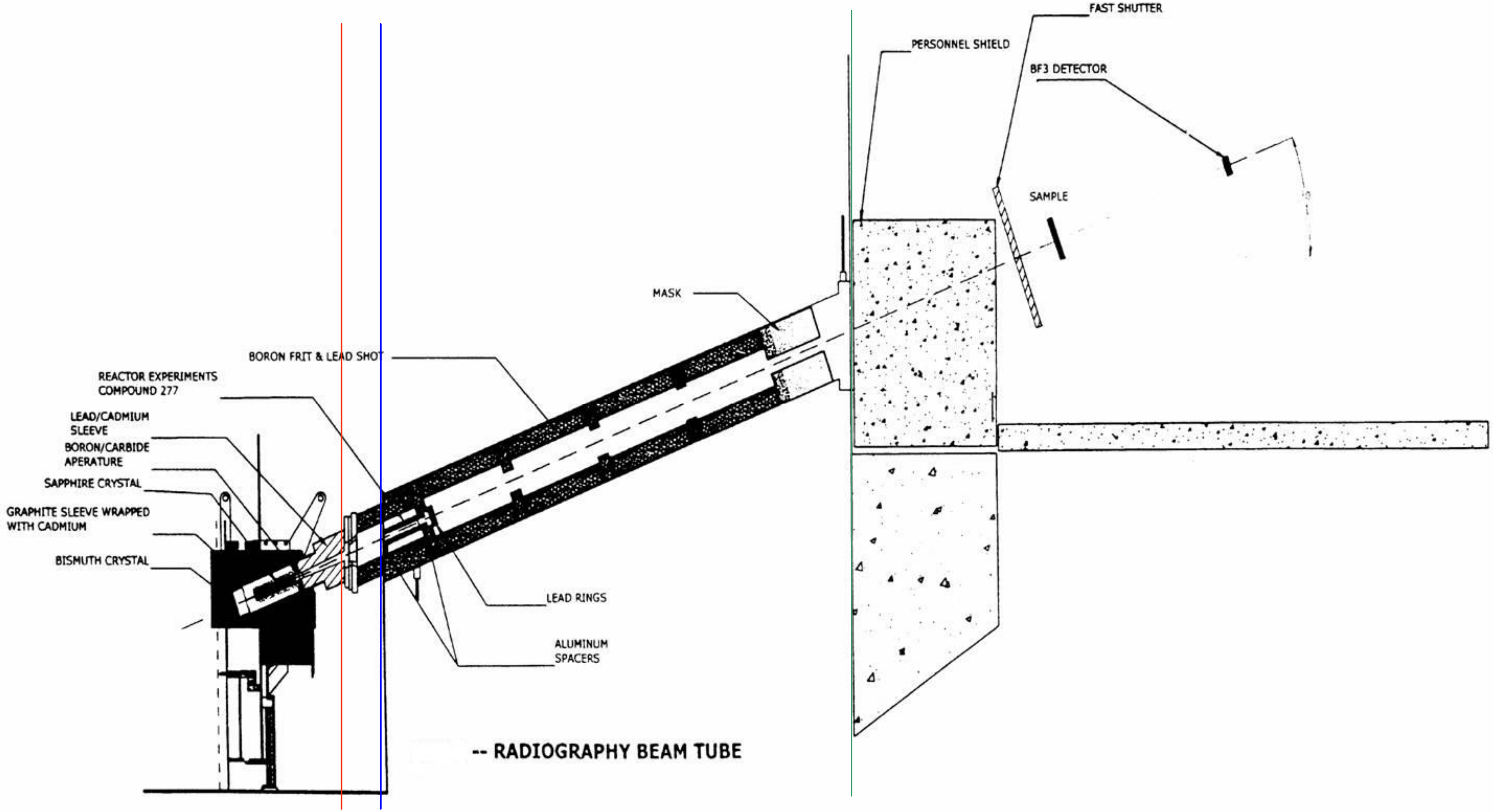
- The beam tubes are made up of 3 sections:

  * The in-tank section

  * The tank-wall section

  * The bulk shielding section

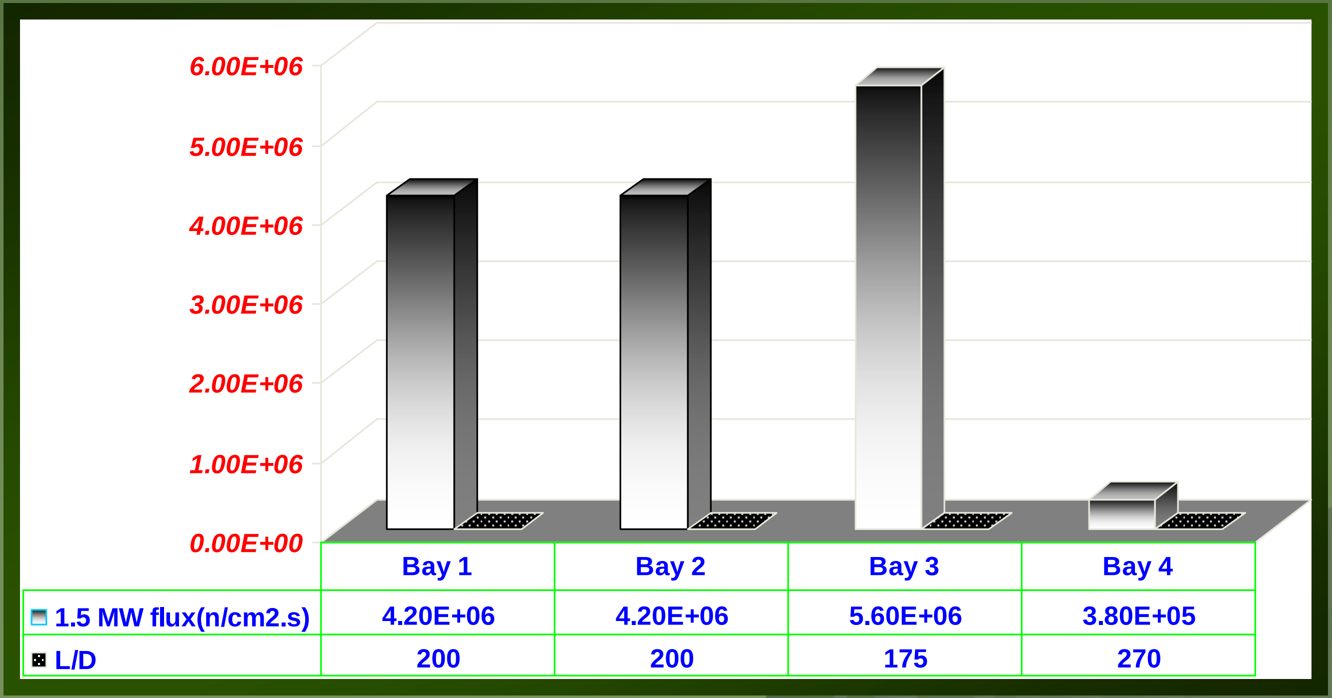
- Each beam tube ends with a bulk shield (personnel shield) and a separate boron-included fast shutter to initiate and complete a neutron exposure



-- RADIOGRAPHY BEAM TUBE

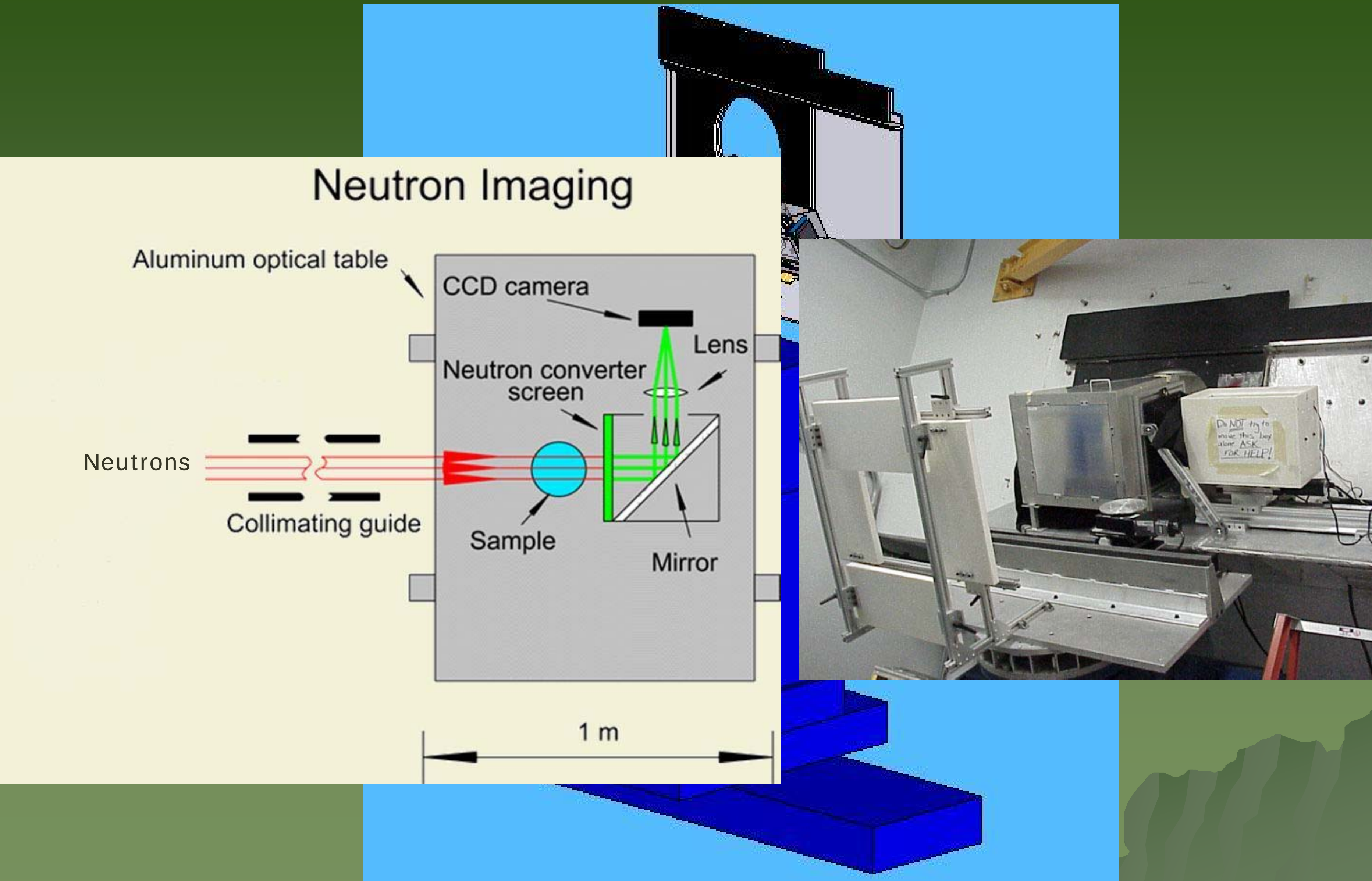
- Typical unperturbed beam parameters are summarized in the following:

Facility	Thermal Flux ($n/cm^2.sec$)	Beam Aperture (inch)	L/D Ratio
Bay 1	$\approx 4.2 \times 10^6$	1.40	200
Bay 2	$\approx 4.2 \times 10^6$	1.40	200
Bay 3	$\approx 5.6 \times 10^6$	1.54	175
Bay 4	$\approx 3.8 \times 10^5$	1.25 x 1.25	270



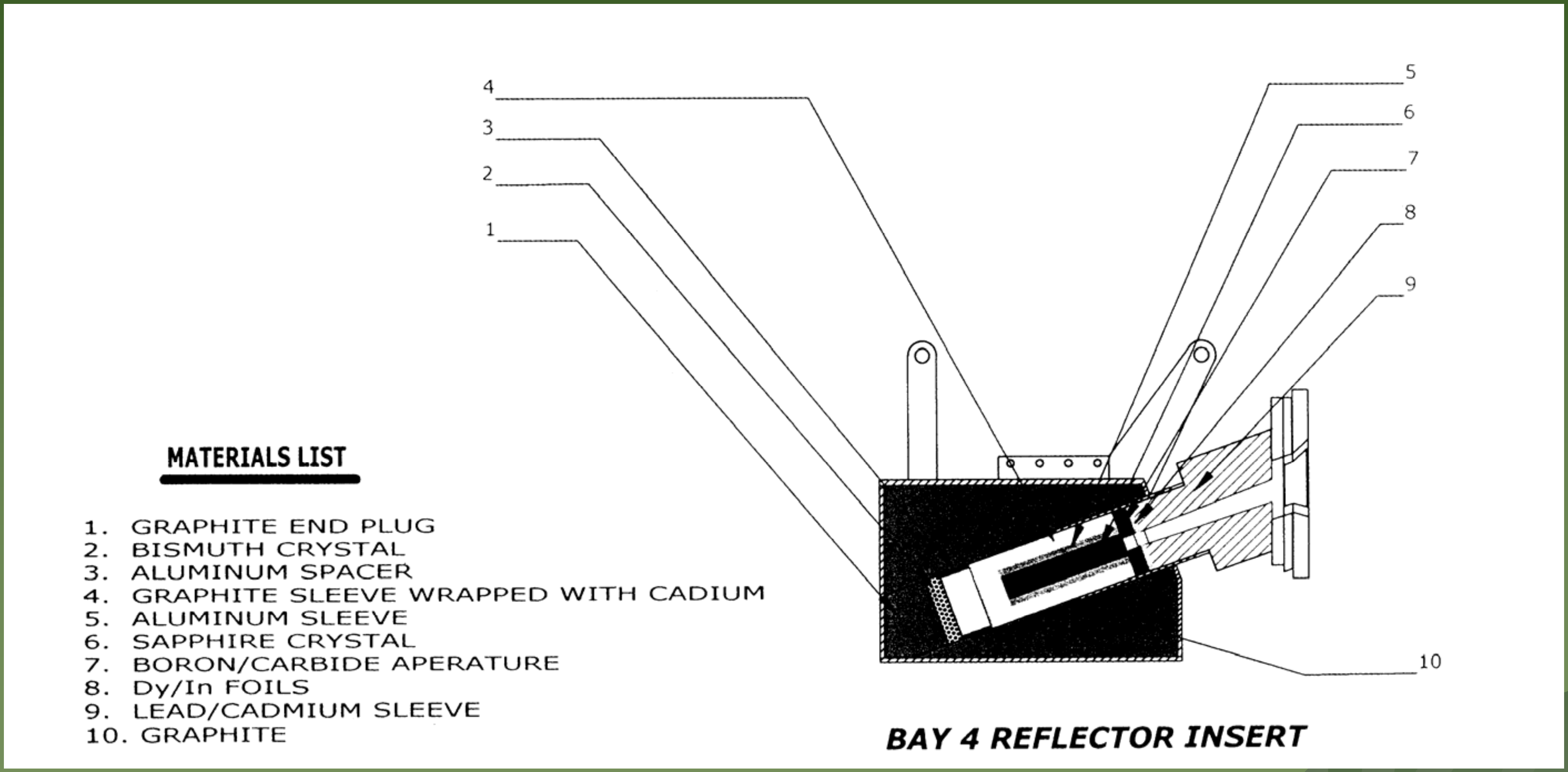
- Traditional film system and more recently computed radiography system utilizing reusable storage phosphor imaging plate (SPIP) are extensively used as 2D imaging recording media.

- Bay 3 is designed with a charge coupled device (CCD) camera with system control hardware and software to perform 3D neutron tomography.



3waymovie.avi

- Bay 4’s beam tube, different from the others, has an 11”-thick sapphire crystal filter to provide an even higher quality beam, i.e. much lower contamination from fast neutrons and gamma rays, for 2D neutron radiography.



IN CONCLUSION

- UCD/ MNRC is committed to offering state-of-the-art neutron imaging experiences for research and non-destructive testing projects.

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

- A few of many services rendered are:

 # Providing quality assurance of complicated titanium castings for aircraft.
 # Looking for corrosion/corrosion effects in Aluminum and other materials that are penetrable by neutrons.
 # Examine uniformity of 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