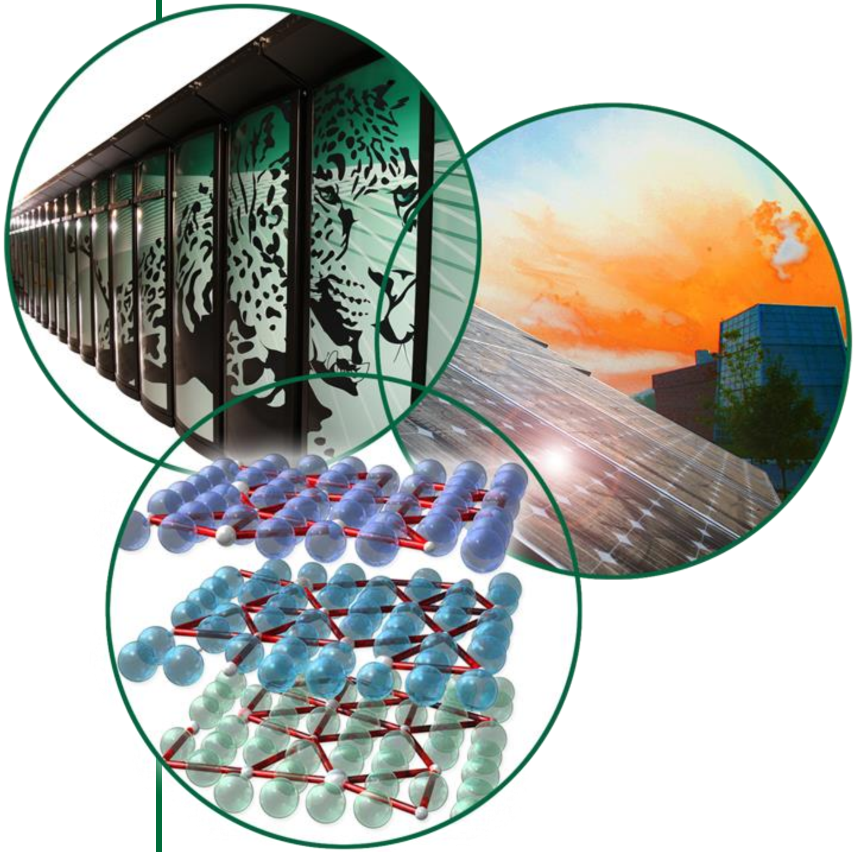
Instrument Safety Design At The Spallation Neutron Source

Greg Rowland, ORNL



U.S. DEPARTMENT OF ENERGY

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BIO

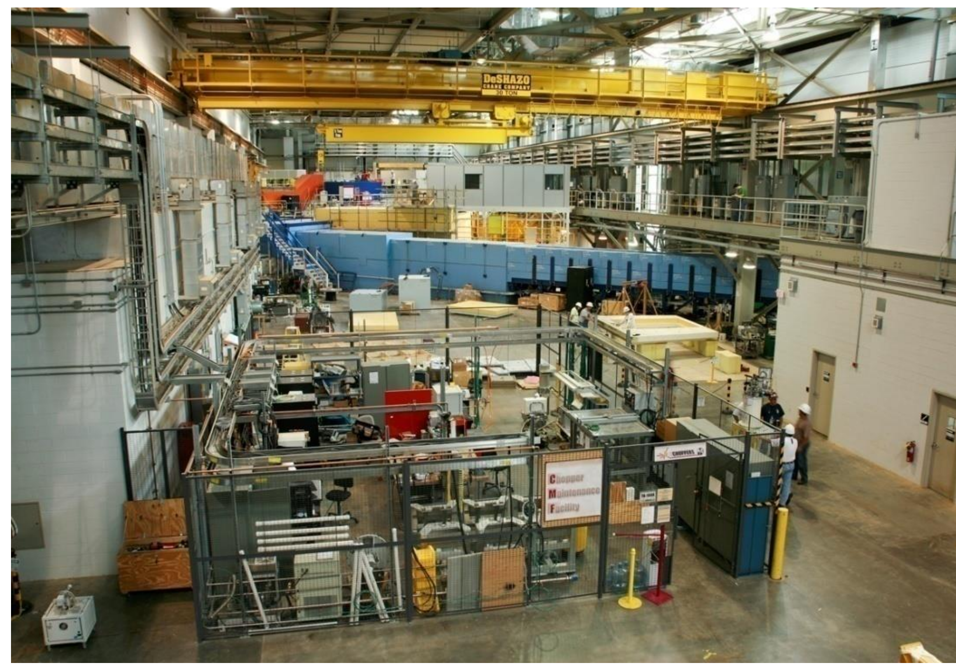
- Mr. Rowland has been employed at ORNL for 20 years and currently supports the Neutron Sciences Directorate (NScD) as a safety and health generalist. Prior to working with NScD he supported several large divisions at ORNL including several years working with the Facilities Development Division providing construction safety support and oversight. Greg has earned a B.A. degree in Biology from the University of Tennessee, a B.S. in Industrial Hygiene from the University of Houston, and an M.S. in Hazardous Waste Management from National Technological University. He is also a Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP). Before working for ORNL, he worked in the Industrial Hygiene group at a large petrochemical plant now owned by DOW Chemical.

Spallation Neutron Source

- Accelerator-based science facility.
- Became operational in August of 2006.
- Purpose is to provide neutron beams for basic and applied research and technology development in the fields of materials science, magnetic materials, polymers and complex fluids, chemistry and biology.
- Up to 2000 researchers a year using the facility.

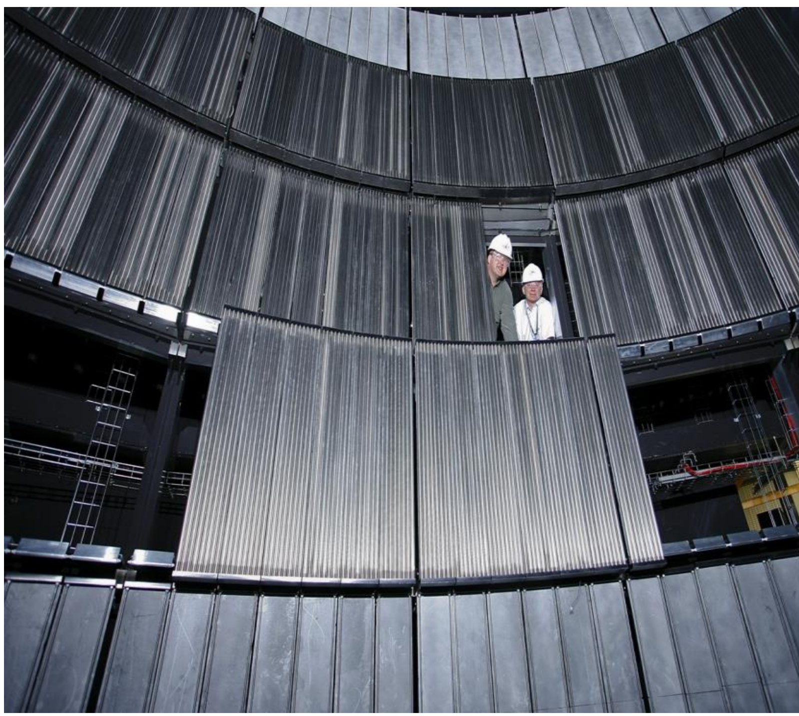
Target Building

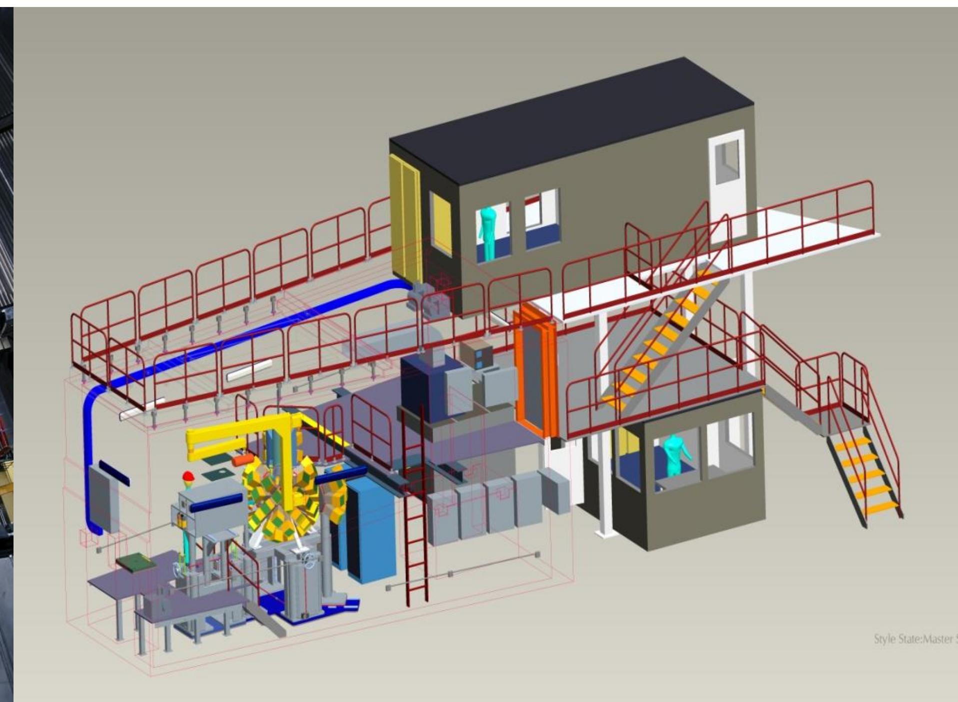
- Protons turned into neutrons and neutrons sent to instruments.
- Neutrons impact materials and scatter in different directions and give scientists information about structure, vibrations, and magnetism.
- Twelve instruments currently commissioned. Total of twenty-four when completely filled.



Instrument?

- Significant structures costing several million dollars.
- Location of significant amount of the scientific work at SNS. User facility.
- Unique in their scientific capabilities and often in there hazards.





Drivers For Design Reviews(Safety In Design)

- DOE O 420.2B, SAFETY OF ACCELERATOR FACILITIES(ARRs,PSADs,FSADs)
- DOE O 413.3A, PROGRAM AND PROJECT MANAGEMENT FOR THE ACQUISITION OF CAPTIAL ASSETS(PDRs,FDRS).
- DOE 10 C.F.R. PART 851—WORKER SAFETY AND HEALTH PROGRAM.
- Require early design review and each has a safety and health component.
- Recommendations are presented back to Instrument Scientist and Lead Engineer for review and discussion. Dialogue started.
- SNS also has design review requirements reinforced at the local level in safety plans and procedures used by the engineers to identify specific hazards.
- SNS has a Instrument Systems Safety Committee(ISSC) that convenes to review design of the instruments. Continues even after an instrument is commissioned.

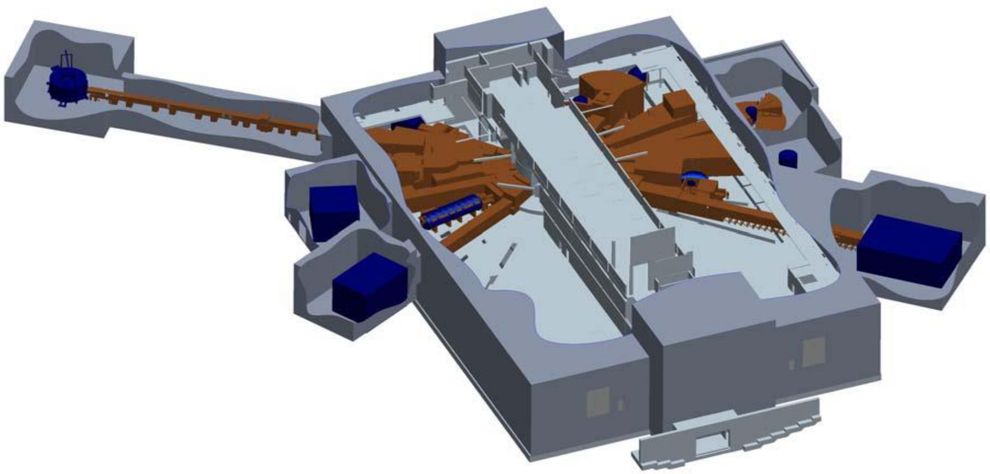
What is generated from the reviews?

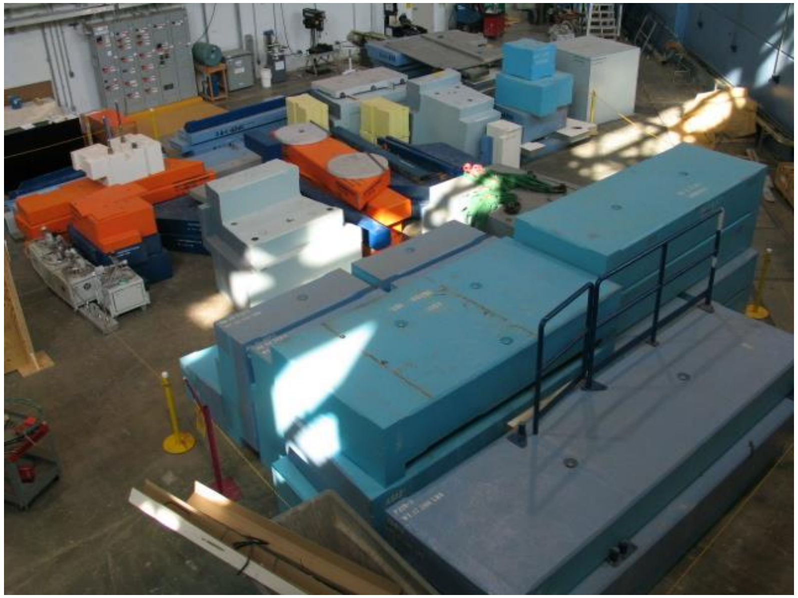
- Not just an academic exercise…
- Recommendations are formalized and responses are documented.
- Dialogue started with the instrument staff to find that balance between their science needs and identifying and controlling hazards early.

Examples…

Shielding

- Radiation is a significant hazard.
- Design goal established of 0.25 millirem per hour in all accessible areas of an instrument .
- Neutronics group that models radiation levels inside the instrument as well as outside to help designers choose shielding material and size shielding.
- Seismic component.





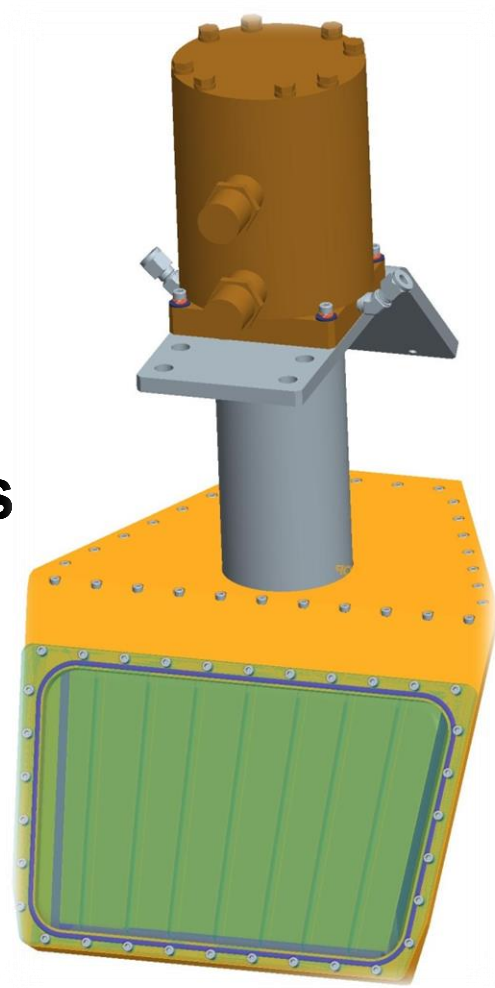
Shielding continued…

Doors…are you serious?

- Present a significant struck-by hazard(~9000 pounds).
- Standards are wanting for design specifications such as travel speed.
- A mix of controls used.

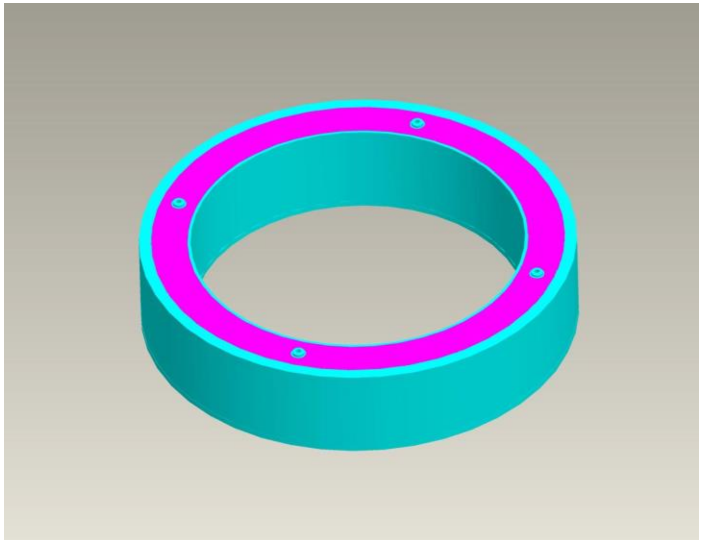
Beryllium

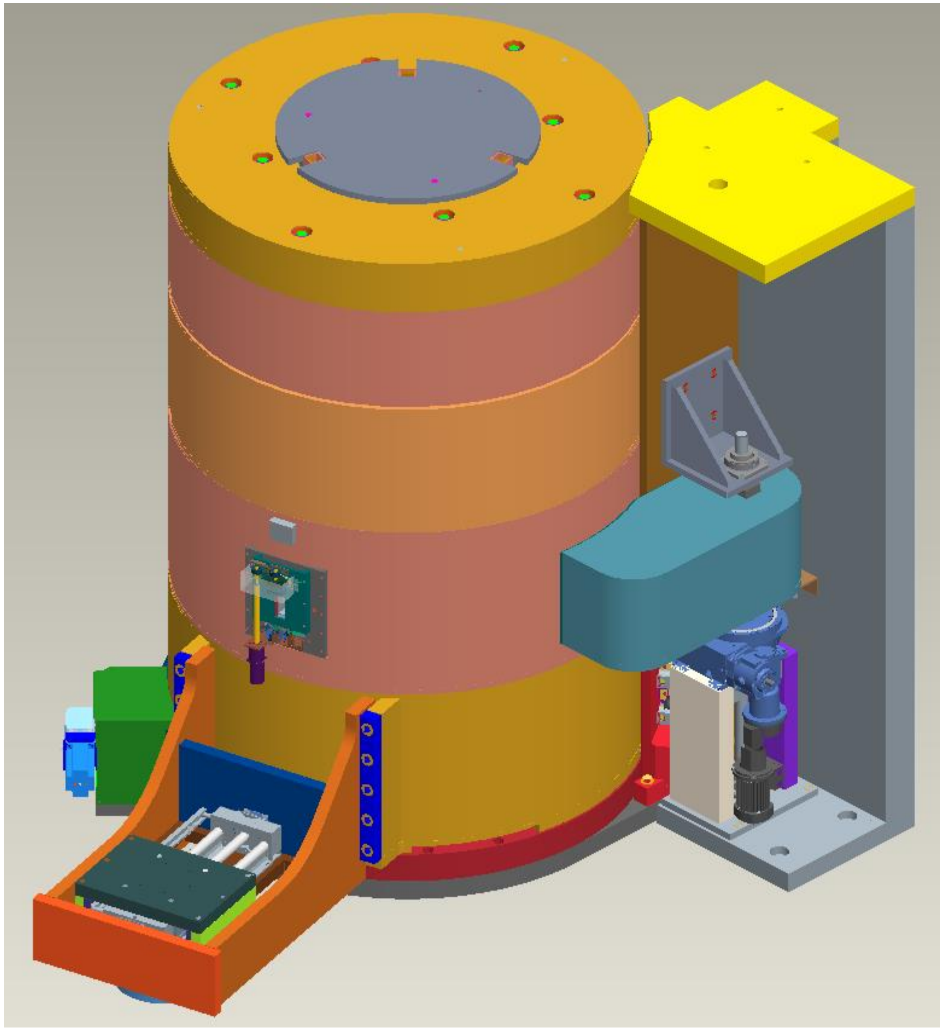
- Use is heavily regulated.
- Very useful when using neutrons for research because, in this specific application, it selects for a specific energy.
- Working with vendor to have the filters assembled at their shop and then cleaned.



Lead

- Again another material that carries a lot of regulatory baggage.
- Very useful in shielding gamma rays.
- Able to work with vendor to place lead in equipment at their shop.
- Lead provided by ORNL (recycling).





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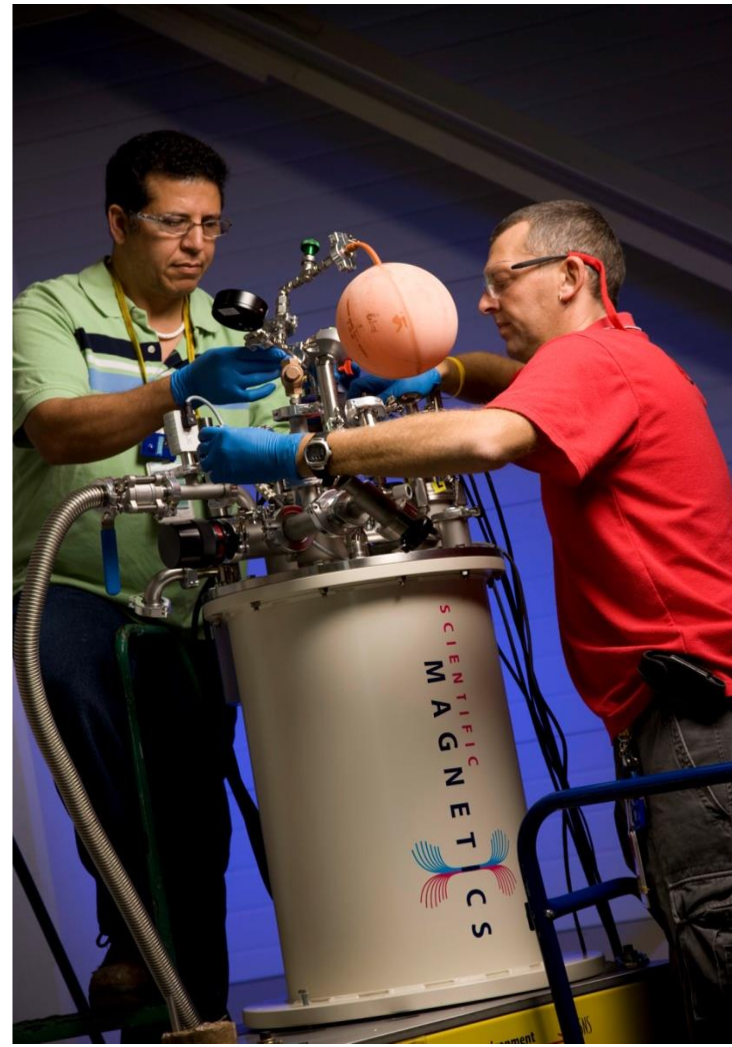
Oxygen deficiency

- **Various cryogens and inert gases used.**
- **Size of instrument "caves" and tanks easily filled.**

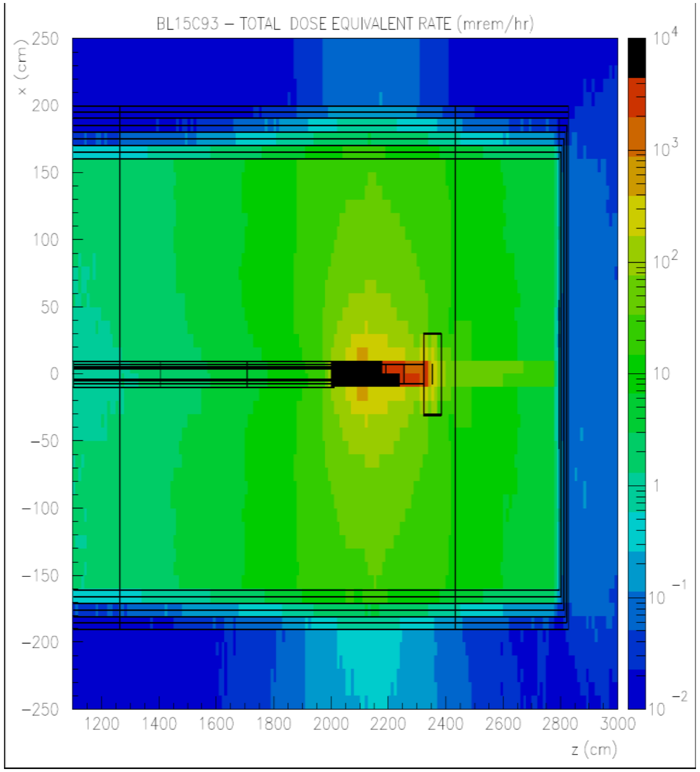


Oxygen deficiency continued.....

- “Standard” issue now on all instruments.

Radiation safety

- Significant modeling done by Neutronics group looking at worse case scenarios and dose rates.
- Robust monitoring system that will only allow entrance if beam is off.
- Additional sweep procedure performed before neutron beam allowed to sample enclosure.

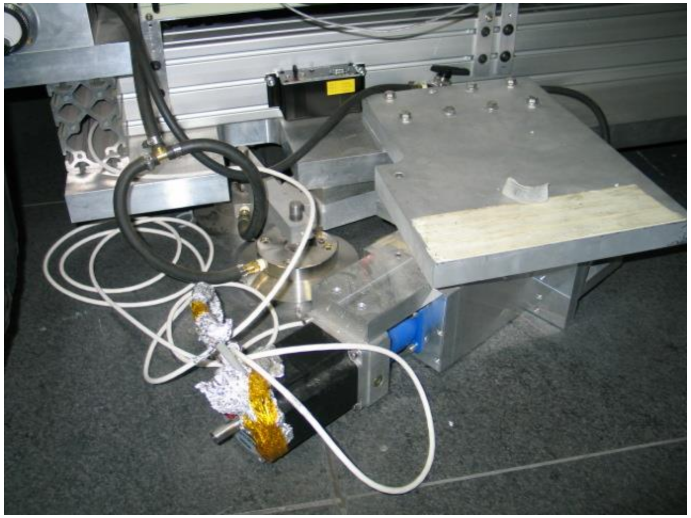


Vacuum tanks

- Pressure systems under 10CFR851 include vacuum tanks.
- No problem usually designing early for back-fill pressurization. However…..
- Sometimes we forget about the confined space standard. Can lead to "discussions" about "limited or restricted means for entry or exit."

Heavy equipment

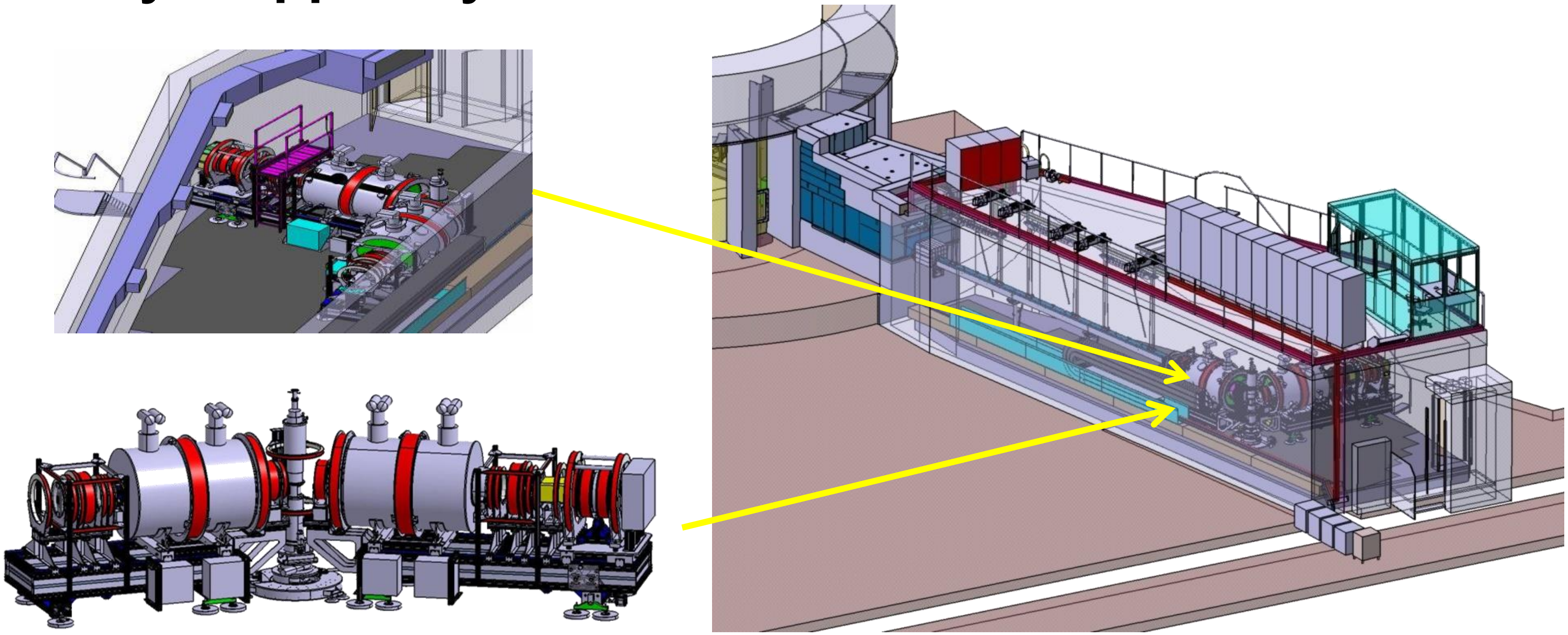
- Components(e.g., detector tables, spectrophotometers) need to move for instrument to function properly.
- Inadvertent movement of significant mass.



Heavy equipment continued….

•Five to ten ton apparatus.

•Friction wheel design allows equipment to be easily stopped by hand.



Magnetic safety

- **Magnetic fields can be generated by permanent equipment or equipment brought in.**
- **Equipment designed with shielding to keep levels low.**

Electrical cabling

- Can present significant fire and electrical hazard.
- *Spallation Neutron Source Cabling Design Criteria*
- Approval is mainly for flammability, radiation resistance, and code compliance.
- Integrated all the way down to the installation contractor.

Summary

- Realistically we cannot always completely eliminate the hazards.
- However, given the proper tools and *time* we can certainly identify hazards and then minimize them or mitigate the consequences.
- From a safety and health perspective it is a gift to be able to influence the design early on and avoid the "crisis backfit."
- Don't forget the "simple" stuff.

No system is perfect…

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Questions?