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Title:	University Pipeline (with UNM) for Criticality Safety Professionals
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University Pipeline (with UNM) for Criticality Safety Professionals

NCS at LANL:

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UNM Faculty:

Dr. Christopher Perfetti

Outline

- Scope of University Pipeline
- Participating Universities
- Benefits of University Pipeline within DOE Complex
- Impact of University Pipeline at LANL
- University of New Mexico (UNM) Pipeline
- UNM Graduate Student Project

Scope of University Pipeline

- The scope of the University Pipeline is to provide students with knowledge of NCS, and to inspire students to pursue a career in NCS after graduation.

LANL NCS Pipeline Participating Universities

- New Mexico State University (2017)
- Idaho State University (2018)
- Texas A&M University (2017-Present)
- University of California-Berkeley (2018-Present)
- University of New Mexico (2020-Present) – NCSP Funding

Benefits of University Pipeline

- The university pipeline results in several benefits:
  - reduced training time and costs
  - interested students will naturally self-sort and pursue the discipline at the university level
  - a pipeline of criticality safety candidates is readily available within the DOE Complex so that unexpected organizational or mission changes can be reacted to with increased agility.

Impact of University Pipeline at LANL

- Over 80 upper level-classmen have been introduced to NCS
- ~20 students have participated in summer internships
- ~8 summer students offered part-time positions
- ~8 summer interns offered full-time positions
  - 4 reached full qualification
  - 3 working toward full qualification

- Over 30 Criticality Safety Evaluation Documents issued
- Over 8 Technical Documents issued

UNM Pipeline

- Bring awareness of the NCS career to our local communities
- Contract established 2021
- Establishes collaboration between faculty and staff at LANL and UNM
- Original scope: NCS undergrad/grad course
- Expanded scope: NCS undergrad/grad course and Graduate Student Project

Two Team Approach

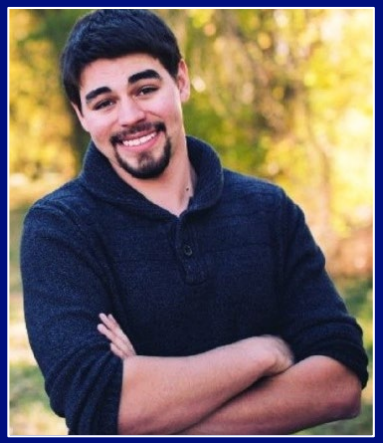
- Team 1: Support students and staff in topics of Nuclear Criticality Safety at UNM during university semesters

- Team 2: Graduate student project mentorship

Team 1: UNM Pipeline Team at Los Alamos National Laboratory

Norann Nell Calhoun

- B.S. Chemical Engineering **NMSU**
- ~4 years at LANL and in NCS
- TSQP Certified Classroom Instructor at LANL



Kaelin Glover

- B.S. Nuclear Engineering **UNM**
- ~4 year at LANL in NCS
- Sr. year worked remotely for NCS
- Summer Internship

Mandy Bowles-Tomaszewski

- B.S. Nuclear Engineering **ISU**
- ~5 years at LANL in NCS
- **University pipeline POC**
- Student intern liaison

Bill Crooks

- Ph.D. Inorganic Chemistry **FSU**
- ~18 years at LANL
- ~4 years in NCS
- Started in academics
- Transitioned to support Pu processing at Savannah River

Team 1 Duties

- NCS at LANL helps to support Dr. Perfetti's Criticality Safety course
- Give real world examples of criticality safety in the industry
- Provide opportunity for summer internships and hiring opportunities
  - Students have to go through full interview process

PROCESS EVALUATION WORKSHOP

Situation No. 2

1. Control Parameter	2. Subcritical Limit	3. Process Change	4. Safety Control	4. Quality of Control
mass	≤450g	double batching [in dissolver]	NDA	
			visual inspection of dissolver	
geometry/ mass	≤ 15.4 cm diameter piping ≤ 5.5 cm filter thickness ≤ 450 g	holdup	Inspect filter every 9th batch	
concentration/ geometry	≤ 7.3 g/L ≤ 15.4 cm diameter pipe	holdup double batching	In-line concentration monitor after filter	

Team 2: UNM Graduate Student Project

Dr. Christopher Perfetti

- UNM Assistant Professor 2018-Present
- Ph.D. Nuclear Engineering and Radiological Sciences **UM**
- NE410/NE510, NE499/NE515, NCS, Nuclear Reactor Theory, Nuclear Reactor Kinetics and Dynamics

Jennifer Alwin

- Senior Qualified NCS Analyst
- Educational background in ChE and NE
- 24 years at LANL
- MCNP Instructor
- Member Criticality Experiments Safety Committee

Team 2 Duties

- NCS to provide graduate students with project topic
- Mentor graduate students weekly
- Invite students to LANL meetings pertaining to project topic

Graduate Student Project

- For MCNP6 models
  - need to know geometry and materials in fissionable material processes
  - or assumptions must be made and quantified for the impact to bias
- One of the systems with a significant amount of bias due to material modeling assumptions is in the area of aqueous plutonium processing
- These are typically plutonium nitrate and plutonium chloride solutions
- They are currently modeled as fictitious plutonium metal-water mixtures
- Little is known about the actual density of the solution and/or no predictive capability approved for use at LANL for modeling them

Materials:
Solution Weight Fractions H-1, H-2, O-16, Pu-239

```
c Water
m200 1001.80c 2.0
     8016.80c 1.0
mt200 lwtr.20t
c PU
m300 94239.80c 1.0
c
C ----------------------------------------
C Pu-239 Metal/Water Mechanical Mixture
C
C ----------------------------------------
C Pu Metal/Water Mechanical Mixture:  1.24 g/cc
m100  1001.80c   -0.0892702573697133
      1002.80c   -2.05190204144513e-05
      8016.80c   -0.708672563732072
      94239.80c  -0.2020366598778
mt100 lwtr.20t
      hwtr.20t
C 0
C Pu Metal/Water Mechanical Mixture: 18.09 g/cc
m400  1001.80c   -0.000573450074917905
      1002.80c   -1.3180911695121e-07
      8016.80c   -0.00455233743845233
      94239.80c  -0.994874080677513
mt400 lwtr.20t
      hwtr.20t
C 0
```

Graduate Student Project Cont.

- 2 graduate students to start work on the plutonium nitrate and plutonium chloride densities
- This research will fill the gap and develop an algorithm for use with MCNP6 to model the density of the solutions
- The method will be validated with experimental data for density and also validated with critical experiments using MCNP6
- The broad objective of this research is aimed at implementing a plutonium nitrate and plutonium chloride density law, and to provide meaningful tools for which a working density law can be derived

Summary

- University pipeline benefits DOE Complex as a whole-students readily available to fill mission needs
- Internal to LANL- We have been able to see the benefits with retention rates and work output
- Impacts the local community in a positive manner
- Graduate Student Project- Will improve knowledge of solution densities and modeling conventions for all users of MCNP6

Questions?

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On behalf of the NCS Division at LANL, I would like to thank the NCSP management for their continued support.