

Memorandum

Date: 28 August 2014
To: Dr. David A. Rockstraw
From: Dr. P. K. Andersen
Subject: Nuclear Chemical Engineering Minor

At your request, I have reviewed the status of our Nuclear Energy minor. Based on my review, I propose that the program be renamed the Nuclear Chemical Engineering (abbreviation NuChE) minor. I offer three reasons for the name change:

1. The current name (Nuclear Energy) is somewhat misleading regarding the content and goals of the program.
2. The proposed name (Nuclear Chemical Engineering) better describes what our program is all about.
3. Calling our program the Nuclear Chemical Engineering minor will set it apart from other academic programs.

Background

In 2008, the Department of Chemical Engineering at New Mexico State University received a grant from the US Nuclear Regulatory Commission to develop a minor program in Nuclear Energy. The purpose of the minor was to prepare students in chemical, civil, industrial, electrical, and mechanical engineering for careers in the nuclear industry.

The NMSU Nuclear Energy minor is unusual in at least two respects. First, it is offered by a chemical and materials engineering department rather than a nuclear engineering department,

Second, the NMSU Nuclear Energy minor focuses on aspects of the nuclear fuel cycle that are not usually emphasized in nuclear engineering departments.

The uranium fuel cycle comprises nine steps:

1. Mining and Milling
2. Conversion
3. Enrichment
4. Fuel Fabrication
5. Reactor Operations
6. Interim Storage
7. Reprocessing and Recycling
8. Waste Stabilization and Immobilization
9. Final Disposal.

Steps 1 through 4 are called the *front end* of the cycle. These four steps consist predominately of chemical processes.

Step 5, Reactor Operations, is the focus of most nuclear engineering programs; it is not the major focus of the NMSU minor.

Steps 6 through 9, leading to the final disposal of nuclear waste and spent nuclear fuel, are called the *back end* of the cycle. Once again, these are predominantly chemical processes.

Nuclear Energy Programs

The name of the NMSU Nuclear Energy minor program is somewhat misleading. An informal survey of 21 ABET-accredited Nuclear Engineering programs shows that courses including the words *energy* or *power* in their catalog descriptions tend to deal with nuclear reactors (Step 5 in the fuel cycle). Some of these are introductory or survey courses. Such courses give relatively little attention to either the front or back end of the fuel cycle, which is the focus of our program.

Nuclear Chemical Engineering

The revised name more accurately reflects the goals of the program. The *McGraw-Hill Concise Encyclopedia of Engineering* (2002) defines *nuclear chemical engineering* as

The branch of chemical engineering that deals with the production and use of radioisotopes, nuclear power generation, and the nuclear fuel cycle.

The same source notes that a nuclear chemical engineer must be trained in both nuclear and chemical engineering:

As a nuclear engineer, he or she should be familiar with the nuclear reactions that take place in nuclear fission reactors and radioisotope production; with the properties of nuclear species important in nuclear fuels; with the properties of neutrons, gamma rays, and beta rays produced in nuclear reactors; and with the reaction, absorption, and attenuation of these radiations in the materials of reactors.

As a chemical engineer, he or she should know the properties of materials important in nuclear reactors and the processes used to extract and purify these materials and convert them into the chemical compounds and physical forms used in nuclear systems.

This is a good summary of what the NMSU program is trying to accomplish.

Market Niche

The revised name will set our nuclear program apart from others in the United States. Ours will be the only department offering a program specifically aimed at Nuclear Chemical Engineering. Some of the ABET-accredited nuclear engineering programs do offer courses that treat the front and back ends of the fuel cycle—the focus of our program—under titles such as Nuclear Fuel Cycles, Nuclear Chemical Engineering, or Waste Management. However, in most cases such courses are not required but are offered as electives.