Title: DEVELOPING ACCELERATOR OPERATORS AT LANSCE

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Abstract
The process of developing an individual into a competent operator who can safely and efficiently operate the Los Alamos Neutron Science Center (LANSCE), or other accelerator facility, is a complex process. It begins with recruiting and ends with retention; steps in between include training, professional development and career advancement. This paper discusses the approaches that the Operations & Technical Support Group at LANSCE has taken to deal with these and other issues associated with assembling a highly competent staff of accelerator operators. Emphasis is placed on operator training, which is accomplished through a self-study program modeled after the United States Navy’s Nuclear Power Plant Operator qualification program.

Introduction
At the Los Alamos Neutron Science Center (LANSCE), we have a team of 16 accelerator operators who are responsible for the safe and efficient operation of the 800 MeV linear accelerator and its ancillary systems. They are expected to perform a wide variety of activities which range from performing safety sweeps of exclusion areas to developing beam tunes for production beam delivery. Their knowledge must be broad and they must continually upgrade their knowledge to keep pace with facility changes. These demands require that we recruit personnel who are capable of meeting these job requirements.

Recruitment
It is very difficult to recruit personnel who have previous experience in accelerator operations. At LANSCE, we have had success recruiting personnel from the United States Navy’s Nuclear Power Program. Our team composition is, and historically has been, dominated by personnel from this specific background.

This background fits well because it provides candidates who meet two important criteria. First, they have a broad technical knowledge base. Second, they have extensive operational experience. The broad technical knowledge base is the result of studies at various military technical schools, including Nuclear Power School. There they received theoretical training in subjects such as electronics, reactor theory, physics, heat transfer and fluid flow, chemistry and radiological fundamentals. Their knowledge is further enhanced and developed during their naval careers as they apply it in real-world applications.

Extensive operational experience is gained from operating a nuclear propulsion plant, which is a complex facility that includes a nuclear reactor primary and secondary system, an electrical power generating and distribution system and mechanical systems used to propel the ship. They have learned how these systems interact with each other and how to determine cause and effect relationships that cross system boundaries. This combination of knowledge and experience provides us with a candidate who has a good chance to succeed as an accelerator operator at LANSCE.

There are two secondary advantages associated with recruiting personnel with nuclear Navy backgrounds. The first is their demonstrated ability to complete a self-study qualification program supported by the US Department of Energy.
program that is very similar to ours. The second benefit is their exposure to shift work. They usually have four to six years of experience working shift schedules. Therefore, they can make an informed decision when offered a position which requires working rotating shifts.

Even though we have had success recruiting externally, as already described, we continue to recruit internally as well. The entry level positions are normally opened to both internal and external applicants and we have hired several qualified candidates from within our local organization. The supervisory positions are normally opened to internal applicants only and are filled by experienced and qualified operators from within the Operations Team. Rarely, if ever, do we fill a supervisory-level position with an external applicant because we require the individual to have extensive and current experience in LANSCE operations.

TRAINING
The Program
Once we recruit and hire an individual we must provide adequate training for them. LANSCE has a formal training program which is modeled after the program used in the nuclear Navy as mentioned earlier. Our program has the following objectives:

1. To provide a systematic, structured and documented program that produces knowledgeable and skilled accelerator operators capable of safely and effectively operating the LANSCE facility.
2. To provide a program that not only maintains, but enhances, the skills and knowledge acquired.
3. To provide a program which is in compliance with applicable orders and standards.

The initial program, which every operator is required to complete, is designed to provide a fundamental understanding of the facility, its systems and its operation. It is comprised of four separate phases or levels, each one defined by a list of specific qualification requirements. These lists are referred to as qualification cards. The requirements include completing oral examinations on facility systems and theoretical concepts as well as performance requirements where the trainee must demonstrate their understanding of and ability to perform certain job tasks and evolutions.

The program is laid out as follows:

Level 1 covers the personnel safety systems at LANSCE.
Level 2 covers the accelerator systems needed to accelerate beam up to 100 MeV.
Level 3 covers the systems needed to accelerate beam from 100 MeV to 800 MeV and includes the high energy experimental area beam transport lines for the high-intensity proton beam (H+).
Level 4 covers the high energy beam transport lines for the negative ion beams (H-), including the proton storage ring.

A qualification requirement is a general statement of something the trainee must learn about. It could be a physical system such as a vacuum system or it could be something more abstract like a piece of computer code or theoretical concept. A list of the qualification requirements for our transition region is shown below.
Transition Region

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<thead>
<tr>
<th>Requirement</th>
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<tr>
<td>1. Mainline, Sidetrack &amp; Centerline</td>
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<td>2. Run Permit System</td>
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<td>3. Fast Protect System</td>
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<td>5. Water Systems</td>
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<td>6. Vacuum Systems</td>
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Each requirement has an associated standard which further defines the specific elements that must be mastered and is used by evaluators to judge whether or not the trainee has achieved this minimum level of mastery. It also serves as an outline for the trainee and guides him in his preparation. The standard for our transition region vacuum system is shown below.

6. Vacuum Systems
The trainee should be able to:
- draw a one line diagram of the transition region showing the location of all vacuum valves and ion pumps.
- explain the interlocks and controls associated with each transition region vacuum valve, ion pump, getter pump and cryo pump.
- explain the possible consequences of poor vacuum.

The Process
Trainees are provided with training materials and are expected to study these materials and seek assistance when it is needed. They are encouraged to walk through procedures and evolutions with qualified operators who can answer questions and correct errors. When the trainees are confident they are adequately prepared, they request an evaluation from a qualified On-the-Job (OJT) instructor/evaluator, usually their supervisor.

The supervisor conducts an evaluation using the applicable standards as a metric in determining whether or not the trainee’s knowledge and/or skill level is satisfactory. If it is, the evaluator documents the successful completion on the trainee’s qualification card. If the trainee does not successfully complete the evaluation, the evaluator identifies areas for further study and practice and directs the trainee to return for another evaluation when the noted weaknesses have been upgraded. It is not uncommon for the trainee to have “look-ups” following an evaluation. Even though the trainee successfully completed the evaluation, there may have been specific questions which were answered incorrectly. The trainee is expected to go and “look-up” the correct answers and then report back to the evaluator.

After a trainee has completed all of the knowledge and performance requirements for a specific qualification level, he requests a final examination from the team leader, as described earlier. If the team leader is satisfied, he documents the trainee’s completion of that qualification phase and retains the trainee’s completed copy of the qualification card as a permanent record. It takes an operator an average of 1.88 years to complete all four levels.

Advanced Training and Development
After an operator has completed the initial program, he has the opportunity to voluntarily enter into a senior operator qualification program. This is a new program that is presently being implemented at LANSE to address a problem with upward mobility and advancement. It was developed based on an evaluation of operators who were considered to be senior, experienced operators that performed their jobs at a high level. This evaluation tried to
identify specific areas that set these individuals apart and the process these individuals had followed to reach this level. The result was a training program that focused on achieving a detailed knowledge level of a few important systems and placed a heavy emphasis on being able to apply the knowledge and skills obtained during the initial qualification process to real accelerator operations and problem solving. In some ways it resembles a mentoring program in that it involves other professionals, such as accelerator physicists, as instructors and evaluators. It focuses on performing complex evolutions or demonstrating advanced skills. The format is the same as the basic program.

Qualification Maintenance
LANSCE does not have a requalification program. Instead, we have implemented a program which is intended to insure our operators remain proficient. As long as an operator works at least two full shifts in a 12 month time period, we consider him to be proficient. If an operator does not meet this requirement, then the Beam Delivery Team Leader, in consultation with the Group Leader, determines the training requirements necessary to regain proficiency. During non-operational periods, a lecture series is provided on relevant topics and is used to maintain and enhance proficiency for all operators. These lectures are presented by system experts and are video taped for viewing by those unable to attend. These video tapes also serve as training resources for future operators.

Career or Not?
Interestingly enough, to date, we have never had anyone retire from LANSCE as an operator, although we have had former operators retire from the operations group. Our present team averages 5.5 years of current experience. Our most experienced operator has been at LANSCE for over 25 years. The work schedule is a significant factor in determining how long an operator stays. The stress of working a rotating shift schedule will eventually take its toll and cause a person to seek a position with normal working hours. This does not necessarily mean that the individual is seeking to leave accelerator operations and take up a new profession. Many of our former operators have moved to positions which give them an improved work schedule while still allowing them to remain involved, at varying levels, with operations. Another factor is the limited number of senior positions available. A person could spend 5 to 10 years as an operator before a senior position opens up. When a position does open, the competition is usually heavy with many applicants competing for one opening. Our senior operator qualification program is an attempt to address this problem. It provides an advancement path that is independent of staffing requirements and is in the direct control of the individual.

Summary
LANSCE has been successful recruiting personnel from the United States Navy’s Nuclear Power Program and we intend to expand our recruiting efforts to include vocational and technical schools. The training program is designed to provide an operator with the knowledge and skills necessary to perform his job and includes a method to monitor and maintain operator proficiency. It also provides an opportunity for a qualified operator to continue to develop his career to an advanced level. The result of this overall effort is a highly competent staff of accelerator operators who can safely and efficiently operate the LANSCE facility.

References

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