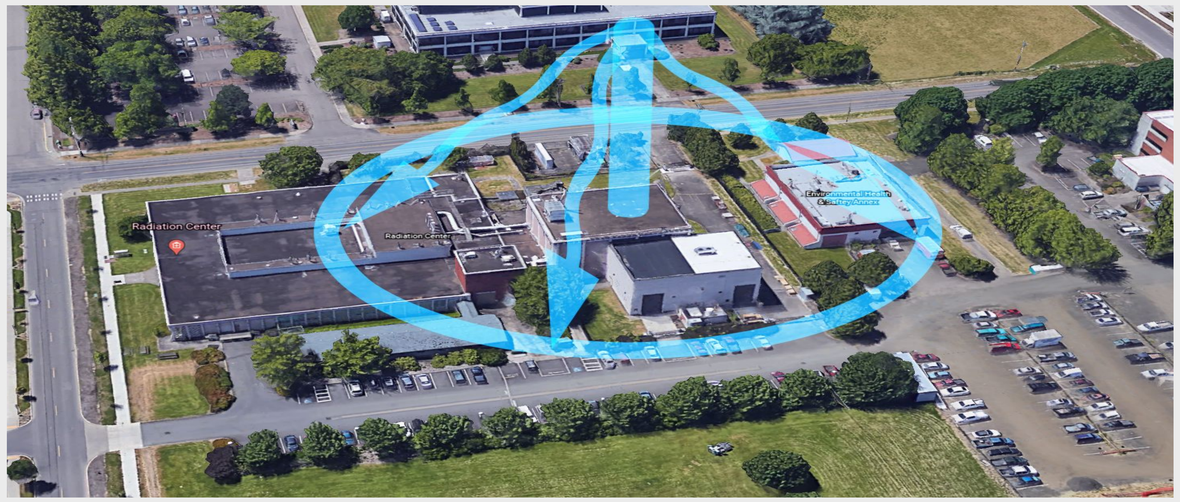
COLLEGE OF ENGINEERING

Nuclear Science and Engineering

Skyshine Dose Project

The virtual modelling and calculation of radiation dose during a loss of coolant accident at the Oregon State TRIGA Reactor (OSTR)



A visual representation of the skyshine phenomenon

Requirements & Design Selection

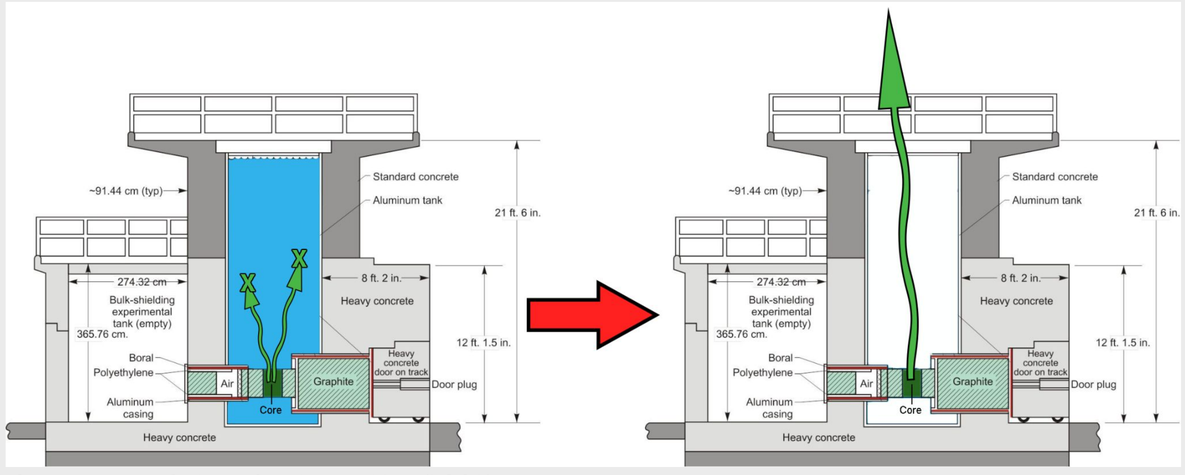
- Perform burnup and decay of OSTR
- Determine the dose rates at three locations around reactor building
  - Reactor top
  - Reactor building roof
  - Parking lot outside reactor building
- Replicate calculations done in the OSTR safety analysis report (SAR)
  - Perform further calculations for skyshine phenomenon
  - Perform SAR calculations with new burnup activity
- MCNP program selected for use of burnup calculations and virtual modelling
  - Useful for wide range of photon energies
  - Built in material libraries for attenuation and energy deposition

Design Solution

The solution is two pronged. Two out of the four person group were the MCNP team who simulated both the burn up and the skyshine dose using the MCNP code. The other two people did analytical calculations to find the dose values at the same locations as well as replicate previous calculations done with the previous data and new data generated by the MCNP team.

Implementation & Testing

- Burnup of OSTR core was performed for 1 year at 1 MW with varying periods of decay at 0 MW afterwards
  - Code performing burnup took approximately 3.5 days to run on OSU's High Performance Computing Cluster (HPC)
- Activity and photons produced were tracked at the end of each decay period
  - Tracked activity was used in replicating SAR calculations
    - created python code to approximate the complex integration required for the skyshine flux calculations
  - Tracked photons were used in MCNP to calculate dose rates
    - Code calculating dose rates has taken about 1 hour to run on the HPC for testing



Consequences of a loss-of-coolant accident (LOCA)

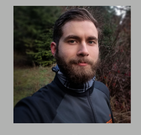
Project Status

- Adapted a previous model of the OSTR
- Completed the burnup simulations for the 5 time steps of interest
- Replicated SAR calculations using given values
- Wrote Python code to do complex skyshine calculations

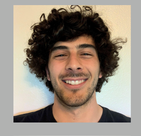
Next Steps & Future Work

- Currently working on simulating the skyshine phenomenon in MCNP
- In process of doing the SAR calculations using activity and energy values derived from the burnup simulations
- Future work could utilize different burnup codes such as Serpent or ORIGEN
  - Burnup could also be more accurate to reflect the normal OSTR operations
- Other codes could be used to track the skyshine phenomenon

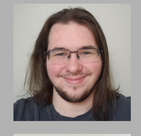
The Team



Samuel Bailey- Nuclear Engineering
Undergrad at OSU
MCNP Team



Gordon Kitchener- Nuclear Engineering
Undergrad at OSU
MCNP Team



Morgan Scott- Nuclear Engineering
Undergrad at OSU
Analytical Team

Thomas Streiff- Nuclear Engineering
Undergrad at OSU
Analytical Team

Oregon State University