

## Definition of a Criticality Safety Engineer Specialist

### Introduction

As more people become involved in nuclear criticality safety without having the experience of working hands-on with fissile materials, it is apparent that what a criticality safety engineer specialist is and what one does are not well understood. Therefore, it is important to have a common understanding of the definition of a criticality safety engineer specialist.

### Background

This white paper was identified by the ANS/NCSD Education Committee as important to meeting the overall mission statement, “To promote development of nuclear criticality safety expertise by providing opportunities that offer technical growth and recognition.” One way to promote development of nuclear criticality safety expertise is to have a definition of what is meant by a criticality safety engineer specialist.

### General Discussion

A straightforward definition of a criticality safety engineer specialist may be formed by combining definitions for the terms ‘criticality safety’ and ‘engineer.’

The field of criticality safety can be defined as:

*Protection from the consequences of a criticality accident, preferably by prevention of the accident. Encompasses procedures, training and other precautions in addition to physical protection.<sup>1</sup>*

An engineer can be defined as a person who is trained in a branch of engineering. The field of engineering can be defined as:

*The application of science and mathematics by which the properties of matter and the sources of energy in nature are made useful to man in structures, machines, products, systems and processes.<sup>2</sup>*

Therefore, a criticality safety engineer specialist can be defined as:

*One who applies nuclear science and mathematics to the understanding of the properties of fissile materials such that they are controlled and made useful in products, systems and processes while protecting from the consequences of a criticality accident, preferably by prevention of the accident.*

While the above definition might seem reasonable, a criticality safety engineer specialist can better be defined by the criticality safety duties performed, the levels at which those duties are performed, and the qualification requirements for those levels.

Common classifications of criticality safety engineer specialists are typically categorized as: criticality safety engineer trainee, criticality safety engineer, and senior criticality safety engineer. In addition, some organizations recognize a subcategory of the criticality safety engineer specialist as a criticality safety analyst who is above the level of the trainee but cannot perform all the duties of an engineer.

Three common classifications are elaborated as follows:

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<sup>1</sup>Hugh C. Paxton, *Glossary of Nuclear Criticality Terms*, LA-11627-MS, October 1989.

<sup>2</sup>*Webster's New Collegiate Dictionary*, 1979.

A criticality safety engineer trainee is someone who holds a baccalaureate degree in science, engineering, or physics with little or no experience in performing nuclear criticality safety work. A trainee is actively in the process of completing qualification as a criticality safety engineer under the direct supervision of a qualified criticality safety engineer or senior criticality safety engineer. A trainee is allowed to perform certain duties of a criticality safety engineer (e.g., assisting in the preparation of an evaluation of nuclear criticality safety, performing a nuclear criticality safety computation) under the direct supervision of a qualified criticality safety engineer or senior criticality safety engineer.

A criticality safety engineer is someone who holds a baccalaureate degree in science, engineering, or physics with at least one year of experience performing nuclear criticality safety work. The engineer has completed qualification as a criticality safety engineer and can work independently with review by a more experienced qualified criticality safety engineer or senior criticality safety engineer. The engineer is expected to perform all the duties of a criticality safety engineer (e.g., independently author and perform all aspects of an evaluation of nuclear criticality safety; conduct a nuclear criticality safety review of operations, processes and facilities; supervise a trainee; supervise a less experienced engineer; and participate in a national society and a standard development activity).

A senior criticality safety engineer is someone who holds a baccalaureate degree in science, engineering, or physics with at least three years of experience performing nuclear criticality safety work. A senior engineer has completed qualification as a senior criticality safety engineer and can work independently. A senior engineer is expected to perform all the duties of a criticality safety engineer (e.g., independently author and perform all aspects of an evaluation of nuclear criticality safety; conduct a nuclear criticality safety review of operations, processes, and facilities; supervise a trainee, supervise an engineer; participate in a national society and a standard development activity; and peer review a journal article). A senior engineer is a senior member of the nuclear criticality safety community who has been actively involved in nuclear criticality safety. A senior engineer is a valuable resource for facility management in regards to recommendations of overall policy, standards, and acceptable practices in nuclear criticality safety.

Facility training or qualification programs (the subject of a separate white paper) are oftentimes established at the organization or facility level. A criticality safety engineer should be knowledgeable in the following areas of nuclear criticality safety:

- nuclear engineering/physics theory
- calculational methods used in nuclear criticality safety
- application of criticality experiments and data
- rules and regulations affecting operations (e.g., license conditions)
- derivation of subcritical limits
- implementation of facility nuclear criticality safety controls
- hands-on experience with fissile materials
- process and facility knowledge
- demonstrated proficiency in authoring evaluations of nuclear criticality safety

## **Conclusion**

As more people become involved in nuclear criticality safety without having direct experience of working hands-on with fissile materials, or performing critical experiments, it is important to have a common understanding of the definition of a criticality safety engineer specialist.