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Developing a Premier Wind Turbine Technology Programs in the East Coast: A Novus Industry and Academia Collaborative Approach

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Abstract

This Lessons Learned paper highlights the authors' experience during a collaborative training program between academia and one of the leading manufacturers of wind turbine technology in the United States. This program took place over five weeks. The program participants engaged in classroom theorem and hands-on activities related to onshore wind turbines' safe and effective maintenance. This paper offers insights from academic faculty on the effectiveness of industry-based training and how collaborative programs can benefit both academia and industries.

Introduction

In January 2021, the State University of New York (SUNY) announced its partnership with the New York State Energy Research and Development Authority (NYSERDA) to support the late governor's goal of achieving 9 Gigawatts offshore wind power by 2035. Together, they launched the Offshore Wind Training Institute (OWTI), a $20 million program with the goal of training 2,500 workers in the renewable energy industry across the United States. This program would work to develop the educational infrastructure necessary to support the ever-growing workforce of the national wind industry.

To further this endeavor, the Renewable Energy and Sustainability Center (RESC) at Farmingdale State College (FSC) launched a pilot program with GE Renewable Energy to provide wind turbine technician training to university students and alumni within the United States. GE Renewable Energy is currently the leading manufacturer of onshore wind turbine technology within the country and is one of the leaders in developing the United States offshore wind industry. This pilot program, funded through the SUNY Research Foundation, would provide its participants with the theoretical and technical skills beneficial for pursuing a career within the wind energy industry. It would also help to serve as a basis for developing FSC's own Wind Turbine Technician Certificate program, which would help expose more university students to the wind industry.

The Recruitment Process

The pilot program consisted of two 5-week sessions during the summer of 2021. Enthusiasts of the program completed online surveys that outlined their academic background, work experience, and relevant technical skills. Faculty from the RESC interviewed applicants to ascertain their expectations for the program and their compatibility with the program's goals. 20 of the 100 applications received acceptance into the program; these applicants were divided evenly between the two sessions.

Additionally, a faculty member from FSC's engineering technology department accompanied the first training session. This faculty member analyzed the practices used by the RELC faculty and acquired recommendations for improving FSC's developing wind turbine technician program.

The Training Venue

The first week of the pilot program was held exclusively through the GE Renewable Energy Learning Center's (RELC) online portal. This outlet provided several learning modules that the participants could complete at their own pace prior to the start of the second week. The topics covered during this period included but were not limited to reading mechanical/electrical schematic drawings, operating hand/power tools, and understanding general safety standards and potential environmental hazards.

The remaining four weeks of the program took place at the RELC located in Niskayuna, New York. This state-of-the-art training facility provided a classroom setting for handling theoretical modules and discussions and laboratory spaces for performing hands-on simulations. Laboratory spaces contained industry-sized turbine equipment, such as decommissioned nacelles and drivetrains. Faculty with experience as wind turbine technicians instructed both the theoretical and technical portions of the program, providing the participants with the opportunity to inquire about potential hazards and dangers in the field.

Technical Essentials

The second week of the pilot program focused on understanding the technical knowledge, safety procedures, and documentation required to successfully perform Lock Out, Tag Out (LOTO) on wind turbine mechanical and electrical systems. LOTO is essential for performing work on these systems as it prevents the potential for a system to become re-energized while technicians are performing maintenance. The participants gained a basic understanding of wind turbine systems. The instructor also outlined the potential mechanical and electrical hazards encountered when operating on these systems. Participants received electrical safety bulletins (ESBs), which highlighted the minimum level of Personal Protective Equipment (PPE) necessary for troubleshooting and maintenance of each system. Specific systems of a turbine cannot be accessed while energized due to the high risk of arc flash. It is essential to understand the minimum safety requirements for each section before performing routine inspections.

The participants also learned how to correctly execute the Plan, Do, Review (PDR) process used by turbine technicians when performing maintenance. The PDR process ensures that technicians perform their responsibilities safely and timely. The participants were broken up into teams and asked to perform LOTO on different turbine systems based on provided work instructions and feedback from the instructors. Teams consisted of different roles, each with its responsibilities during the activities. Lead technicians initiated strong communication between team members and kept the team on track. Environmental health and safety (EHS) coordinators would ensure team members utilized the right PPE and demonstrated safe actions during exercises. Recordkeepers were responsible for documenting all work performed through the PDR process and noting any incidents that arose during the exercise and how best to prevent these in the future. After completing these assignments, the participants were officially certified to perform LOTO on turbine components.

Preventative Maintenance

The program's third week covered performing preventative maintenance on critical systems within the turbine. Participants utilized PDR documentation and work instructions to complete a series of routine maintenance tasks expected of technicians out in the field. These tasks included blade pitch alignment, generator alignment, and the replacement of yaw system components. The participants utilized manual, hydraulic, and electric torque wrenches to complete these tasks. Participants utilized torque specification manuals to identify the correct torque values required for the exercises. They also learned how to correctly calculate the settings required for each hydraulic and electric torque wrench to get to the correct rating.

Turbine Fundamentals

The final two weeks dealt with the 2.X ESS wind turbine series. This section gave the participants an in-depth analysis of the major systems of the turbine, such as the turbine's pitch system, yaw system, drivetrain, and generator. Participants also observed through schematic diagrams how the various systems were interconnected. Should one or more of these systems produce an error, the entire turbine system will shut itself down and prevent further rotation until the maintenance team has corrected the error (s).

Once the participants familiarized themselves with how the systems were linked, they completed troubleshooting exercises. The turbine generated error codes during these exercises and displayed them through the SCADA system. The participants would identify the error code to determine which portion of the turbine produced the error. They would then examine the physical systems and troubleshoot the connections until they identified the precise issue. The participants completed these exercises by utilizing multimeters and looking for visual and audio cues from the systems.

At the end of this period, the participants were allowed to perform mock interviews for GE's wind industry positions. These positions included engineering, fleet reliability & operations, and technician positions in the onshore and offshore wind industry. These interviews allowed the participants to see the various roles involved in the wind industry and improve their soft skills for future interviews.

Program Feedback

The RESC surveyed the participants both before and after their respective sessions. Before their session, the participants communicated their expectations and any concerns they might have prior to the program's start—many expressed interests in learning about how wind turbines function and performing hands-on tasks. Many also expressed interest in wanting to climb wind turbines and learning the necessary safety requirements. However, this opportunity was unavailable for the pilot program due to safety concerns and wanting to make the program more inclusive to those not interested in becoming technicians.

The participants provided feedback on the program once their session had concluded. Many were pleased with working hands-on and with actual turbine components instead of industrial trainers or simulators. However, many emphasized concern over wishing they had more time for the program, specifically more opportunities to work hands-on and perform troubleshooting exercises. Participants also provided feedback on the effectiveness of their instructor at the RELC. Most were

pleased with their instructor, highlighting their knowledge of the material and their experience working in the field.

Recommendations

Collaborative programs between academia and industry such as this can produce many benefits and opportunities for those involved and society. There are some items to consider when first developing these joint programs to meet the required expectations of all parties.

When first selecting the curriculum material for these programs, it must cover a broad field of view to make the program accessible to the most significant number of enthusiasts. The goal of this program was to provide an introductory overview of the onshore wind turbine industry to its participants. If the program included climb training practices, then the curriculum would have been more tailored to prospective wind turbine technicians than other areas of the wind industry, thus potentially reducing the number of program enthusiasts.

It is also essential to follow up with participants after the program's conclusion. These conversations can provide insight into the applicability of the course material within the industrial sphere. Future course materials can then be focused on more pertinent topics for later participants to ensure that these programs stay relevant.

Outcomes and Conclusion

This program provided many opportunities for the student participants and the faculty at FSC. The participants received the chance to work with industry-rated equipment under the guidance and supervision of industry professionals. They were able to ask these professionals questions about their work experience as wind turbine technicians and the hazards one may encounter on the job. Most participants decided to continue their studies at their respective universities, expressing interest in applying for jobs in the wind industries once they completed the program. Some decided to apply for positions within the industry following the conclusion as wind technicians, having been interviewed and later hired for said positions.

The faculty at FSC received significant feedback on their program curriculum from industry advisors at the RELC. The faculty will work to teach from the lens of a wind turbine technician, much like the program at the RELC, as well as better emphasizes certain parts of their lesson plans. FSC will continue to maintain connections with the RELC for further input on how to improve their program’s curriculum.

In addition, the School of Engineering Technology at FSC has benefited by forging a closer alliance with one of the world's leading turbine manufacturers. An industry expert from the company will be serving as a member of the Advisory Board for the Mechanical Engineering Technology and will work with individual faculty in the Wind-related programs on continuous improvement.

This program demonstrates the effectiveness of joint operations between academia and industry leaders. Programs like this can introduce students to niche fields within the industry and help cultivate the technical skills necessary to perform in these fields. As the demand for renewable energy sources continues to rise in the region, there will be an increasing need for skilled

technicians. Proactive efforts like this program will aid the region in meeting its renewable energy goals.

Roles of the Authors:

Dr. Khosro Shirvani is an assistant professor in the Mechanical Engineering Technology department at Farmingdale State College (FSC). He was among the faculty members who developed the certificate program proposal for the Wind Turbine Technology (WTT) program. He also coordinated and developed curriculum development for a WTT maintenance course in the program. Moreover, he was the faculty member who traveled to GE Renewable Energy Learning Center and attended the summer training to integrate some of the training components into his maintenance course.

Professor Marjaneh Issapour is the Associate Dean of the School of Engineering Technology and the Director of Renewable Energy and Sustainability Center at Farmingdale State College. She is the industry liaison on behalf of the college and the designer of this collaborative venture. She was involved in negotiating with the industry partner, articulating the entry requirement to the program, interviewing the candidates, selecting the course material, and acquiring feedback following the program's conclusion. She also prepared a budget and got the approval of the College administration and the industry partner.

Conor Ricchetti is a graduate of Farmingdale State College in 2020 with a bachelor's in Mechanical Engineering Technology. He was one of the participants in the first session of this pilot program. He currently works full-time as an engineer and wants to acquire his master's in mechanical engineering within the next few years.