ANSI/ANS 3.1-2014 incorporates the systematic approach to training that will help the nuclear power industry more efficiently develop and maintain a supplemental workforce of radiation protection technicians.

ANSI 3.1-2014 and the Supplemental Workforce of Radiation Protection Technicians

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Abstract: Attrition in the supplemental workforce of radiation protection technicians continues to present challenges in supporting the US nuclear power industry with contract technicians during refueling outages, major projects, and decommissioning. Industry-wide adoption of ANSI 3.1-2014, Selection, Qualification, and Training of Personnel for Nuclear Power Plants, can help overcome these challenges by accelerating the training and development of technicians in the supplemental workforce by applying the systematic approach to training (SAT).

Key words: operational topics; nuclear power industry; regulatory guides; safety standards

INTRODUCTION

Over the past three years, the number of senior radiation protection technicians in the supplemental workforce available to support refueling outages has decreased by approximately 37%.

The causes of this attrition are those common to an aging workforce, an increasing technician demand for decommissioning, and long-term employment opportunities offered to technicians by utilities and other employers. To counter this attrition, hundreds of individuals have been recruited over the past three years to participate in entry-level junior technician training programs with the objective to increase throughput to the senior level. This effort has had limited success due to junior technicians leaving the workforce before they gain the experience to become qualified as senior technicians. Approximately 30% of junior technicians leave the supplemental workforce to pursue other career paths. Common feedback is that these technicians want to pursue career paths that provide increased compensation and benefits earlier in their careers as compared to working as a supplemental junior technician.

The steady-state population of senior technicians in the supplemental workforce will stabilize when the number of trainees achieving qualification as a senior technician is equal to the number of senior technicians leaving the workforce. The question that remains is if reasonable training activities will stabilize the workforce at the number of senior technicians necessary to support the US nuclear power industry.

Experience to date indicates that current training activities will not stabilize the workforce at a sufficient level unless attrition is reduced. Actions are needed to improve the attractiveness of pursuing a career as a radiation protection technician in the supplemental workforce. Reducing the time to reach senior technician qualification provides incentive for junior technicians to stay in the supplemental workforce.

Currently, most licensees require a junior technician to have two to three years of experience before the technician can qualify to perform senior level tasks. When a technician primarily works only during refueling outages, a technician usually works 10 to 20 refueling outages to qualify as a senior radiation protection technician. Leldon (L.A.) Blue is the Director of Technical Support for BHI Energy. He obtained a Bachelor’s of Science from Oklahoma State University in health physics related studies. L.A. has over 45 years of experience in the nuclear power industry including over 20 years as the radiation protection manager at the V.C. Summer Nuclear Station. He was also a loanee to the Institute of Nuclear Power Operations as a senior evaluator for over two years, the site training manager at V.C. Summer for over three years, and a consultant for the nuclear industry for over five years. During the previous five years, L.A. has assisted with development of standard radiation protection processes for the nuclear power industry, including the industry process for the training and qualification of supplemental radiation protection technicians. In his current position, L.A. leads the development and implementation of radiation protection training programs for BHI Energy. L.A. is a certified health physicist and a certified senior reactor operator. His email is leeldon.blue@bhienergy.com.

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Standardized Task Evaluations (STE)

STEIs are evaluation tools developed using the EPRI AP3 protocol to validate that a supplemental worker has the knowledge and skills to perform specific tasks. This process uses task analysis and task design to establish an evaluation process to ensure a candidate can demonstrate sufficient knowledge through written exams and can demonstrate the required skills through performance evaluations (EPRI 2015).

Institute of Nuclear Power Operations (INPO)

Nuclear utilities are required to maintain training programs consistent with objectives and criteria for accreditation. Accreditation objectives and processes are managed through the National Academy for Nuclear Training, an entity within INPO, as described in ACAD documents. ACAD 91-006, Rev. 4, Guidelines for On-the-Job Training and Evaluation, allows granting credit for task qualification using an industry-based standardized task evaluation that meets station criteria and standards (NANT 2020a).

Nuclear Energy Institute (NEI)

NEI is a member-based policy organization with a mission to promote the use and growth of nuclear energy through efficient operations and effective policy. NEI has hundreds of members that include companies that own or operate nuclear power plants, reactor designers and advanced technology companies, architect and engineering firms, fuel suppliers and service companies, consulting services and manufacturing companies, companies involved in nuclear medicine and nuclear industrial applications, radionuclide and radiopharmaceutical companies, universities and research laboratories, law firms, labor unions, and international electric utilities. A Board of Directors establishes, delegates, and monitors industry actions through its members to accomplish the NEI’s mission.

Table 1. NISPs for supplemental RP technicians.

| NISP-RP-001 | Portable Survey Instruments |
|-------------|-----------------------------|
| NISP-RP-002 | Radiation and Contamination Surveys |
| NISP-RP-003 | Radiological Air Sampling |
| NISP-RP-004 | Radiological Posting and Labeling |
| NISP-RP-005 | Access Controls for High Radiation Areas |
| NISP-RP-006 | Personnel Contamination Monitoring |
| NISP-RP-007 | Control of Radioactive Material |
| NISP-RP-008 | Use of HEPA Equipment |
| NISP-RP-009 | Radiography |
| NISP-RP-010 | Radiological Job Coverage |
| NISP-RP-011 | RP Fundamentals |
| NISP-RP-012 | Training and Qualification of Supplemental RP Technicians |
| NISP-RP-013 | Radiation Protection Standard Glossary of Terms |

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Table 2. Task list for supplemental radiation protection technicians.

| Task Description                                                   | Task Description                                                   |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
| 1. Perform a Pre-Use Instrument Inspection and Check              | 32. Respond to a Contamination Monitor Alarm                       |
| 2. Operate an Ion Chamber Survey Instrument                       | 33. Determine the Contamination Hazard from a Personnel Contamination |
| 3. Operate a GM Survey Instrument                                 | 34. Decontaminate Personnel                                     |
| 4. Operate a Count Rate Meter with a GM Frisker Probe             | 35. Assess and Document Dose from Personnel Contamination          |
| 5. Operate a Count Rate Meter with an Alpha, Beta, or Dual Scintillation Probe | 36. Release Personal Items from an RCA                           |
| 6. Operate a Neutron Rem-Meter                                    | 37. Release Non-Personal Items from an RCA                        |
| 7. Survey Dose Rates in an Area                                   | 38. Release Liquids from an RCA                                   |
| 8. Directly Frisk a Surface                                       | 39. Release Bulk or Aggregate Materials from an RCA               |
| 9. Perform a Smear Survey                                         | 40. Conditionally Release Material from an RCA                    |
| 10. Perform a Large Area Smear Survey                             | 41. Store Radioactive Material                                    |
| 11. Survey for Discrete Radioactive Particles                     | 42. Move Radioactive Material                                    |
| 12. Analyze Smears                                                 | 43. Select HEPA and Vacuum Equipment                              |
| 13. Evaluate Smears for Alpha                                     | 44. Setup HEPA and Vacuum Equipment                               |
| 14. Respond to Abnormal Survey Results                            | 45. Monitor HEPA and Vacuum Equipment Operation                   |
| 15. Document a Radiological Survey                                | 46. Store HEPA and Vacuum Equipment                               |
| 16. Determine the Need for an Air Sample                           | 47. Survey and Store a Radiography Source                        |
| 17. Collect a Particulate and Iodine Air Sample                    | 48. Review a Radiography Shot                                    |
| 18. Collect a Noble Gas Sample                                    | 49. Prepare for a Radiography Shot                                |
| 19. Operate a Continuous Air Monitor (CAM)                        | 50. Monitor for a Radiography Shot                                |
| 20. Set Up and Operate a Personal Air Sampler                      | 51. Restore an Area from Radiography Operations                   |
| 21. Analyze a Particulate Air Sample Filter                        | 52. Respond to an Emergency During Radiography                    |
| 22. Post External Radiation Hazards                               | 53. Prepare for Radiological Job Coverage                         |
| 23. Post Areas with Smearable Contamination                       | 54. Survey a Work Area in Support of Radiological Job Coverage    |
| 24. Post an Airborne Radioactivity Area                           | 55. Monitor and Verify Protective Measures During Low Risk Radiological Job Coverage |
| 25. Label Tools, Equipment, or Containers of Radioactive Material | 56. Monitor and Verify Protective Measures During Medium or High Risk Radiological Job Coverage |
| 26. Control Area Configurations for HRAs and LHHRAs^              | 57. Track Stay Time                                               |
| 27. Conduct an HRA Entry Brief                                    | 58. Respond to Unexpected Conditions During Radiological Work     |
| 28. Conduct an LHRA Entry Brief                                   | 59. Exercise Stop Work Authority                                  |
| 29. Issue a Key to Access an LHRA^                                |                                                    |
| 30. Transfer Possession of an Issued LHRA Key^                     |                                                    |
| 31. Terminate Access into an LHRA and Return the Key^             |                                                    |

^Senior Level Task Only.

INPO, and EPRI. Table 1 lists the NISPs applicable to supplemental radiation protection technicians. The common tasks performed by supplemental technicians are listed in Table 2 (NISP 2021).

10 CFR 50.120

In 1993, the US Nuclear Regulatory Commission amended its regulations to add 10 CFR 50.120, Training and Qualification of Nuclear Power Plant Personnel. The Federal Register publishing the final rule stated that SAT-based training for licensee personnel was required. However, SAT-based training was not required for supplemental personnel. The Federal Register also stated that each licensee is responsible to ensure that personnel specified by the rule, regardless of whether they are employees or contractors, are qualified (US NRC 1993).

NRC Regulatory Guide 1.8

NRC Regulatory Guide 1.8, Rev. 4, Qualification and Training of Personnel for Nuclear Power Plants, describes methods acceptable to the NRC for complying with regulations associated with the selection, qualifications, and training for nuclear power plant personnel. Regulatory Guide 1.8, Rev. 4, endorses ANSI 3.1-2014 (US NRC 2019).

ANSI 3.1-2014

ANSI 3.1-2014 requires radiation protection technicians to have two years of related experience which shall include one year of applicable nuclear power plant experience. An acceptable alternative to the related experience requirement is successful completion of a training program based on SAT and one year of applicable nuclear power plant experience (ANSI/ANS 2014). A training program based on SAT provides personnel with the necessary knowledge and skills, using structured processes, before tasks can be performed independently. SAT processes establish expectations for high levels of human performance and proficiency (NANT 2020b).

ANSI 3.1-2014 provides an opportunity to take advantage of the SAT-based training and qualification program described by NISP-RP-12, Training and Qualification of Supplemental RP Technicians. NISP-RP-12 is a training standard applied throughout the commercial nuclear power industry (NISP 2021). The benefits from implementing ANSI 3.1-2014 for supplemental radiation protection technicians include:

1. Assurance that a supplemental senior technician will have at least one year of radiation protection experience in a nuclear power plant;
2. The ability to qualify a supplemental technician to perform senior level tasks after one year of radiation protection experience at a nuclear power plant provided the systematic approach to training (SAT) is used for task qualification; and
3. The use of a more recent ANSI standard, as compared to ANSI standards that were published.
over 40 years ago, to determine if a supplemental technician meets ANSI experience requirements.

The reasons why NISP-RP-12 enables the benefits from implementing ANSI 3.1-2014 for the supplemental radiation protection workforce include:

1. Entry level radiation protection technicians entering the supplemental workforce since January 2018 are trained and qualified using a SAT-based program;
2. Nuclear Industry Standard Processes (NISP) provide the basis for the task analysis and design phases of the SAT process. NISPs are industry-wide procedures for common tasks performed by both utility and supplemental technicians; and
3. ACAD 93-008, Rev 1, Guidelines for Training and Qualification of Radiological Protection Technicians was used to identify knowledge and skill requirements for supplemental technicians. ACAD 93-008 is the industry task analysis used for accreditation of utility training programs, published by the National Academy for Nuclear Training (NAN T 2016).

Table 3. CIRP task qualifications.

| Junior task qualifications |
|-----------------------------|
| 1. RP02.01, Operate Portable Radiological Survey Instruments per NISP-RP-001 |
| 2. RP02.02, Perform Radiation and Contamination Surveys per NISP-RP-002 |
| 3. RP02.03, Collect and Evaluate Radiological Air Samples per NISP-RP-003 |
| 4. RP02.04, Post Low Level Radiological Hazards per NISP-RP-004 |
| 5. RP02.05, Control Access to High Radiation Areas per NISP-RP-005 |
| 6. RP02.06, Monitor Personnel Contamination per NISP-RP-006 |
| 7. RP02.07, Control Radioactive Material Within an RCA per NISP-RP-007 |
| 8. RP02.08, Control HEPA Vacuums and Ventilation Equipment per NISP-RP-008 |
| 9. RP02.10, Perform Low Risk Radiological Job Coverage per NISP-RP-010 |

CIRP tasks were classified as a junior level CIRP task or a senior level CIRP task. CIRP tasks are listed in Table 3 (NISP 2021).

Task analysis and design were based on NISP standards and applicable topics from ACAD 93-008. ACAD 93-008 is used in conjunction with specific job analysis information to select training program content to reflect unique job duties, equipment, operating experience, and trainee entry qualifications (NANT 2016).

EPRI Technical Report 3002006470, EPRI Standardized Task Evaluation Program Implementation Guide, Revision 1, was used to develop the content and structure of the qualification program. This process uses task analysis and task design to establish an evaluation process to ensure a candidate can demonstrate sufficient knowledge through written exams and can demonstrate the required skills through performance evaluations (EPRI 2015).

Each CIRP Task qualification listed in Table 3 requires a written exam and a performance evaluation. Cognitive enabling objectives and exam questions were developed as part of the task design phase to validate that a trainee has the knowledge required to perform the tasks described by NISPs. Performance enabling objectives were developed as part of the task design phase to validate that a trainee can perform the tasks.
independently, without coaching, and in compliance with NISP requirements and standards (EPRI 2015).

A junior level fundamentals examination must also be successfully completed prior to a trainee being administered STE exams and evaluations. The junior fundamentals exam is based on the topics from ACAD 93-008 applicable to junior level tasks. In addition, a senior fundamentals examination must be successfully completed prior to a trainee being administered senior level STE exams and evaluations. The senior fundamentals exam is also based on the topics from ACAD 93-008 applicable to senior level tasks (NISP 2021).

The development and delivery of training to support the Standardized Task Evaluations (STE) can be provided by utility training programs, vendor-supplied training, vocational and technical schools, and training from other agencies such as US DOE. In some cases, relevant experience is all that is required to gain the knowledge and skills needed to be successful in completing an STE evaluation. Therefore, the STE process does not provide training but does establish an evaluation process to ensure the necessary knowledge and skills have been acquired (EPRI 2015).

The effectiveness of the training and qualification program is reviewed by an Industry Training Oversight Committee (ITOC) composed of subject matter experts. The composition and responsibilities of the ITOC are described by NISP-RP-12 (NISP 2021).

Technicians with radiation protection experience prior to 2018 are granted equivalencies based on prior training and experience. Instructions for granting equivalency for CIRP tasks are prescribed by NISP-RP-12 (NISP 2021).

Candidate selection

Gaining the experience as specified by an ANSI standard does not automatically qualify a technician to perform the senior level tasks listed in Table 2 and Table 3. Gaining ANSI experience simply allows a technician to undergo the SAT-based evaluation process for a senior level STE if an appropriate level of training and experience has been achieved. Management personnel are responsible for evaluating objective evidence, i.e., previous experience and training, that the candidate will likely succeed in passing both the knowledge and skills portions of an STE before the STE is administered (EPRI 2015).

Task qualification of a senior technician enables management to administer an STE only when the technician has had sufficient on-the-job training and has demonstrated knowledge of the applicable NISP for the task. For example, a senior technician may become qualified to unconditionally release materials from a radiologically controlled area well before becoming qualified to provide job coverage for medium and high risk activities. Work assignments for senior technicians can be scheduled to provide the on-the-job training necessary to support progression through the senior level task qualifications.

US NRC Regulatory Guide 1.8, Rev. 4, section 1.5, allows 2,000 working hours to be acceptable as representing one year of experience. There is no expectation of a minimum timeframe for accumulating these 2,000 hours (e.g., not less than 40 weeks), nor is there a limit applied to the number of hours that can be credited in a week. However, no more than 2,000 hours can be credited toward related experience for radiation protection technicians in any one calendar year (US NRC 2019).

Technicians who work primarily during refueling outages work five or more refueling outages to gain 2,000 hours of experience. Technicians with this level of experience are excellent candidates to undergo senior level STEs due to their experience with radiologically significant activities.

ANSI standards

Another benefit of the industry uniformly adopting ANSI 3.1-2014 is the establishment of one single standard for the industry. Currently, a technician qualified to perform senior level tasks at one plant may not be qualified to perform senior level tasks at other plants because of different ANSI standard commitments in plant licensing basis documents. These differences provide obstacles to enable senior technicians to work multiple outages. ANSI standards currently applicable to supplemental radiation protection technicians in the nuclear power industry are described below.

ANSI N18.1-1971

Technicians in responsible positions shall have a minimum of 2 years of working experience in their specialty. These personnel should have a minimum of one year of related technical training in addition to their experience (ANSI/ANS 1971).

ANSI/ANS-3.1-1978

Technicians shall have 3 years of working experience in their specialty of which 1 year should be related technical training (ANSI/ANS 1978).

ANSI/ANS-3.1-1993

Technicians shall have 2 years of related experience which shall include 1 year of nuclear power plant experience. An acceptable alternative to the related experience requirement is successful completion of a training program based on a systematic approach to training and 1 year of nuclear power plant experience (ANSI/ANS 1993).

ANSI/ANS-3.1-2014

Radiation Protection Technicians shall have 2 years of related experience which shall include 1 year of nuclear power plant experience. An acceptable alternative to the related experience requirement is successful completion of a training program based on a systematic approach to training.
approach to training and 1 year of nuclear power plant experience (ANSI/ANS 2014).

**Unit staff qualification requirements**

Experience requirements for nuclear power plant personnel have historically been described in the administrative section of Plant Technical Specifications under the heading of Unit Staff Qualifications. Most licensees commit to follow either ANSI 18.1-1971 or ANSI 3.1-1978 with any positions being excepted that are qualified to a different standard. Typical exceptions include the Radiation Protection Manager, Operations Manager, Shift Engineer, and licensed operators. Such exceptions are common in the industry when there is an acceptable alternative to the ANSI standard. Therefore, a specific exception to adopt a more recent ANSI standard applicable to supplemental radiation protection technicians does not conflict with US NRC requirements.

Many licensees have removed Unit Staff Qualifications from their Technical Specifications, in whole or in part, and revised their quality assurance program to address Unit Staff Qualifications. This action is consistent with US NRC Administrative Letter 95-06 that recommends the relocation of Technical Specification requirements to the quality assurance program that do not satisfy the criteria of 10 CFR 50.36 for protecting the integrity of barriers that guard against the uncontrolled release of radioactivity, i.e., safety limits, limiting safety system settings, and limiting control settings. Changes to the quality assurance program are regulated per 10 CFR 50.54(a) (US NRC 1995). 10 CFR 50.54(a) does not require prior NRC approval if the change does not reduce previous commitments to the NRC. The use of a QA standard approved by the NRC that is more recent than the current commitment is not considered to be a reduction in commitment [US NRC 1999].

**CONCLUSION**

1. An industry-wide effort to adopt ANSI 3.1-2014 for supplemental radiation protection technicians at US Nuclear Power Plants will allow for more efficient development and deployment of senior radiation protection technicians in the supplemental workforce.
2. Administering SAT-based written exams and performance evaluations for senior level task qualification is far superior to simply relying on a work history review and years of related experience;
3. Supplemental technicians can progress through the qualifications as they gain the experience and knowledge required to complete the STEs;
4. The knowledge and skills required to progress through the STEs are well defined through the SAT process;
5. Allowing technicians to complete senior level STEs with one year of applicable nuclear power plant experience provides an earlier opportunity for those technicians who are ready to progress to a senior level; and
6. Adopting a single ANSI standard for supplemental radiation protection technicians enhances the portability of qualifications and the ability for senior technicians to rotate from one outage to another.

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