# Overview and Status Update of the Nuclear Criticality Safety Training and Pipeline Program

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Nuclear Criticality Safety Program (NCSP)
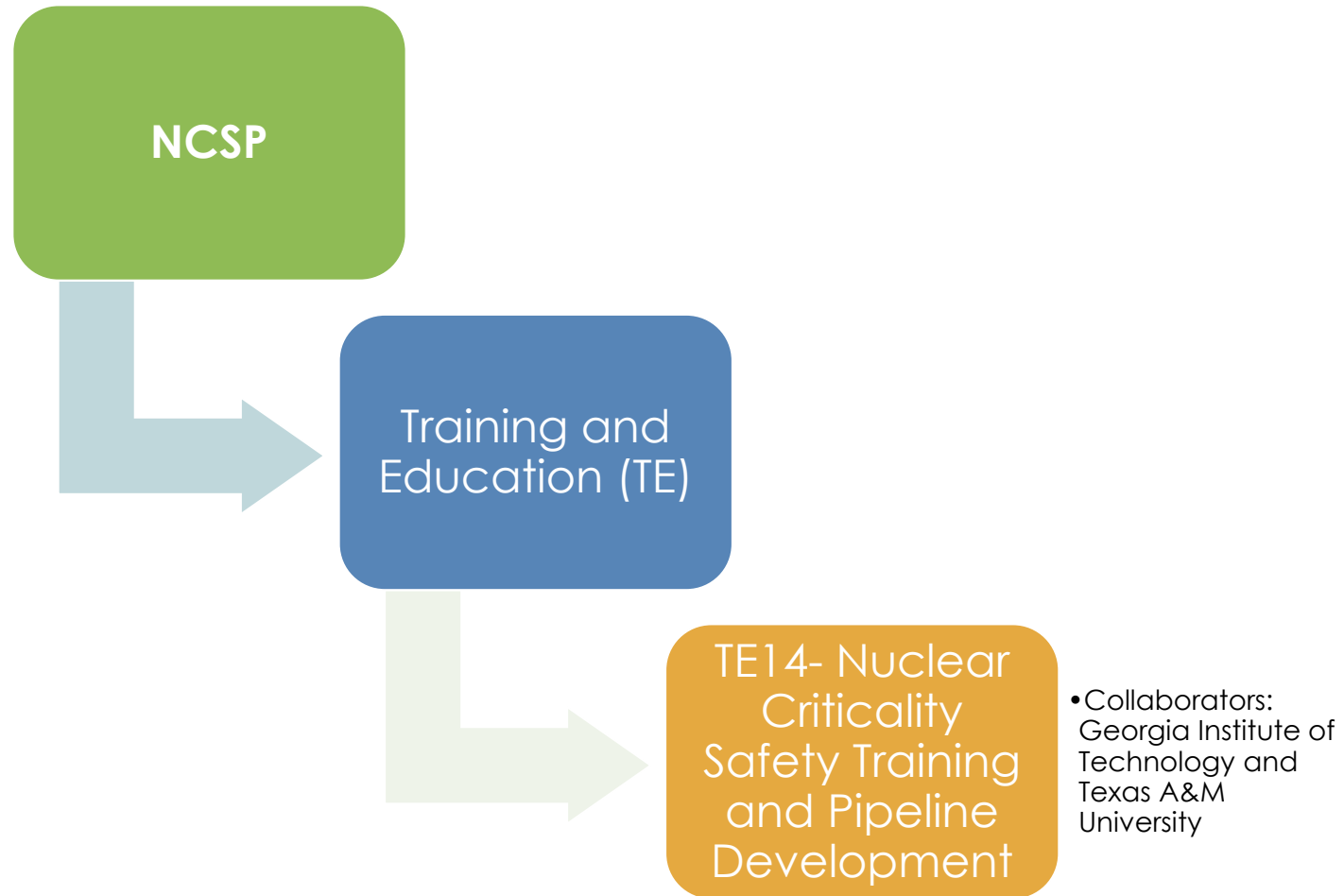Technical Program Review
February 20-23, 2024
Brookhaven National Laboratory, Riverhead, New York

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# Outline

- Introduction
- Program Overview
- Status Update

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# Introduction

**NCSP**

Training and Education (TE)

TE14- Nuclear Criticality Safety Training and Pipeline Development

- Collaborators: Georgia Institute of Technology and Texas A&M University

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# Introduction

- Why:
  - Gaps in knowledge of incoming professionals
  - Better prepare students for the NCSP Hands-on training courses

- What
  - Develop a pipeline of nuclear criticality specialists into the Department of Energy Laboratory Complex

- Who
  - Undergraduate and graduate engineering, physics, and mathematics students
  - Regional focus on the Southeastern United States

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# Program Overview

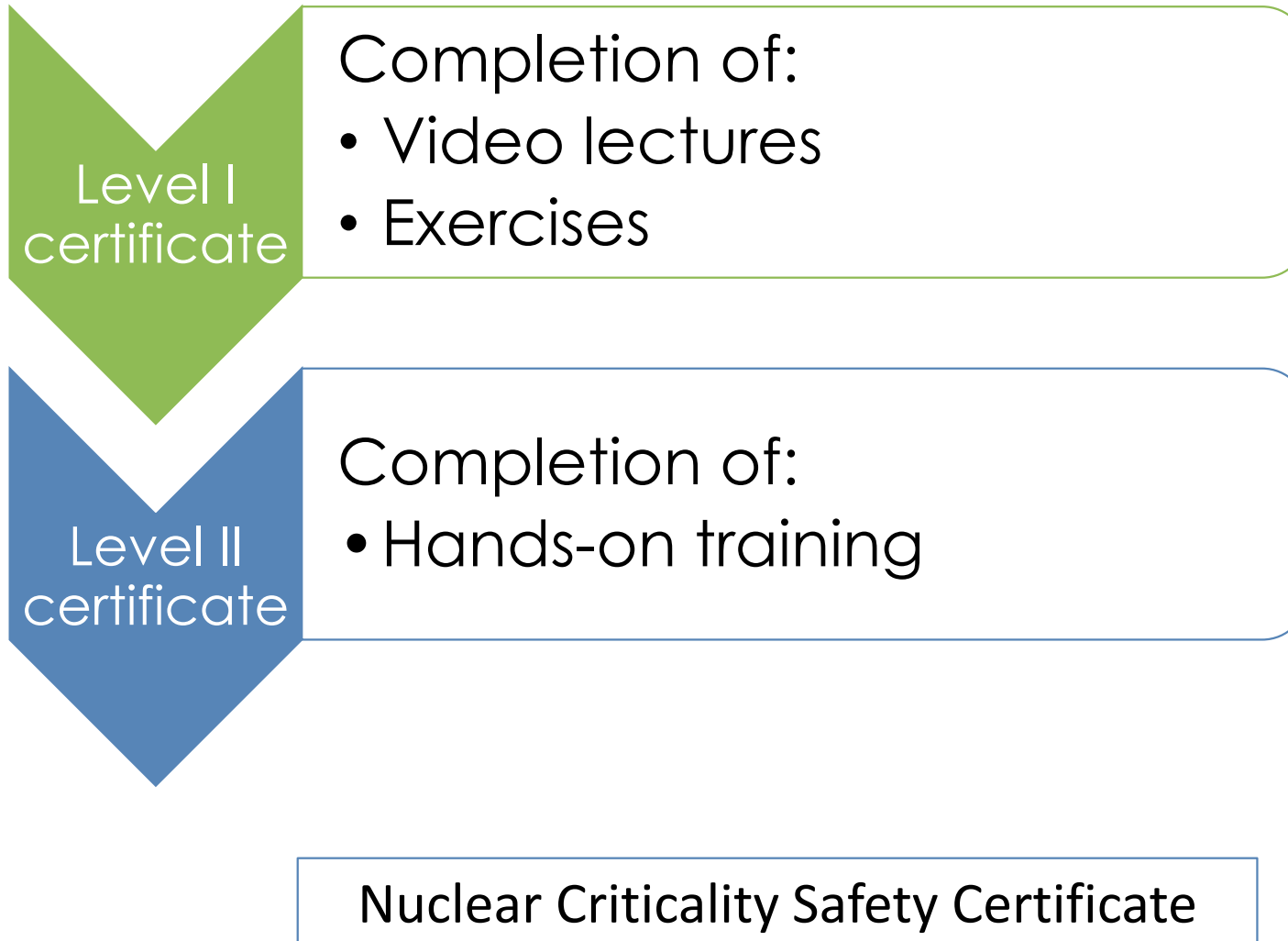## Phase 1: Program Development

- Years 1 and 2
- Develop training material
  - Outline
  - Objectives
  - Training Slides
  - Video lectures
  - Exercises
  - Hands-on training session
- Website

## Phase 2: Recruiting & Program Delivery

- Years 3, 4, and 5
- Recruit students
- Offer the course (certificate program)

Nuclear Criticality Safety Certificate

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# Program Overview

**Level I certificate**

Completion of:
- Video lectures
- Exercises

**Level II certificate**

Completion of:
- Hands-on training

Nuclear Criticality Safety Certificate

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# Status Update

| Lecture # | Title |
|---|---|
| 1 | Course Introduction and Nuclear Criticality Safety Overview |
| 2 | Nuclear Particles and Nuclear Notation |
| 3 | Nuclear Structure and Radioactive Decay |
| 4 | Atom Density, Cross-Sections, and Nuclear Data |
| 5 | Radiation Interaction with Matter and Reaction Rates |
| 6 | Criticality and 6-Factor Formula |
| 7 | Neutron Flux and Fick's Law |
| 8 | Diffusion Equation |
| 9 | Critical Condition from Diffusion Equation |
| 10 | Delayed Neutrons and Pulses |
| 11 | Factors in criticality safety and MAGICMERV |
| 12 | Criticality Safety Considerations for U and Pu Systems |
| 13 | Hand Calculations - Hand calculation methods for criticality safety |
| 14 | History and lessons learned of Process Criticality Accidents |
| 15 | Safety Culture, Formality of Operations, ANS-8 standards, and Regulations (NRC/DOE) |
| 16 | Process Analysis (Part 1) |
| 17 | Process Analysis (Part 2) |
| 18 | Calculation/assessment lecture |
| 19 | Control Implementation, training, maintenance, credible abnormal conditions |
| 20 | Alarms and emergency response - Criticality Accident Alarm Systems and Emergency Preparedness |
| 21 | Validation requirements from ANS-8.1 and ANS-8.24 |
| 22 | Validation approaches and methods |
| 23 | Examples of use validation to ensure subcriticality and use in control selection from process analysis |
| 24 | Criticality Safety Evaluation Process |
| 25 | Criticality Safety Evaluations Writing and Steps - Bringing it all Together |
| 26 | Criticality Safety Evaluations for U and Pu Systems |
| 27 | Summary and Review |

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# Status Update

## Phase 1: Program Development

- Develop training material
  - Outline √
  - Objectives √
  - Training Slides √
  - Video lectures √
  - Exercises (in process)
  - Hands-on training session
- Website

## Phase 2: Recruiting & Program Delivery

- Recruit students
- Offer the course (certificate program)

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# Moving Forward

- Aim to complete Phase 1 this year

- Start recruiting

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# Questions/Comments/Bright Ideas?