



ANS NCSD

Engineering Calculation Competition

Problem Statement

You are a criticality safety engineer at a nuclear waste treatment facility. Waste is treated, conditioned, and stored at this facility, and some processes produce fissile material in solution.

You have been asked to set appropriate limits on the volume of uranyl nitrate solution that can be stored in a process tank to ensure the system remains subcritical during normal operations.

Given the specifications below, describe the parameters of concern for safe storage and movement of the uranyl nitrate solution, and the limits (administrative, engineering, or other) you deem appropriate. State any assumption clearly. Your submission may be comprised of a written draft design document, a model, an engineering drawing, or other appropriate format of your choice but make it clear to the judges how you will ensure the system remains subcritical during storage, how solution is placed and removed from the tank, and how you will prevent inadvertent criticality during normal operations.

Specifications:

- The solution is highly enriched uranyl nitrate
 - $\text{UO}_2(\text{NO}_3)_2$
 - 93% U^{235} , 5.8% U^{238} , and .9% U^{234} , and the remainder U^{236}
- Facility management wants to process as much waste as possible, and so you are asked to store as much solution as safely possible, and allow it to move in and out of the tank as quickly as safely possible.
- The company operating this facility has specific requirements for the design of the tank. It has been manufactured at an appropriate quality level from an approved vendor. Assume at this point, redesigning the tank is not a financially reasonable option. However, inlet and outlet nozzles have not yet been designed. They are waiting for your instructions on positioning and diameter. They have provided you these drawings of their tank design:



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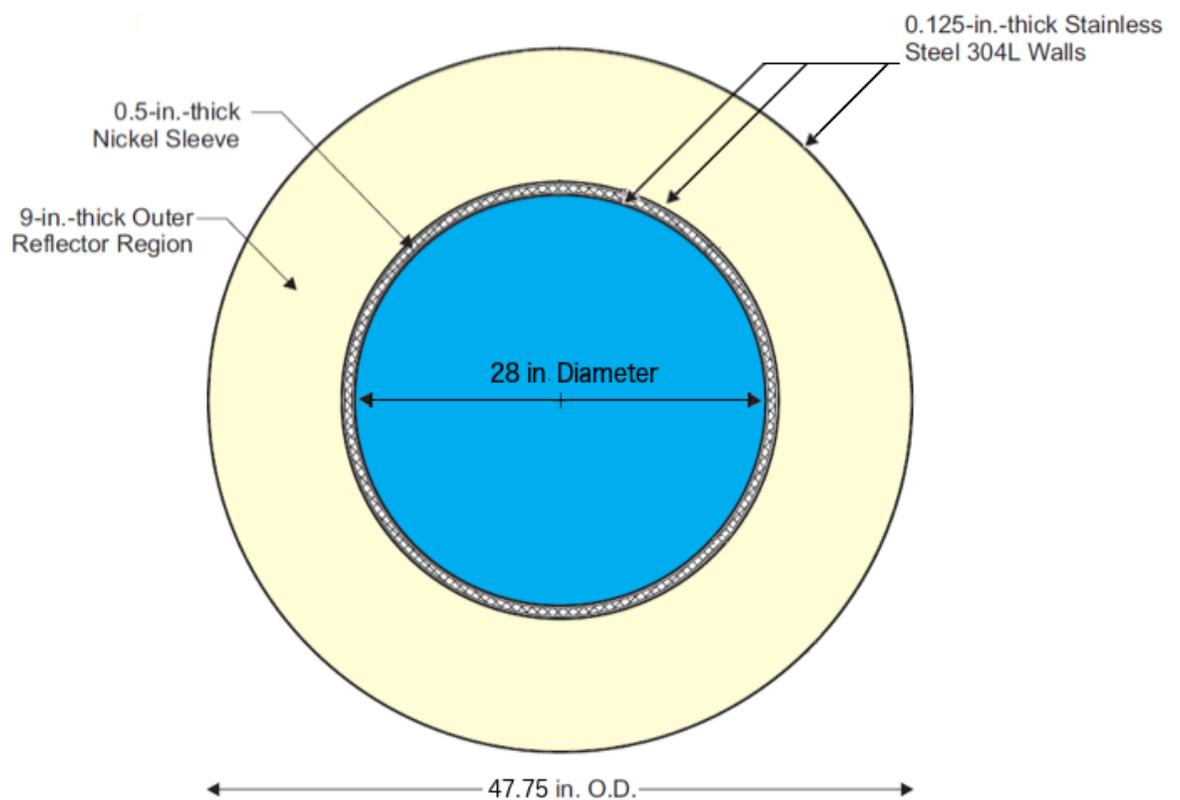


Figure 1: Top-Down View of Tank Assembly



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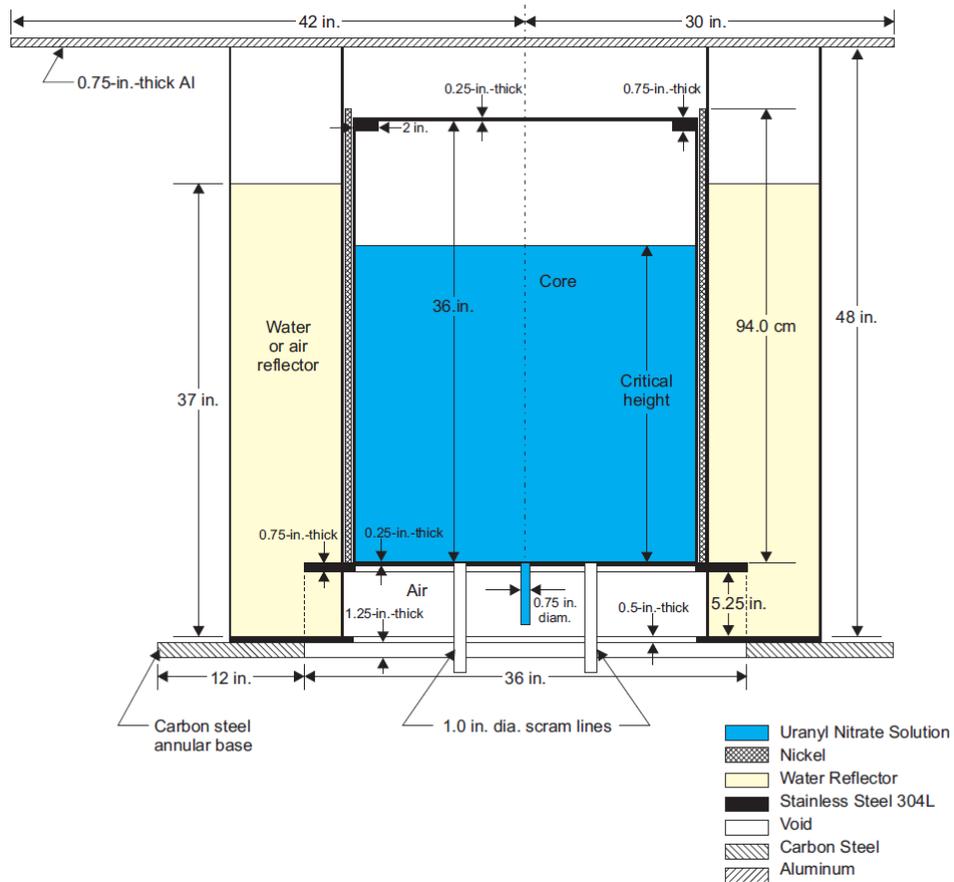


Figure 2: Vertical Cross Section of Tank Assembly

Feel free to use any references, calculations, or descriptions you feel are appropriate. Site sources as appropriate. If you have questions, please use Collaborate and post in the NCSD Competition Group. You are also free to ask any NCSD member for their guidance or advice, but please include the name of anyone who helped you in your submission. Be sure to check the rules and FAQ! Good luck.