Delivering the Nuclear Promise
Top Innovative Practice

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Innovative Approach to the Nuclear Initial License Operator Training Program Design and Implementation
2023 Top Innovative Practice Winner[1]

Summary

Duke Energy has reduced Initial License Operator Training (ILT) to a 12-month duration, producing highly trained and competent operators in 25-50% less time, thereby reducing costs and increasing productivity of the Operations and Training departments. Across Duke Energy's six nuclear stations, ILT programs formerly ranged from a duration of 15 months to 24 months and, at times, struggled to keep up with site staffing needs and operator attrition rates. The goal of this initiative was to redesign and implement a standardized 12-person, 12-month ILT program for producing highly trained and competent operators with a 100% NRC exam pass rate. The program optimization resulted in reduced costs and improved productivity for the operations and training departments as well as improved talent development across the sites to meet station staffing needs.

Innovation

Standardizing the ILT program required a team approach to develop a solution that could be implemented across all sites. A team was formed comprising a corporate operations training lead and program superintendents from three sites that would be starting a new license class in 2020. To address the program redesign, three distinct phases of the project were identified: (1) Analysis of Current Station Programs; (2) Design and Development of a Single Program Structure to Implement Across Fleet ILT Programs; and (3) 12-Month Program Implementation.

During Phase 1, Analysis of Current Station Programs, the team evaluated the existing structure of the programs. Classroom schedules and student qualification guides were reviewed to determine the required program content versus additional topics and tasks that have been added into the program over the years. This comparison verified compliance with the approved training program and industry requirements to ensure no required training items were removed. A focus was placed on analysis of program lessons that were not tied to the Knowledge and Abilities Catalog for Nuclear Power Plant Operators[2] to determine if the material would be deleted, remain in the program or transition to a different means of delivery. Duke determined that a subset of those lessons could be deleted, and non-testable lessons were transitioned to self-study topics to be completed either prior to starting the class or following completion of the NRC exam. Existing program weekly schedules were reviewed to determine instructor-to-student contact time ratios to gain an understanding of the

[1] Winning entries of from NEI's Top Innovative Practices (TIP) awards are republished as DNP Efficiency Opportunities to ensure the broadest possible dissemination of these operating plant innovations.

[2] NUREG-1122, "Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized Water Reactors"; and NUREG-1123, "Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Boiling Water Reactors"; available at https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/index.html

efficiency of the program. This showed a significant variance over the length of programs with some weeks having less than 25% contact time and an overall average of approximately 55% week-to-week student-to-instructor contact time.

Phase 2 of the project, Design and Development of a Single Program Structure to Implement Across Fleet ILT Programs, generated fleet standard governance on the backbone structure of the program. While this governance provided the roadmap, each of the individual Duke Energy nuclear sites performed site specific analyses to develop their own 12-month backbone schedules to meet the requirements of the approved program. The key elements from Phase 1 informed the standardized fleet governance and provided common elements from the analysis phase that fed into each site's program. Figure 1 below shows an example of a site-level analysis completed to align the station's ILT program to the 12-month structure. Instructor-contact to self-study ratio was aligned to 80% contact/20% self-study. Additionally, Duke Energy adopted a five-day training workweek vice the standard four-day, 10-hour workday schedule. These changes proved to be the largest contributor to achieving the 12-month target across the sites' programs. To ensure student comprehension of topics, integration of two quizzes per week was used to track student progress and close knowledge gaps in real time. Quizzes were generated using readily available technology, such as Microsoft Forms, which did not result in additional burden on the instructor staff to develop quizzes, or grade, track, and trend results. A method for tracking quiz results for specific topics was established to allow instructors to use focused self-study time with students to ensure knowledge gaps did not carry forward in the program. Figure 2 below shows an example of the results from the use of technology for student quizzes. Systems-level lectures were redesigned to include the use of the simulator on a weekly basis to drive student familiarity with the control boards prior to the designated simulator portion of the program. This strategy allowed instructors to demonstrate key elements of the systems while providing students early exposure to the control board configuration to gain proficiency in hands-on operations performed later in the program. Based on the length of the new program, an oversight board process comprised of station, operations and training leaders was established. Inputs to the board included the use of key student metrics on progress through the program, regularly scheduled mentor updates to student performance and the development of a Program Health dashboard for early detection of declining performance.

Phase 3, 12-Month Program Implementation, occurred across three sites over the course of 15 months beginning in the first quarter 2020. A fleet-level oversight group comprised of fleet leaders, station operations and training leaders was formed to monitor the implementation of the program. A heat map was used as a visual representation of class status to show a student's cognitive ratings by the line and training as well as exam scores. Figure 3 below is an example of a program heat map. To capitalize on the station learnings, ILT superintendents across the fleet observed the station monthly oversight meetings for implementation of real-time operating experience. Modifications to the program were implemented through this feedback loop.

Safety

This initiative created an efficient, standardized ILT program and produced highly trained and competent operators with a 100% NRC exam pass rate. Overtime for licensed operators has decreased and experienced control room operators can now be better utilized in roles outside the operations organization.

Cost Savings

The first three Duke Energy stations to run the 12-month ILT program successfully completed the program as designed with the expected 100% NRC exam pass rate. As of the fourth quarter 2022, five of the six Duke Energy sites have completed a minimum of one 12-month ILT program. To date, over the two years since the program has been implemented, nine classes have been completed, producing 76 licensed operators with 100% NRC exam pass rate. As a comparison to the two-year period prior to the program redesign, five classes were completed producing 51 licensed operators. Thus far, implementation of this program has saved approximately 70,000 student hours and 35,000 instructor hours. This has resulted in an approximate savings to operations of over $3.25 million to produce a fully qualified licensed operator. Additionally, fleet-wide

operations overtime for licensed operators has decreased over the period as generation of new licenses has outpaced normal attrition. Lastly, stations can support talent development needs across the sites by utilizing experienced control room operators in various roles outside the operations organization. As an example, one of the single unit sites produced 20 licensed operators in two classes over the 24-month period. This provided the site with the ability to move various experienced operators to leadership roles in maintenance, engineering, chemistry, and training.

Productivity/Efficiency

To date, over the two years since the program has been implemented, nine classes have been completed producing 76 licensed operators with 100% NRC exam pass rate. As a comparison to the 2-year period prior to the program redesign, five classes were completed producing 51 licensed operators. The resulting savings in person hours through implementation of this program thus far is approximately 70,000 student hours and 35,000 instructor hours.

Transferability

The 12-Month Program is now in progress at all six Duke Energy nuclear sites. The process described above is transferable across the industry. Using the steps outlined above, regardless of the type of reactor, any site in the industry could develop and implement the program. Key aspects to consider when implementing this program include maximizing instructor contact time, incorporating operators into the simulator early in the program and using quizzes to detect and close any knowledge gaps real time throughout the program.

Team Members

- Frank Giannone, Manager, Advanced Nuclear Team, Duke Energy
- Stacey Hamm, Advanced Nuclear Team, Duke Energy
- Tony Doss, Corporate Manager Operations Training, Duke Energy
- Elizabeth Whitley, Operations Training Superintendent, Robinson Nuclear Plant

Additional Information

Figure 1 – Sample Analysis for ILT Project Plan

Phase	Current Phase Duration (weeks)	12 Month Program Duration (weeks)	Analysis supporting the change
Systems	15	11	Based on scheduled class time hours through systems and Simulator C Guides (Panel Familiarization) - a total of 395.1 hours of instructor led training are needed in these phases, and it is desirable to complete all three of these phases prior to sending candidates to On-the-Job Training (OJT). The total hours (395.1) divided by 32 hours a week (80/20 instruction to self-study) equals 12.3 weeks. Select topics will be changed to self-study to enable this portion to be completed within 11 weeks.
Pre-OJT	1	0.5	Need to keep - 25.6 hours of instruction - optimize to 20 hours.
OJO	15	13	13 weeks is minimum possible and still meet NRC requirements. With a gap between Generic Fundamental Training and the start of Systems, candidates can complete up to 100 hours of OJT prior to Systems beginning.
Normal OPS	4	1.5	One week removed for Simulator Familiarization guides moved to Systems. Two weeks remain for 58 hours of instruction.
Abnormal Procedures (AP)	6	4	Instead of entire class getting classroom AP training for 2 weeks and then 4 weeks of simulator, combine the AP classroom lessons over the 4 weeks of Simulator Training. In addition, the Simulator A guides will have been modified to remove the DEMO portion of the APs and that DEMO portion will be completed during the classroom training by using the glasstop simulator. Current program phase scheduled instruction time over the 6 weeks is 131 hours (including an operating exam). New program removes AP operating exam and incorporates efficiency in demonstrations to be able to fit into 4-week period.
Teams Training	1	0.5	Teams training current program is 18.5 hours of instruction/simulator time. Program design is based ACAD requirements.
Emergency Procedures (EP)	6	4	Similar to AP. Combine EP lessons with EP Simulator to achieve 80/20 ratio. Based on 140 hours of instruction in the EP classroom and EP simulator phases, a 4.5-week schedule would allow at least 8 hours per week self-study.
Multiple Malfunctions (MM)	11	11	This should not be drastically changed due to the integrated practice needed prior to the audit exam.
Audit Exam	2	1.5	This can be completed in 1.5 weeks if operating exam is completed the first week and written is completed on Tuesday of the second week.
Post Audit Work ups	4	3	A 3-week duration is all that is needed to ensure required ARB and license applications are completed. Students are at their peak at the Audit exam and will benefit from less time between exams.
Vacation	4	2	Less vacation needed due to smaller class duration.
Total weeks	69	52	
Other changes			
Preaudit exams	3 written	2 written	The first exam is a diagnostic, this is not needed since the last EP written exam accomplishes the same task. Removing the diagnostic exam would have no impact on student averages and will allow more time between written exams. This change will save 10 hours.
System exams	7 written	4 written	This change will save 20 hours and the students will be given more questions through quizzes.
AP Sim exam	1 operating	None	An operating exam during this phase of the program has shown to be no value added. This change saves 20 hours per split group.
Quizzes	None	2/week	Based on removal of two written exams, utilize quizzes to gage real time understanding. Increasing the number of questions on the exams following the Systems Comp (all will be 100 questions) as well as integration of quizzes will increase the number of questions seen by the students. Dropping to one quiz per week on weeks with an exam is allowable.

Figure 2 – Bi-weekly Quiz Example

5. Given the following: • Unit 1 is at 30% RTP • A Turbine trip has occurred due to a rapid loss of vacuum • "C-9 COND AVAILABLE FOR STEAM DUMP" status light (1SI-18) is DARK Based on the given plant conditions the crew will enter _____(1)_____ AND subsequent steps ____(2)___ direct the crew to trip the reactor and GO TO E-0. Procedure Legend: AP/1/A/5500/02 Turbine Generator Trip AP/1/A/5500/23 Loss of Condenser Vacuum EP/1/A/5000/E-0 Reactor Trip or Safety Injection (Select the answer that completes the statements above) (1 point)

82% of respondents (9 of 11) answered this question correctly.

More Details Insights

A. (1) AP-02 (2) will	9	✓
B. (1) AP-02 (2) will NOT	1	
C. (1) AP-23 (2) will	1	
D. (1) AP-23 (2) will NOT	0	

6. Given the following on Unit 1: • A Reactor Trip and Safety Injection have occurred due to a LOCA • LOCA SEQ ACTUATED TRAIN B status light on 1SI-14 is DARK • The Phase A "RESET" lights for Trains "A" and "B" are LIT 1) Based on the conditions above, the "S LATCHED" light for 1NI-185A (RB SUMP TO TRAIN A ND & NS) _____ LIT. 2) When the "S LATCHED" lights are LIT for 1NI-185A and 1NI-184B, depressing the "SS RESET" pushbuttons _____ disable the Auto OPEN signal. Which ONE (1) of the following completes the statements above? (1 point)

55% of respondents (6 of 11) answered this question correctly.

More Details Insights

A. 1) is 2) will	6	✓
B. 1) is 2) will NOT	2	
C. 1) is NOT 2) will	3	
D. 1) is NOT 2) will NOT	0	

Figure 3 – Heat Map for ILT Candidates