LA-UR-17-25165
Approved for public release; distribution is unlimited.

Title: Development of Criticality Safety Pipeline Courses at Partnering Universities

Author(s): Bunsen, James Clark
Wade, Elijah Daniel Yongson
Wysong, Andrew Russell

Intended for: American Nuclear Society Winter Meeting, 2017-10-29 (Washington D.C., District Of Columbia, United States)

Issued: 2017-10-24 (rev.1)

Development of Criticality Safety Pipeline Courses at Partnering Universities

James Bunsen, Elijah Wade, Andrew Wysong

Los Alamos National Lab, Mail Stop E585, jbunsen@lanl.gov elijahw@lanl.gov wysong@lanl.gov

INTRODUCTION

A Nuclear Criticality Safety (NCS) Pipeline is being created to overcome the challenges in NCS staffing and to expedite the qualification timeline of Criticality Safety Analysts (CSAs). Staffing is currently a challenge due to the high demand across the Department of Energy Complex. At LANL, this is coupled with high work demand and an aggressive program improvement schedule. The time required to qualify a CSA exacerbates the staffing shortage as initial qualification takes upwards of 18 months. For many years NCS organizations operated within an expert based paradigm. The issue with this approach is that as attrition of these experts occurs (especially in rapid succession) the expertise and historical understanding are lost along with them. Largely to combat this issue updated regulatory orders and standards require NCS organizations to shift to a compliance based paradigm of operation involving rigorous documentation. This compliance based paradigm assists with turnover and a broadened understanding of NCS within an operation, yet increases the time required to document the safety of an operation.

The NCS Pipeline intends to expose students to the field of NCS and begin their qualification training while still in school. Students participating in the NCS Pipeline will take an NCS course during their junior year, after which, the highest performing students will receive an internship within the Nuclear Criticality Safety Division (NCSD) at Los Alamos National Laboratory (LANL). Upon a successful internship, students will be encouraged to continue training through their senior year via part time employment and once complete, potentially receive a full time staff position at LANL. Inroads have been made at New Mexico State University (NMSU), University of New Mexico (UNM), and Texas A&M University (TAMU) who have all expressed interest in participating in the development of the NCS Pipeline. The students at the end of the NCS Pipeline will be much further along in qualification than a typical new hire straight out of university and likely only lack facility specific training. Additionally, the students will have already self-selected into the discipline and be familiar with LANL facilities, NCS history, and NCSD personnel – all helping the retention of new employees within the division.

DESCRIPTION OF WORK

The NCS Pipeline course will be primarily the same content but is tailored slightly for each university taking into account existing courses that students will have completed or will be taking concurrently. For example, NMSU does not have a nuclear engineering program and thus there are no prerequisites to take the NCS Pipeline Course whereas TAMU has a well-developed nuclear engineering program. The course at NMSU will require more material on nuclear physics and criticality where TAMU students will have a previous exposure to these topics and will only require a brief refresher. The NCS Pipeline will have similar course objectives across each university which will include and are not limited to:

- Demonstrating a basic understanding of nuclear fission
- Explain and define what criticality is and how safety applies to preventing criticality
- Understand what MAGICMERV stands for and how it applies to criticality
- Discuss past criticality accidents
- Describe the ANSI/ANS criticality safety regulations
- Describe DOE regulations and practices in NCS
- Identify and understand how to preform common hand calculations for criticality
- Describe the methodology supporting Monte Carlo Codes and Deterministic codes and how they should be applied
- Understand the importance of validation of computer codes and how validation is accomplished
- Complete a Criticality Safety Evaluation (CSE) as a course project

Current University Participants

New Mexico State University

The course at NMSU will be offered online to juniors and senior through the Chemicals and Materials Engineering Department. The course will be co-taught by the LANL NCSD Leader and a qualified

CSA. The NCS Pipeline course will be taught using a combination of PowerPoint coupled with notes, weekly discussions with peer review, and assigned reading from an NCS textbook.

Texas A&M University

The TAMU course will be offered to juniors and seniors within the Nuclear Engineering Department who have completed course NUEN 302, Introduction to Nuclear Engineering II. The class will be taught in conjunction with course NUEN 301, Nuclear Reactor Theory, which discusses k_{eff}, geometric buckling, and many other topics related to criticality. The NCS Pipeline course will take these topics taught in 301 and 302 and apply them to NCS. The course will have an introduction to MCNP which students will be required to apply the methodology to a CSE.

University of New Mexico

The integration of required content for CSA Qualification into the UNM curricula is still being discussed. The material will likely serve as an additional certificate that students can pursue alongside the already offered reactor theory course; however no final decisions have been made as of this writing.

RESULTS/FUTURE WORK

The LANL NCS Pipeline is being launched at NMSU, UNM, and TAMU this coming fall, 2017. LANL NCSD anticipates that between 6-8 students will take the course at each university giving the division a large pool of potential applicants for the coming 2018 summer internship program. In addition, this also gives the NCS Pipeline a base to expand from. Additional universities have expressed interest in integration with the NCS Pipeline in future years.

NOMENCLATURE

NCS – Nuclear Criticality Safety
CSA – Criticality Safety Analyst
NCSD – Nuclear Criticality Safety Division
LANL – Los Alamos National Laboratory
UNM – University of New Mexico
NMSU – New Mexico State University
TAMU – Texas A&M University
NUEN – Nuclear Engineering
MCNP – Monte Carlo Neutron Particle Transport
MAGICMERV – Mass, Absorption, Geometry, Interaction, Concentration, Moderation, Enrichment, Reflection, Volume

ENDNOTES

Additional development of the LANL NCS Pipeline is ongoing and there is planned expansion in future years to include additional universities and a more extensive program.