The U.S. Nuclear Waste Technical Review Board Intern Program: Developing Next Generation Nuclear Waste Professionals – 16102

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ABSTRACT

The U.S. Nuclear Waste Technical Review Board (Board) created an internship program in the fall of 2013 for undergraduate and graduate students interested in management and disposal of spent nuclear fuel and high-level radioactive waste. Interns must select a project topic in a technical area related to the Board's mission and prepare a well-supported briefing for the agency. The ability to review technical and scientific information in a critical and unbiased manner is essential for completion of the intern's project and this is a particular focus of the interaction between the mentor and the intern. The interns from 2014 and 2015 selected and reviewed topics related to the areas of commingling waste forms for disposal and deep borehole disposal. In addition to the technical project, interns acquire a broad perspective of the federal agencies involved in managing and disposing of radioactive waste while participating in inter-agency networking opportunities. In this review of the Board internship experience, two past interns discuss the personal impact of the program and how they believe the experience prepared them to face the challenges of a career in management and disposal of spent nuclear fuel and high-level radioactive waste.

INTRODUCTION

The U.S. Nuclear Waste Technical Review Board (Board) was established as an independent federal agency in the Executive Branch, in accordance with the terms of the Nuclear Waste Policy Amendments Act of 1987. The Board's role is to evaluate the technical and scientific validity of activities undertaken by the U.S. Department of Energy (DOE) related to management and disposal of spent nuclear fuel and high-level radioactive waste, and report its findings, conclusions, and recommendations to Congress and the Secretary of Energy. The Board has 11 members, appointed by the President from a list of candidates provided by the National Academy of Sciences, and who have been selected solely based on distinguished professional service and eminence in a field of science or engineering. The Board members have expertise in the geological sciences, materials science,

[a] The views expressed in this paper are those of the authors and do not necessarily represent the views of the U.S. Nuclear Waste Technical Review Board. The first (elainara@umich.edu) and second (butzen@wisc.edu) authors, while staff interns for the Board during the summers of 2014 and 2015 respectively, completed this study under the guidance of the third (leslie@nwtrb.gov) author, who is a member of the Board's Senior Professional Staff.

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nuclear engineering, and social sciences, and are supported by a small team of senior professional and administrative staff.

The internship program is intended to give students the opportunity to complete a project on a technical topic that supports the Board's activities while working in the professional environment of a federal agency. During the internship, a mentor from the Board's Senior Professional Staff guides the intern's work and helps him or her develop the oral and written communication skills necessary for presenting scientific and technical information.

In its role as an independent federal agency, the Board undertakes rigorous reviews of DOE activities, based on the expertise and experience of, and involving collaboration between, members of the Board and the Senior Professional Staff. Board interns are fully immersed in the processes of writing and revising technical and scientific information in a critical and unbiased manner. This communication development is a particular focus of the interaction between the mentor and the intern. The Board's intention is for interns to build on their existing skills and capabilities and to leave the program better equipped to communicate technical and scientific issues effectively to any audience, both orally and in written form.

The program exposes the intern to the role that federal agencies play in the management and eventual disposal of spent nuclear fuel and high level radioactive waste. During their time in the program, interns may attend Board public and business meetings, as well as visit other agencies to participate in meetings relevant to the Board's mission.

The number of applicants for the Board's summer intern program doubled from the inaugural year to over 100 in 2015. The applicants reflect diverse levels of education, areas of study, and knowledge or experience with nuclear waste. The majority of the applicants have been undergraduates, with only a few graduate candidates applying. Applicants from engineering programs include mechanical, systems, civil, materials science, chemical, and nuclear engineering students. Applicants from science programs include health physics, soil science, statistics, geography, and Earth science students. Almost all applicants had no previous work experience in the nuclear waste field. Few applicants had studied nuclear waste topics as part of their education.

The inaugural intern joined the Board staff for 14 weeks before beginning graduate work at the University of Michigan. Her interest in nuclear waste issues began while working toward a Bachelor's degree in Engineering Science at Stony Brook University, NY. In an effort to broadly understand the nuclear waste problem in the United States, the intern set a goal to gain experience in industry, government, and academia. The intern experienced a summer working with radiation detectors and spent nuclear fuel at Pacific Northwest National Lab. She also participated in undergraduate geology research, studying isotope immobilization in natural wetland environments. Immediately after graduation, the intern began an internship with Kurion, Inc. There, she assisted in the design and development of technologies to isolate radionuclides from contaminated water. The next step brought her to the

Board before beginning graduate studies in radiation damage of materials at the University of Michigan.

The 2015 summer intern was a geological engineering student from the University of Wisconsin-Madison. She began working for the Board while enrolled in a dual-degree program where students receive a Bachelor's degree in Geological Engineering and a Bachelor's degree in Geology and Geophysics. The intern also majored in Japanese and studied abroad for a year in Tokyo, Japan.

Prior to her internship, the intern wrote a term paper on the Fukushima Daiichi nuclear disaster after returning from Japan and decided to pursue contaminant studies following a hydrogeology course. For the course, the intern attended a presentation on the potential deep borehole disposal of radioactive wastes in Japan. The topic drew her interest despite a lack of knowledge about nuclear engineering and radioactive waste management. She applied for the Board internship because it paired her career interest in contaminant studies and interest in the nuclear field. In addition, the internship offered the opportunity to meet established professionals in a variety of technical and scientific fields of study.

DISCUSSION

Critical Thinking and Communication Development

It did not take long for the interns to realize that at the Board, every word matters. The interns readily, and somewhat painfully, recall the rigorous writing review process that exists within the Board. First, the interns submitted a draft to their mentor and were rewarded with many, *many* corrections, which were indicated by soon-to-be-familiar red ink. Rather than simply providing edits on content and grammar, the interns' first iteration of edits emphasized critical thinking and crafting logic through text. Once the logic of the work flowed easily, the second iteration of corrections focused on grammar and sentence structure. Finally, the third iteration thoroughly examined each word on the page as if it were held under a microscope. The reviewers' purpose was to ensure that the intention was obvious and not easily misconstrued.

For the 2014 intern, the review process revealed the emphasis that the Board places on the meaning of every single word. After a few cycles of the review process, she learned that each word required assessment from all viewpoints. If the sentence could be read in any other light than the author's intention, it must be clarified further. The intern left the Board with a deep respect for the effort it takes to make every word precise. Though exhausting, the Board's position in the federal landscape of storage and disposal of nuclear waste mandates this rigorous review and editing process.

For the 2015 intern, learning to accept the many constructive criticisms and input from the reviewers became the most difficult aspect of the review process. It was a challenge for the intern to accept having her words transformed through the

intensive review cycle, compared with the light reviews that she experienced prior to the Board internship. However, through the process, the intern learned that great improvement can come when reviewers are specific and critical. The high expectations of the review process led the intern to actively seek improvement in her ability to convey specific facts through writing. The critiques and comments on her first piece of work proved instrumental in developing written communication skills for future work. Looking back, the intern valued re-reading her work after it cycled through the complete review process as an opportunity to understand and recognize the growth from first draft to the final version.

Federal Perspective

From the first week in both internships, the Board sent the interns to a variety of meetings in order to fully understand the federal landscape and the many different agencies and organizations involved in developing a program to manage and dispose of nuclear waste. The interns traveled to meetings at the U.S. Nuclear Regulatory Commission (NRC), U.S. Environmental Protection Agency, and DOE, as well as Board meetings that occurred during the summer. Both interns were able to tour Catholic University of America's Vitreous State Lab, located in the District of Columbia.

The 2014 intern recalls that her favorite trip was to the National Academies of Science Beebe Symposium on the science and response to a nuclear reactor accident. Surrounded by a wide demographic of industry leaders, academic professionals, and high-ranking government officials, the intern remembers the transparent and encouraging discussion that ensued on the past, present, and future responses to radiological events. The 2014 intern also attended NRC meetings on spent nuclear fuel storage and high-level waste transportation, American Association for the Advancement of Science panel meetings on plutonium disposition and deep borehole research, Congressional committee hearings, and the Board meeting in Idaho Falls, Idaho.

The 2015 intern recalls that her favorite trip was to Denver, Colorado for the June 2015 Board meeting on transportation of radioactive waste. As part of the visit to Colorado, she toured the Transportation Technology Center. Transportation was just one of the many aspects that the intern would come to recognize as part of the radioactive waste disposal process. The intern attended a variety of meetings in preparation for the Board's workshop on deep borehole disposal in October 2015. She also traveled to Sandia National Laboratories, the U.S. Geological Survey in Reston, Virginia, and participated in several internal meetings. The intern found the internal meetings to be enlightening as they allowed her to understand how the staff and Board members worked together.

Participation at these meetings and conferences developed a deeper understanding of where the Board fits in the federal landscape of nuclear waste issues. The trips helped the interns see the many current efforts underway to find a solution to the management and disposal of nuclear waste. Additionally, the Board's interns

developed relationships with staff members from several other federal agencies that will be vital as they develop into the next generation of nuclear waste professionals.

Transfer of Ownership

In creating the internship program, from first interview to final presentation, the Board's objective was to encourage independence and initiative, with the hope that it would also foster enthusiasm for becoming a professional in the nuclear waste community. The interns, with advice from their mentor, chose their summer projects in a technical area related to the Board's mission. As a result, the interns gained a sense of ownership that increased over the course of the project, while the final product supported the work of the Board.

The 2014 intern chose to review the history of commingling defense and commercial wastes in single or separate repositories in the United States [1]. This resulted in her preparing a primer for the Board that will be useful in any future work the Board may complete on those scientific and technical areas. The intern specifically chose a topic that straddled the areas of science and policy because it is an interest that she identified prior to beginning her internship with the Board. The intern valued the process of digging into US history, with several trips to the Library of Congress, to examine the evolution of commingling and the role that science and technology played in those decisions. Selecting this topic allowed the intern to further develop her curiosity for the intersection of science and policy and accompany that interest with refined communication skills.

The 2015 intern developed a research project on deep borehole disposal of radioactive wastes. She valued the freedom and independence to choose how to approach the topic. This experience played a critical role in introducing the possibility of a career in the nuclear field. The intern found the research on deep borehole disposal to be intriguing and challenging. The intern attributes an increase in confidence and the potential to thrive in the nuclear field to the project, which resulted in her first conference paper [2]. Through the construction of the intern's project, she developed a sense of ownership over the findings and developed a desire to contribute to the nation's radioactive waste management and disposal efforts.

A key aspect in the Board's internship program was the encouragement of pre-existing talents held by each of the interns. Early in the internship, the 2014 intern revealed an aptitude for communicating through graphics and design. She soon was given the responsibility to work on several infographics for not only her own report, but for staff reports as well.

The Board internship also encouraged the 2015 intern's pre-existing talents in Japanese through her work on translating technical documents related to nuclear waste management from Japanese to English. Through the internship, she worked with a staff member to understand recent developments in Japan's radioactive waste management and disposal program. The intern located and translated

relevant documents as she contributed to the agency with her appreciated language skills.

Upon completion of their internships, the interns were further mentored to submit abstracts to the 2015 and 2016 Waste Management Symposia. The 2014 intern orally presented her work on commingling during the 2015 conference [1] and the 2015 intern will present her work during this year's conference [2]. This continuing support from staff and Board members has increased the interns' enthusiasm in becoming nuclear waste professionals and increased their opportunities for networking and professional development.

CONCLUSIONS

The Board internship program emphasized critical thinking and communication by having the interns produce well-developed reports for the agency. Interns sent their work through the Board's rigorous review cycle, which refined their abilities to effectively communicate scientific and technical work to any audience. Professional networking and development opportunities were developed through trips and meetings to several government agencies, as well as to organizations contributing to the efforts in nuclear waste management and disposal. The Board not only encouraged interns as professionals, but also as individuals. Pre-existing skills and talents were encouraged via short-term deliverables. The Board's interns in 2014 and 2015 agree that the experience with the Board significantly increased their readiness for a career in a nuclear waste field.

REFERENCES

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