



ANS NCS D

Engineering Calculation Competition Rules

1. The problem is open-book, open-software, open-internet, and open-resource. You may use any references, calculations, or descriptions you deem appropriate, but you must appropriately reference any resources used, from conversations with mentors to online references or textbooks. Failure to properly credit sources is a serious professional grievance, and in this competition will result in disqualification.
2. If you have questions, feel free to ask any NCS D member for their guidance or advice, but include the name of anyone who helped you in your submission. Specific technical questions can be asked of Jim Mormon, John Miller, James Bunsen, Deb Hill, Jerry Hicks, or Theresa Culter – and even if you find their email address they might not be checking it during the meeting, so finding these individuals in person is recommended. Good luck!
3. Submissions should be small enough to send as a regular email attachment. The judges will not open attachments via Google Drive or other hosting sites
 - a. However, please note that the judges will not be able to ask you clarifying questions. Please include everything in your submission you believe is necessary for the judges to understand your solution, such as descriptive text, images, tables, sample calculations, etc.
 - b. The judges will also not verify or run any codes/software/programs/etc. You may still attach things like software input decks if you feel it adds to your submission but understand we will not use any codes or software in grading and you must explain their use as appropriate if an important element of your submission.
4. Submission file names should be formatted as follows: yourlastname_filetitle.fileextension
5. Email your submission to ncsd.competition@gmail.com
6. No late submissions will be accepted. Submissions must be received by noon Eastern Standard Time on Tuesday, November 13th.
7. You must attend the NCS D awards dinner on Tuesday night to receive your prizes. All winners will receive a complimentary ticket (\$90 value). The dinner will be from 7pm-9pm at Fogo De Chao Brazilian Steakhouse, 48282 International Drive, Orlando, FL 32819. The prizes are as follows:
 - a. First Place for Undergraduate and Grad/YMG: \$150 Amazon Gift Card, official ANS award certificate, and complimentary ticket to NCS D awards dinner
 - b. Second Place for Undergraduate and Grad/YMG: Amazon Echo Dot with Alexa, official ANS award certificate, and complimentary ticket to NCS D awards dinner
 - c. Third Place for Undergraduate and Grad/YMG: Official ANS award certificate and complimentary ticket to NCS D awards dinner



ANS NCSD

Engineering Calculation Competition Problem Statement

You are a Nuclear Criticality Safety Analyst working at a plutonium production facility that regularly stores large amounts of material in vault style rooms. The company that operates the facility, Plutonium Production Inc (PPI) is in the process of building a new vault; the design process requires a nuclear criticality safety engineer to provide input to the design to ensure safe storage of plutonium metal.

You've been tasked with designing this new room, and specifying how large the vault will need to be to store plutonium safely, the size and layout of permanent storage structures such as racks or other engineered storage. PPI has provided the following specifications that the storage area must accommodate in order to be useful for their process and work performance. A few key assumptions have already been included in the preliminary design work, and you should strive to work within these bounds as well.

Specifications:

- Storage of 500 kg of alpha phase plutonium metal
- The vault can be any size
- Single storage units should range from 2,000 – 7,000 g of plutonium
- The facility wants to optimize the spacing of the storage of fissile material to minimize building costs both for the room and shelving

Assumptions:

- No abnormal conditions are to be analyzed
- All storage units are equally spaced apart
- The only material stored is full density, metal plutonium
- Critical Sphere Mass
 - Reflected – 5.8 kg
 - Unreflected – 10.6 kg

PPI management has requested a detailed report on your design recommendations, to be included in a final design which you will be required to review and approve. Your report must include at a minimum:

- an estimated volume of your vault design

- detailed explanation of methods used to ensure a subcritical storage configuration, and technical justification of your approach
- a detailed description (i.e. text or drawing) of the size and layout of the room, including:
 - dimensions of all walls
 - the size of the fissile storage array (how many units within the array, dimensions of the array, and containerization of the stored units, etc)
 - how much material is being stored in each location.
- Discussion of any potential abnormal conditions along with their potential effects on the subcriticality of the system – but it is not necessary to analyze these conditions in detail
- Justification of any further assumptions beyond those provided by PPI
- Address the practicality of your design with respect to the functionality of the room. This may include the geometry of fissile units (spheres, cuboids, cylinders), and/or the feasibility of the fissile array
- Consideration of safety, cost, feasibility, and other relevant engineering design factors
- Any shortcomings of your evaluation or design

You may use any references, calculations, or descriptions you deem appropriate to bound your analysis. Be sure to comply with the rules at the front of this packet, and check out the FAQ that follows this problem statement. Good luck!



ANS NCSO

Engineering Calculation Competition FAQ

Who can compete?

- Current students and young members attending the ANS Winter Meeting
- Undergraduates will be graded separately from graduate students and young members.

When is the competition?

- The competition opens on Monday, November 5th and final submissions must be received by noon Tuesday, November 13th. Solutions will be emailed to ncsd.competition@gmail.com and only those time stamped before noon local time will be eligible.
- A special hints segment will be conducted during the NCSO Education Committee meeting on Sunday November 11th at 1pm in the Nassau room. Stop by for some tips and a chance to ask questions.

How do I know if I win?

The first through third place winners of the undergraduate and graduate/young member categories will be contacted via the email used to submit their competition entries. The winners will be invited via email to attend the NCSO awards dinner Tuesday November 13th from 7-9pm at Fogo De Chao Brazilian Steakhouse, 48282 International Drive, Orlando, FL 32819. All 6 individuals who place will receive a complimentary ticket to the NCSO awards dinner (a \$90 value) Tuesday evening and an official ANS award certificate.

- o First Place for Undergraduate and Grad/YMG: \$150 Amazon Gift Card, official ANS award certificate, and complimentary ticket to NCSO awards dinner
- o Second Place for Undergraduate and Grad/YMG: Amazon Echo Dot with Alexa, official ANS award certificate, and complimentary ticket to NCSO awards dinner
- o Third Place for Undergraduate and Grad/YMG: Official ANS award certificate and complimentary ticket to NCSO awards dinner

The solution to the problem will be presented during the NCSO Hand Calculation morning technical session on Wednesday, November 14th. This session is open to any who are interested in learning the process required to solve the kind of sample problem highlighted in the calculation competition. If you

want to see where you can improve, or how an NCS D professional would solve this problem, be sure to attend the session.

Can I ask for help?

- Yes! You are encouraged to find NCS D members and ask for technical tips and assistance in your approach to the problem. You are free to ask anyone as long as you credit your sources, but it is recommended you find knowledgeable NCS D members who have professional experience with these kinds of problems. You can identify knowledgeable division members by the radiation symbol sticker on their name badges:



And don't forget to take advantage of the hints session during the NCS D Education Committee meeting, Sunday November 11th at 1pm in the Nassau room. Stop by for some tips and a chance to ask questions.

What do I have to do to compete?

- Go to ncsd.ans.org to download the problem statement. Propose a solution and send it to the provided email. Your solution may include a basic physics hand calculation, a computer model, a statement of safety and reasonability, or some other justification to explain why it is a satisfactory solution. You may reference US standards or regulations, other documented safety analysis, or findings from nuclear safety incidents. The problem is broad, and as in real life there may be many 'right' ways to solve the problem. The judges will grade the submissions on technical merit, completeness, and choose the best answer as the winner.