

DEVELOPMENT OF A DECOMMISSIONING CERTIFICATE PROGRAM

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ABSTRACT

A new Facilities Decommissioning Certificate Program has been developed at Washington State University Tri-Cities (WSU TC) in conjunction with Bechtel Hanford, Inc., and the U.S. Department of Energy. Motivation for development of this Program, the manner in which it has been developed, the objectives of the Program, and a summary of the content are described. Lessons learned from the inaugural offering of the Program are also summarized.

This Program has been developed in response to the current and future need for qualified professionals to direct and manage the variety of activities associated with the deactivation, decontamination and decommissioning (D&D) of facilities across the nation. Existing professionals in this area have historically acquired experience from training on decommissioning projects. Although the demand for qualified D&D professionals nationally and internationally has kept pace with decommissioning demands to date, many of these professionals are approaching the end of their careers. The demand for qualified workers is expected to increase with the aging of the nuclear complex. Additional qualified workers will, therefore, be required to meet this growing need. The challenge in meeting this need involves the preparation of people to enter the D&D field in a more effective and efficient manner. This challenge was addressed by developing a program involving education on topical areas in key disciplines in addition to D&D technology, practices, and procedural guidelines. The WSU Certificate Program involves 160 hours of classroom instruction in a modular format on topics including radiation science; physical and chemical properties of hazardous and non-radioactive materials; risk assessment and pathway analysis; characterization; regulations; D&D engineering, technology and practices; and project management. Scientific and engineering fundamentals and their relevance to D&D concepts and activities are emphasized. The Program is also designed to provide a D&D context for instruction drawn from projects and case studies. Capstone modules involve the application of these topics in assessment exercises based on specific case studies. The target audience for this Program includes existing D&D professionals wishing to enhance their technical competency, existing technical and management personnel intending to transfer into this field, and traditional students seeking careers in D&D. Successful completion of the Program is intended to provide students with the basic tools needed to accelerate their ability to contribute in D&D projects and to provide employers with an effective and reliable mechanism to expedite the development of D&D professionals. The establishment of an appropriate curriculum and identification of qualified instructors have been the key elements in development of the program.

INTRODUCTION

A Decommissioning Certificate Program has been developed at Washington State University Tri-Cities (WSU TC) in conjunction with Bechtel Hanford, Inc. (BHI), and the U.S. Department of Energy (DOE) to address the increasing need for qualified professionals to direct and manage decommissioning projects. The cooperative effort between academia, industry, and government

in the development and delivery of this Program of education and training is described, as well as the Program's design to prepare students to contribute sooner, and at a higher level, to decommissioning projects. The terms “decommissioning” and “decontamination and decommissioning” (D&D) are used generically here in referring to the activities associated with deactivation, decontamination, facility transition, surveillance and maintenance, storage, isolation, removal actions, waste management, and decommissioning as described in U.S. Nuclear Regulatory Commission (NRC) and DOE guidelines (1, 2).

The objective of the Program is to provide an educational background in key academic disciplines and in decommissioning technology, practices, and procedural guidelines. This Program is intended to provide students with a foundation for better understanding the technical activities and challenges encountered in decommissioning projects.

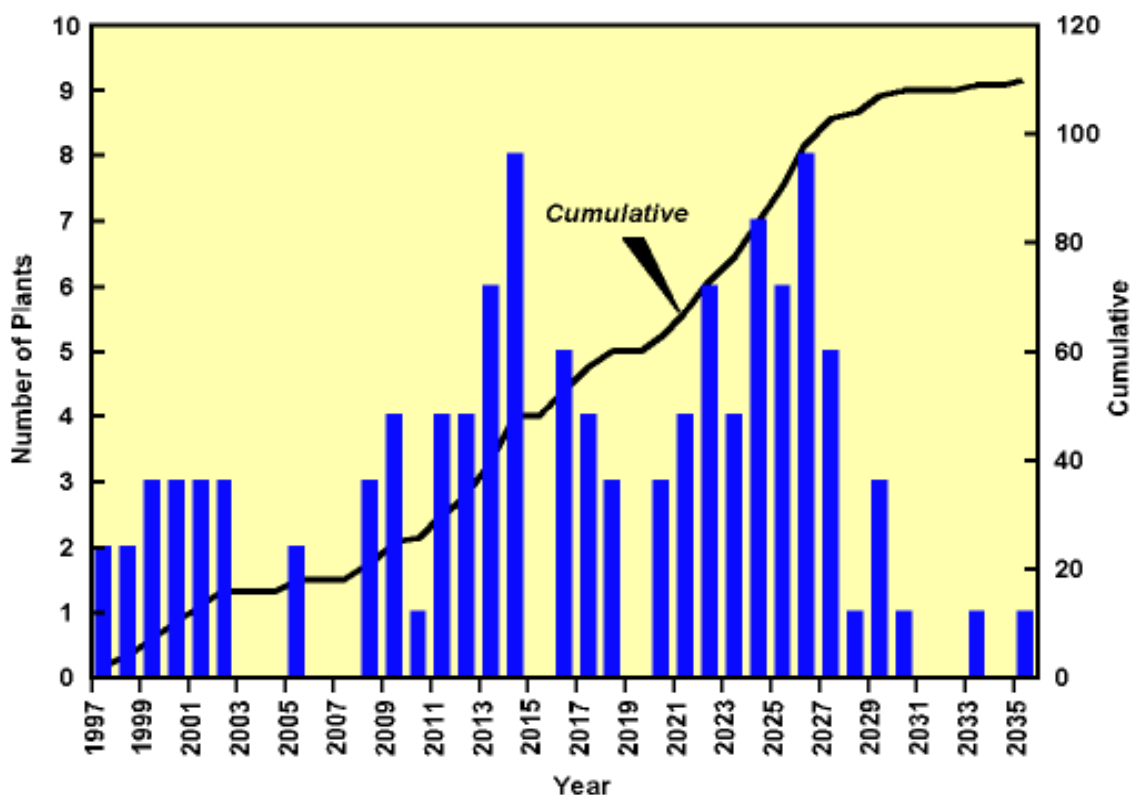
BACKGROUND

Decommissioning refers to the wide range of activities relating to, and required for the cessation, closure, and disposition of Federal and licensed commercial and facilities used in, e.g., power generation, defense, research, and waste treatment. Decommissioning encompasses a wide variety of activities ranging from project management to demolition. Decommissioning professionals are required to perform tasks having components of both routine and non-routine activities. Routine activities may involve the planning and direction of characterization, decontamination, and demolition activities, somewhat analogous to those in the construction industry. However, decommissioning activities pose unique challenges due to hazardous and often radioactive work environments, and to the unknown factors and unexpected situations that are commonly encountered. Some of the challenges posed by the nature of the work environment may be equated to the difficulties posed in attempting to perform construction activities remotely or with minimal exposure of workers to the construction site. The challenges that arise as the result of unexpected events are perhaps the most formidable because they require the conceptualization and implementation of innovative approaches and solutions to situations that invariably arise in these projects. The ability to deal with such challenges requires a broad understanding of relevant concepts and principles that can be used to effect solutions.

Contemporary decommissioning professionals responsible for oversight and management of projects are now required to have a traditional background in engineering or science, as well as an understanding of all technical components in these projects. In this regard, decommissioning professionals must have the capability to orchestrate technical activities rather than capabilities solely as a subject matter expert. Although professional engineers trained as subject matter experts will always be needed, engineers and scientists with education in disciplines relevant to decommissioning are needed in the role of technical management. However, most traditional science and engineering programs do not provide students with sufficient breadth in subjects relevant to decommissioning. Topics such as nuclear physics, industrial plant issues, and relevant regulatory concerns vital to the decommissioning professional, for example, may not be included in most traditional science and engineering curricula.

THE GROWING NEED FOR DECOMMISSIONING PROFESSIONALS

The current and future need for qualified professionals to direct and manage activities associated with decommissioning is increasing more rapidly than new qualified personnel are becoming available. Professionals currently in the industry became qualified primarily by on-the-job-



training, which to date, has continued to be the primary method of preparing and developing new personnel to work in this field. This mode of preparing workers can no longer keep pace with the demand for personnel because many of these professionals are approaching the end of their careers, and the demand for qualified workers is expected to increase with the aging of the nuclear complex. Since the beginning of the decommissioning business in the late 1970s and 1980s, the number of projects has increased and regulatory controls have matured and become more rigorous. As many as 5,000 DOE and government facilities and at least 25 commercial reactor facilities are expected to require some form of decommissioning activities by the year 2010 (Figure 1). A clear trend of sustained decommissioning work is also recognized to extend through the year 2035, as shown in Figure 1. A greater number of qualified workers will be required to meet this current and growing need. A mechanism is, therefore, needed to effectively prepare new and existing workers for employment opportunities in this field.

Fig. 1. Projection of the Number of NRC Licensed Plants to Require Decommissioning by Year.

PROGRAM CONCEPT

The need for a decommissioning educational program was recognized by decommissioning project engineers at BHI in discussions concerning the qualifications of personnel to hire and

support various decommissioning projects at the Hanford Site. It was noted in these discussions that, except for an aging cadre of personnel who had gained their experience in decommissioning in the 1970s and 1980s, significant training and grooming appeared to be required for nearly all other engineers to fully participate and contribute in decommissioning projects. Many engineers and scientists in the environmental and nuclear industries have educational backgrounds and experience relevant to some areas of decommissioning. But few individuals have the background and experience necessary to effectively contribute to decommissioning project without some form of re-education. It, therefore, became apparent that these deficiencies were not individual shortcomings but rather an indication that the educational needs in this emerging industry were not being met by traditional academic curricula. Although a number of short courses focusing on decommissioning procedures have emerged in the past few years, a program designed to provide an educational background in key academic disciplines relevant to decommissioning did not exist.

A program of appropriate education with practical applications to decommissioning activities was, therefore, envisioned to address these needs. The concept was presented to personnel from WSU Tri-Cities. Evaluation of the concept included a local needs survey, consideration of the educational components required, and the ability of the university to meet these needs. Although specific courses in decommissioning technology were not available at the university, it was recognized that many of the components needed for the program existed within the science and engineering graduate curriculum. The Decommissioning Certificate Program was then proposed to be developed jointly by university faculty and industry personnel.

WHY A CERTIFICATE PROGRAM?

The certificate program approach was chosen as the most appropriate mechanism for providing a program of focused education relating to decommissioning. Certificate programs are being developed at colleges and universities across the country for the specific purpose of providing education in emerging and evolving fields not encompassed by existing degree programs. These programs draw upon components of academic curricula and the experience and expertise in the private sector to create a highly relevant form of focused contemporary education. Certificate programs vary widely in the subject matter covered and in the level and depth of instruction. The programs developed at WSU Tri-Cities are largely designed to provide a mechanism for clientele to pursue professional development and/or career changes. The Decommissioning Certificate is intended to be a meaningful credential indicative of a level of education and accomplishment achieved through participation in the program.

PROGRAM STRUCTURE AND CONTENT

Target Audience

The Decommissioning Certificate Program was designed to provide students with exposure to academic subjects with practical applications to decommissioning activities. The target audience for this Program includes existing D&D professionals wishing to enhance their technical competency, existing technical and management personnel intending to transfer into this field, and traditional students interested in a technical management career path in decommissioning. The group composed of existing workers includes managers, executives, practicing engineers

and scientists, and training and decommissioning personnel concerned with the development and maintenance of a qualified pool of decommissioning professionals. Members of this group typically need specific educational components to complement their background in order to qualify, or enhance their qualifications, for positions as decommissioning professionals. The second group, composed of younger students, are those presented with the opportunity to become the new generation of D&D professionals.

Program Development

The path forward for development of the Program required the assignment of personnel responsible for Program direction and coordination. Specific university and industry personnel assumed the responsibilities for developing and implementing the Program. Under the direction of these Program coordinators, input was solicited from appropriate sources regarding the structure, scope, sequence, and content for the Program. This information provided the framework for Program content.

The Program was designed jointly by a team of academic faculty and by industry personnel with practical experience and expertise in decommissioning. Development of the basic Program framework was based on the key elements regarded as fundamental to most decommissioning projects, and identified as weaknesses common to many individuals entering the decommissioning field. These elements include aspects of radiation science; physical and chemical properties of hazardous and non-radioactive materials; risk assessment and pathway analysis; characterization; regulations; D&D engineering, technology, and practices; and project management. Each of these subjects was designated as a specific module and subdivided into topics that served as the basis for the module content. The framework initially defined for the program is shown in Table I. The first series of modules (radiation science, physical, chemical properties of hazardous and non-radioactive materials, risk assessment and pathway analysis, and parts of characterization) provide a technical foundation for their applications in characterization, regulations, D&D engineering, technology. The project management module is intended to integrate these modules, utilizing the major components of project management in the context of decommissioning projects. Capstone modules at the conclusion of the first half and at second half of the Program were established to reinforce the learning process by providing students the opportunity to use and apply this material in assessment exercises based on specific case studies. The Capstone sessions also provide an opportunity to address topics requiring further discussion or missed in earlier modules.

Table I. Washington State Tri-Cities Decommissioning Certificate Program Outline. (2 Pages)

Module Title*	Module Content
First Half - Course Content	
Introduction	- Course Content and Overview
Physical and Chemical Characteristics & Properties of Materials	- Basic Chemical Structure & Theory - Chemical Characteristics - Physical Characteristics - Worker Protection - Course/Material Assessment
Basic Radiation Science	- Radiation Types and Properties - Interactions of Radiation/Matter - Radioactive Decay and Progeny - Dosimetry - Exposure Limits - Detection Methods/Instruments - Worker Protection - Course/Material Assessment
Risk Assessment/Pathway Analysis	- Basic Toxicology - Exposure Pathways/Receptors (food chain, water and air transport) - Assessments Methods and Codes - Examples and Case Studies - Course/Material Assessment
Characterization	- Basics of Applied Statistics, Population, & Hypothesis Testing - Handling Errors, Uncertainty, and Error Propagation - Data Quality Objectives, Quality Control - Sampling, Analysis, and Data Management - Data Interpretation - Course/Material Assessment
Case Study #1	- Actual Project Case Study for student teams to prepare project plan outlines and documentation. This exercise is intended to serve as a form of "mid-term exam".
Second Half – Course Content	
Regulations	- Existing NRC and DOE regulations - RCRA/CERCLA/State Regulations, NEPA - NRC Licensing Issues - Other non-Radiological Regulations (CWA, CAA, etc.) - Radiation Regulations (NRC, ICRP, others) - Safety and Safety Basis, etc.
Engineering and Technology	- Nuclear Fuel Cycle Overview - Nuclear Facility Design, Construction, Operations Overview - Shutdown and Deactivation Decision Process - Deactivation and Stabilization Projects and Technologies - D&D Planning and Documentation - Decontamination and Demolition Technologies - Waste Management - Course/Material Assessment

Table I. Washington State Tri-Cities Decommissioning Certificate Program Outline. (2 Pages)

Module Title*	Module Content
Project Management	- Scope Management with Discoveries - Integration with Other Activities - Schedule Management with Discoveries - Communications - Course/Material Assessment
Case Study #2	- Actual Project Case Study for student teams to prepare project plan outlines and documentation. This exercise is intended to serve as a form of "final exam".

* The course material has been designed for decommissioning examples and experiences to be used to illustrate concepts and applications of the topics in each module.

Qualified instructors were then identified. Instructors worked with subject matter experts and Program personnel to develop the curriculum for each module. These aspects of the Program required approximately six months to develop.

LOGISTICS

The current Program consists of nine modules, most involving 16 contact hours, and totaling 160 hours of classroom instruction. Twenty-four contact hours are devoted to the D&D Engineering and Technology module. Instruction in all modules is intended to have a D&D context drawn from instructor experience and case studies. Student accountability is regarded as integral to a successful learning environment. The Program plan, therefore, calls for examinations to be administered at the end of each module. The certificate, awarded for successful completion of the Program, is intended to be a meaningful credential. The standard established for successful completion of the Program is a passing grade on all module exams. The examinations are intended to focus on key concept and principles and their relevance to decommissioning.

The initial offering of the WSU Tri-Cities Decommissioning Certificate Program is intended to be a "beta-test" version, populated primarily by employees, hand-picked BHI, DOE, and other Hanford Site contractors involved in decommissioning work, representing the type of student for whom the Program was developed. This cohort provides unabashed constructive criticism for refining and improving the content and delivery of instruction prior to advertising and marketing subsequent offerings of the Program for public participation.

Scheduling of the "beta-test" version was, therefore, based largely on employer provisions regarding the availability of the employee students. This version of the program was scheduled to meet for 8 hours per week, from October 1998, to March 1999, excluding holidays.

The instructional facilities utilize contemporary audio-visual equipment including computer projection capabilities and concurrent video play and recording capabilities. All Program modules are video recorded and are made available to students missing class sessions due to job-related absences (e.g., travel) or illness.

COORDINATION AND PREPARATION OF INSTRUCTORS

Organizational meetings were held with instructors prior to beginning the Program, to coordinate instruction between modules, minimize undue redundancy, and provide for appropriate

redundancy. Specific guidelines were prepared by the Program staff to establish instructor expectations and deliverables. A seminar for instructors was also held to promote quality in the delivery of instruction. Instructor expectations included progressive development of the module outline and presentation materials that would allow for timely evaluation of the module content by Program staff and industry personnel. A uniform format for presentation and handout materials was adopted (e.g., using Microsoft Power Point) for consistency and quality control. Instructor deliverables included a module syllabus, preparation and transmittal of an electronic copy of instruction materials and any other support materials to Program staff, preparation and grading of module examinations, and a biographical sketch. Binders and copies of all presentation materials were provided to students in the Microsoft Power Point handout format. Other handout materials included a Program syllabus, list of participants and instructors, glossaries, and other support materials provided by instructors.

WASHINGTON STATE UNIVERSITY TRI-CITIES AND THE HANFORD SITE

Washington State University Tri-Cities (WSU Tri-Cities) was regarded as an appropriate site for development of this Program. WSU Tri-Cities is a branch campus of WSU's main campus in Pullman. The branch campus is located in the city of Richland, in south central Washington State, and serves a population center of about 250,000 people. WSU Tri-Cities is adjacent to the DOE's Hanford Site, which is the focus of one of the nation's largest centers of environmental remediation, restoration, and research. One of the missions of WSU Tri-Cities is to provide opportunities for higher education, particularly in fields of local, regional, and national need, and to serve as an academic resource and a partner for industries in the region. Academic programs have been developed to meet these needs, including the demand for professionals educated in contemporary environmental studies in the 1990s.

One of academia's current challenges is to provide contemporary and relevant education in emerging and rapidly evolving areas, such as the environmental industry. WSU Tri-Cities has kept pace with the evolution of the environmental industry because of its location, clientele, and relationships with the industry. As a result of these relationships, WSU Tri-Cities has been a vanguard in the recognition, evaluation, and response to growth and change in this industry. Development of the Decommissioning Program at WSU Tri-Cities is an outgrowth of this relationship.

The proximity of WSU Tri-Cities to the Hanford Site and access to the Site's personnel resources was an important motivation for this partnership. Hanford Site personnel have extensive experience in decommissioning activities and environmental restoration at the Hanford Site, elsewhere in the United States, and abroad. Companies and personnel in this region, therefore, have a vested interest in this Program.

PROGRESS TO-DATE AND LESSONS LEARNED

The "beta-test" version of the Program began in October, 1998, with an introductory session involving seven guest lecturers from industry, government, and academia, who prepared overview presentations on key topics to be covered in the Program and on the background, scope, and direction of the decommissioning industry. Twenty-seven students registered for the

program, consisting of personnel from DOE's Richland Operations Office (DOE-RL), BHI, and other contractors.

After delivery of about 50% of the Program, most logistical aspects of the Program have proceeded smoothly. However, it is recognized that certain aspects of the Program require modification. Many of the lessons learned to date have already been incorporated into upcoming modules. The most significant lessons learned involve instructor and curricular issues. Key concepts and the applicability of the instructional material have been communicated reasonably well in most, though not all instances. For example, there have been some lapses in the presentation of principles and materials in the context of decommissioning. Achieving the appropriate balance of necessary breadth and depth for each topic has been a constant challenge for instructors. This challenge has been compounded by the often-necessary utilization of a team-teaching approach for the modules.

The selection of qualified instructors is integral to the success of such programs. This selection process can be complicated when the qualifications call for knowledgeable instructors, preferably with industrial experience, who are effective communicators, as well as experienced and effective teachers, and who are also willing and available to participate in such programs. As many as 45 hours or more are devoted to instructing traditional academic courses for material in each of the decommissioning program modules. The condensation and culling of material to create an abbreviated but effective version of these subjects, with the appropriate focus for the intended audience, is an arduous task often requiring a number of iterations for even the best instructors to reach the right balance. Although university faculty are experienced in the development and delivery of instructional modules on many of the subjects in this Program, they were largely unavailable to participate as instructors. Obtaining the appropriate balance between subject matter content and depth was, therefore, more formidable for instructors with less teaching experience. Involving more instructors with good teaching and communication skills will improve the Program. It is also expected that the quality of instruction by less experienced instructors will also improve as they gain experience.

The ability of instructors to provide a decommissioning context for the material presented is a reflection of professional experience. Many of the instructors lack the decommissioning experience for establishing this context themselves. Efforts were, therefore, made to provide these instructors with a better understanding of the decommissioning context by arranging meetings with experienced industry personnel prior to instruction. Yet, many of the practical examples and case studies continued to be drawn from instructor experience and background in areas other than facility decommissioning. Increased involvement of experienced decommissioning personnel in the role of instructional consultants, and greater utilization of these consultants by instructors, will improve the decommissioning context of instruction.

Based on the results of module examinations, it is indicated that it should not be assumed that students with industrial experience already know and fully understand the material presented, particularly those alleged to be highly knowledgeable and/or experienced in specific subjects. The module exams were included in the Program to promote a learning environment. Exams administered to students are intended to fairly and effectively evaluate comprehension of key materials. The module exams appear to have successfully provided student accountability and have also increased the motivation to learn the material. Because each instructor has been

responsible for their module exams, the scope and content of the examinations administered to date have varied more than anticipated. Greater control of examination content by Program personnel is expected to reduce this variability. One of the most important control measures will be to ensure that instructors abide by the policy of providing examination materials to Program personnel for review well in advance of the examination date.

A policy was also established for dealing with students not receiving passing grades on module exams. The policy allows students to be re-tested if they fail to receive a passing grade on a module exam. This policy was adopted because the goal of the Program is to provide for and encourage students to expand their understanding and knowledge of the subject material. This re-testing has been manifested in the form of modified exams in addition to reworking problems missed, as a homework assignment. These measures provide an evaluation of the student's knowledge for the material all students are expected to comprehend by the end of the course. Study guides directing attention to these materials are provided to help these students focus their study efforts. Consequently, the make-up exams are more highly focused, somewhat more challenging, and appear to provide a mechanism that successfully assists these students in learning the material necessary to meet the standards established for the course.

The demands placed on the students, instructors, and industry advisors for the startup of this Program were initially underestimated. In some instances, this impacted timely development of instructional materials and preparation of exams. The initial development of such programs would be greatly enhanced by the allocation of Program personnel resources commensurate with actual work scope. Arrangements for support personnel to participate in a capacity not entirely extra-curricular, can also ameliorate schedule and availability issues. This item is currently being addressed by providing Program staff and instructors recognition from the WSU Tri-Cities Dean and BHI President, and a statement of appreciation concerning the importance of their involvement in the development of this Program to the decommissioning industry. Implementation of lessons learned to date has already improved many aspects of the course, including the focus of staff and students. Students have also been encouraged to be pro-active and assertive in providing constructive criticism for the Program and in evaluating instructor presentations and testing materials.

SUMMARY

The Decommissioning Certificate Program under development through the cooperative efforts of industry and academia represents a blend of education and training that is timely, strategically located and that meets the needs of the decommissioning industry. The Program is intended to provide appropriate grounding in the scientific and engineering fundamentals and their applications to decommissioning for the growing number of professionals needed to engineer and manage D&D projects. The level of instruction in this Program is more robust than most training programs, and commensurate with upper division or graduate levels of instruction in content and contact time. This type of program represents a new form of education with specific applications to new and emerging fields in the private sector, previously unavailable in industry or academia. The program blends components of academic curricula with experience and practices in the private sector to create a highly relevant form of focused contemporary education with specific practical applications. Development of instructional materials relevant to activities in decommissioning, with an appropriate balance of breadth and depth, has been initially

challenging. Efforts to date in the “beta-test” offering of the Program have provided valuable experience and lessons learned for refining the content and delivery of the Program. This type of program may become increasingly important for the development of professionals to meet the challenges of evolving industries such as decommissioning in the 21st Century.

REFERENCES

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