ANNUAL REPORT
ON
THE EFFECTIVENESS OF TRAINING
IN THE NUCLEAR INDUSTRY
FOR
CALENDAR YEAR 1999

May 2000

TABLE OF CONTENTS

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BACKGROUND

The history of NRC regulation of training in the nuclear industry dates to the 1982 Nuclear Waste Policy Act (NWPA) which required the NRC to provide guidance on the instructional requirements for workers at nuclear power plants. To meet this directive, the Commission published a policy statement on training in March 1985 which endorsed the performance-based training accreditation process managed by the Institute of Nuclear Power Operations (INPO). When issuing the policy statement, the Commission deferred rulemaking to allow the industry to continue its efforts to upgrade their training programs. After an initial two-year period, evaluations of the accreditation process concluded that it was generally effective in bringing about improvements to the training programs so rulemaking related to the training of non-licensed personnel was not initiated. In May 1987, 10 CFR Part 55 was revised to incorporate several new requirements and endorsements. The 1987 changes included removing instructor certifications, endorsing Regulatory Guides 1.8 on personnel training and 1.149 on the simulator certifications, requiring operating examinations to be conducted on a simulator, and establishing the operator requalification training program. In November 1988, an amended policy statement on training was issued to reflect the existing Commission views on training for non-licensed workers at nuclear power plants.

In response to a 1990 court decision requiring a rule on training to satisfy the NWPA, 10 CFR 50.120, "Training and Qualification of Nuclear Power Plant Workers," was issued in April 1993 and became effective in November 1993. This rule recognizes that the safety of nuclear power plant operations and the assurance of general public health and safety depends on personnel performing at adequate levels. The rule requires that training programs be established, implemented and

maintained using a systems approach to training (SAT) for nine categories of non-licensed workers at nuclear power plants. The systematic determination of job performance qualification requirements and the provision for periodic retraining enhances public confidence in the ability of workers to perform successfully when required. The Code of Federal Regulations, 10 CFR 50.120, complements the requirements for SAT-based training for the requalification of licensed operators contained in 10 CFR Part 55, which was issued in 1987. 10 CFR Part 55 allows facility licensees to have an operator requalification program content that is derived using a SAT-based process or which meets the requirements outlined in 10 CFR 55.59 (c) (1) through (7).

NRC MONITORING OF TRAINING

Public health and safety depends on proper operation, testing and maintenance of a nuclear power plant's systems and components by nuclear power plant personnel. Successful performance by nuclear power plant personnel is assured by having workers achieve and maintain job-task qualification through the SAT-based training and continuous re-training required by 10 CFR Parts 55 and 10 CFR 50.120. The overall implementation of a systems approach to training is monitored by INPO as part of their accreditation reviews conducted at nuclear power plants and is reflected in the status of accreditation throughout the industry as a whole. Therefore, indications of favorable job performance and successful SAT implementation provide a reasonable assurance that the training of nuclear power plant workers is adequate to maintain public health and safety.

The NRC monitored training-related activities in 1999 as indicators of worker performance and SAT implementation. The NRC monitored worker performance by: reviewing Licensee Event Reports (LERs) and inspection reports for training-related issues; inspecting training programs when an appropriate cause is identified; and administering, inspecting, and reviewing the results of operator licensing activities. The NRC monitored SAT use by reviewing the effectiveness of the accreditation process administered by INPO. These activities were selected because they provide an efficient and effective assessment of industry activities with minimal impact to licensees. Although each activity can provide plant-specific information, the information is used in the composite for this report to assess the overall effectiveness of training in the nuclear industry.

Guidance for administering examinations for licensed operators is contained in NUREG 1021, "Operator Licensing Examination Standards." Guidance for inspecting the aspects of the operator training programs unique to requalification is found in Inspection Procedure 71111.11, "Licensed Operator Requalification Program Evaluation." In addition, the NRC, for cause, verifies compliance with the requirements for SAT-based training through its inspection program and has done so when appropriate using Inspection Procedure 41500, "Training and Qualification Effectiveness," which references the guidance in NUREG-1220, "Training Review Criteria and Procedures." The Operator Licensing and Human Performance Section (IOHS) of the Operator Licensing, Human

Performance and Plant Support Branch in the NRC's Office of Nuclear Reactor Regulation has the programmatic responsibility for ensuring that utilities implement training requirements for all personnel addressed by 10 CFR 50.120 and 10 CFR Part 55 in an acceptable manner.

The NRC also monitors the effects on the industry as new regulations and associated guidance documents are implemented. During 1999, several difficulties were identified as the industry assumed responsibility for initial licensing examinations. The Focus Group on Initial Operator Licensing was formed in cooperation with the Nuclear Energy Institute (NEI) to provide a forum for discussing and resolving issues related to the development of initial licensing examinations by individual facility licensees. Through the group's efforts, the examination development process was streamlined, thereby reducing the resources needed. The group was also instrumental in defining the need for nation-wide workshops on topics related to examination development. The group continues to focus its efforts on issues related to initial examinations. In addition, the demonstrated success of this approach has identified it as a potential forum for addressing generic training-related issues in all areas, as they may be identified.

INDICATOR 1: Training-Related HFIS Data

Issues in LERs, Inspection Reports and Examination Reports

Several aspects of worker performance are continually monitored and documented in the Human Factors Information System (HFIS) by IOHS during its ongoing reviews of LERs, inspection reports, and operator licensing examination reports. Twice each year IOHS compiles the available human performance data from HFIS for all plants, including training data, and identifies those plants where power plant worker performance may challenge a licensee's ability to operate safely.

Figure 1 - HFIS 3-Year Trend

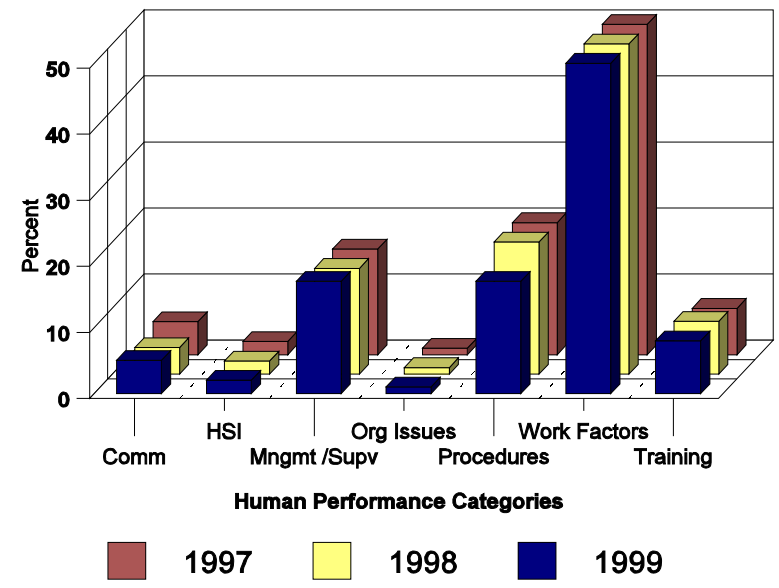


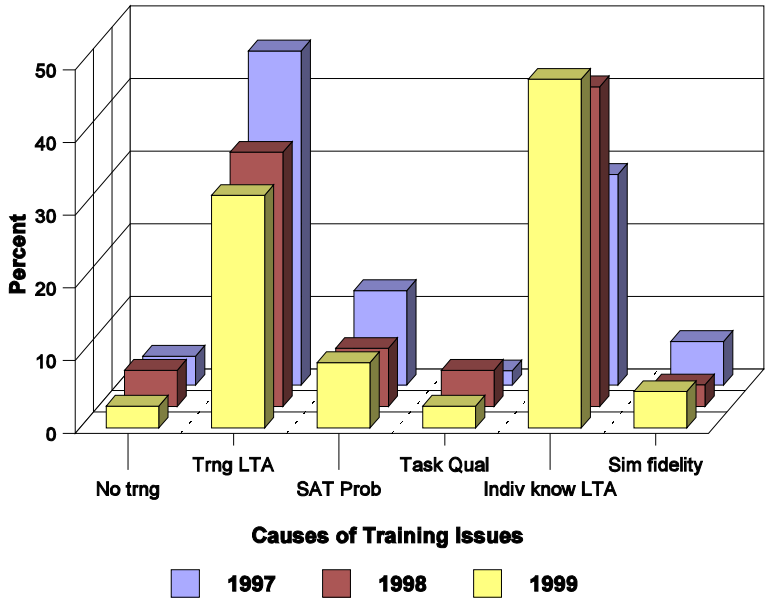
Figure 1, *HFIS 3-Year Trend*, shows the relative contribution of various categories of human performance issues to the overall industry total. A total of 12,363 human performance items were identified in LERs, inspection reports and examination reports during 1999. Of that total, 930 items were related to training. Over the last three years, the contribution of training has remained relatively constant at approximately seven percent for the industry as a whole. A review of the 1999 data showed that the number of training-related items for most licensees is clustered near the industry mean. The number of training items at nine plants identified them as having outlying performance in the area of training. Four of those nine were identified as also having outlying

overall human performance. Within the context of this report, outlying performance is defined as exceeding two times the national average for the industry as a whole.

An analysis of training items by NRC Region showed that the distribution of training-related issues among the regions in 1999 varied from that of previous years. In 1997 and 1998, the training issues were evenly distributed among the Regions with a deviation from the regional-group average of approximately six percent. In 1999, however, the deviation from the group average within the regional group increased to 24 percent. Although plants in Regions II and IV are near the industry average for human performance as a whole, the average number of training-related items for both of those regions is greater than the industry average. No specific cause has been identified for this change. Human performance in each region will continue to be reviewed to identify any emerging trends.

Figure 2, *HFIS 3-Year Training Data*, shows the breakdown of the training-related items into their specific causes. The graph in Figure 2 identified that the causes of the 930 training-related issues

Figure 2 - HFIS 3-Year Training Data



identified in 1999 continue to be concentrated in two distinct areas: “Training less than adequate

(LTA)"[1] and "Individual knowledge less than adequate (LTA)"[2]. The declining trend in "Training LTA" is in contrast to the increasing trend in "Individual knowledge LTA." The 1999 data suggests that the causes of poor performance appear to be becoming more focused on the individual rather than on a group or class of worker. Inadequate training has historically been identified as a cause, and retraining implemented as the corrective action, for a wide variety of performance problems throughout the nuclear industry. Whenever inadequate training is determined to be a contributing cause to poor performance, all individuals who have had the same training need retraining. However, corrective actions focused on group retraining is not always successful because of differences in the level of skill throughout the worker population. Research on the effectiveness of various performance improvement strategies has shown that wide-scale retraining is an appropriate solution to performance issues only about 40 percent of the time. Therefore, the increasing trend in the number of issues attributed to "Individual knowledge LTA" may not be an issue in and of itself but rather may signal a change in emphasis within problem identification and corrective action programs.

A shift in emphasis from training program to individual performance, however, would also be reflected in the use of the systems approach to training. Successful use of SAT requires that training-related issues be assessed during the program evaluation phase to determine if a group of individual knowledge deficiencies indicate problems with the overall effectiveness of the training programs. Repeat problems, with inadequate training as an underlying cause, are an indicator of inadequate training program evaluation as well as inadequate corrective actions. As the emphasis changes to the performance of an individual, the greater the likelihood that a corrective action will address the immediate problem and will prevent recurrences. An increase in the number of performance problems attributed to inadequate individual knowledge is more likely to be caused by the inadequate evaluation of the group of performance problems associated with a training program. Therefore, an increase in individual performance problems will indicate a problem with use of SAT in the area of training program evaluation. Inadequate training program evaluation has been documented as a weakness during NRC for-cause inspections of training over the past four years, and continued to challenge the industry in 1999.

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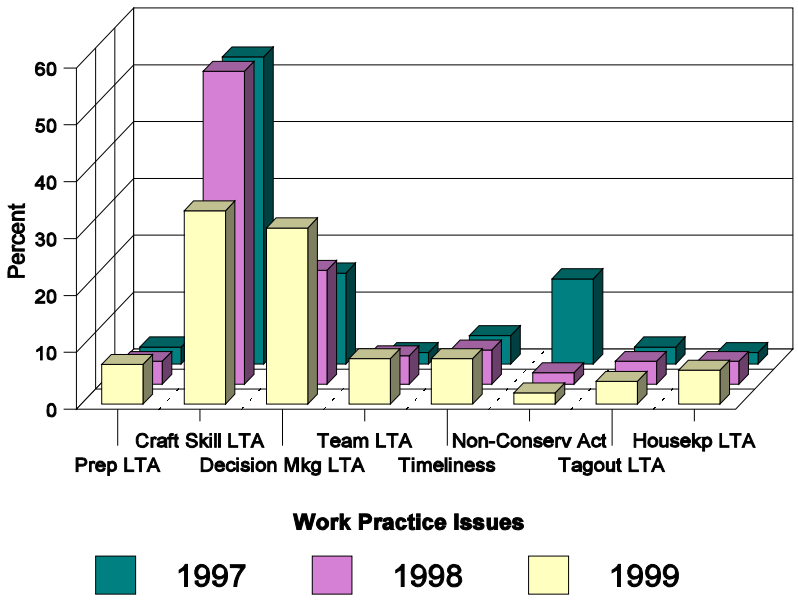
[1] Training was provided and was attended by the worker but content was incorrect or incomplete.

[2] Complete and accurate training was received by the worker but the worker was unable to perform successfully on the job.

As shown in Figure 1 on page 5, Work Factors continues to be the single greatest area of human performance issues. Many training-related issues are reflected in the area of *Work Practices*. *Work Practices* focuses on performance deficiencies resulting from power plant workers using practices that are inconsistent with the type or difficulty of the task being performed.

Figure 3, *1999 HFIS Work Practices Data*, provides a breakdown of the 3493 work practice items identified in 1999. The largest contributor remains "Work practice or skill of the craft less than adequate (LTA)."[3] The issue of craft skill can apply to entire categories of workers, such as

Figure 3 - HFIS 3-Year Work Practices Data



electricians or radiation protection technicians. As a result, training-related corrective actions to address this type of performance issue would have to include the entire population. As indicated previously, this type of wide-scope corrective action is appropriate for and successfully resolves less than half of the performance issues. A change in emphasis to individual performance can be seen in a decrease in the number of issues attributed to "Work practice or skill of the craft LTA" in 1999. Within *Work Practices*, the 21 percent decline in the "Craft skill LTA" is offset by increases in several of the other, more individually focused, items. For example, "Decisionmaking LTA" increased by 11 percent. Smaller increases were also noted in "Preparation LTA," "Teamwork

[3] Work not performed consistent with management expectations, safety significance of the activity or industry standard.

LTA," "Timeliness," and "Housekeeping LTA." The common characteristic of each of these is a limited scope corrective action which would apply to a limited number of plant workers. If the apparent increased focus on individual performance continues and if licensees become more successful in performing training program evaluation, fewer work practice issues and fewer training-related issues should be identified in the future. Continued monitoring of the use of the systems approach to training using HFIS data will provide assurance that the change in emphasis to individual performance is being reflected in the conduct of training program evaluation.

INDICATOR 2: NRC Inspection of Licensee Training Programs

For-Cause Training Inspections and Operator Licensing Examination Report Findings

The NRC can inspect facility training programs at any time to verify satisfactory implementation of the training requirements in 10 CFR Parts 50 and 55. Through inspections conducted prior to the implementation of 10 CFR 50.120, the NRC had found that training programs accredited and implemented consistent with the industry-wide objectives would be in compliance with the requirements contained in Parts 50 and 55 to have SAT-based training programs. As a result, training program performance indicators are monitored in lieu of routine inspection. Training program inspections are conducted whenever the number or type of training-related human performance issues suggests training-related deficiencies. Inspections of training programs were conducted at two sites during calendar year 1999. The operator training programs were inspected at St. Lucie after a high failure rate on the NRC's written examination administered in December 1998. Follow-up inspections were conducted in 1999 to ensure the adequacy of the initial license training program at Hope Creek after the licensee experienced problems related to initial operator licensing examinations in February and December 1998. The purpose of the follow-up inspections was to ensure operator performance at Hope Creek and St. Lucie was adequate to maintain safety.

The St. Lucie training inspection was conducted in March 1999 and focused on the training of licensed operator candidates. The inspection assessed the licensee's response to the low pass rate on the initial licensing examination given in December 1998. The results of the inspection were documented in Inspection Report 50-335/99-09 and 50-389/99-09. The inspectors found that the use of SAT at St. Lucie was weak in several areas, particularly those related to SAT Analysis, and was a direct contributor to the poor pass rate. The licensee did not conduct an adequate analysis of changes to the schedule used to implement the initial licensed operator training program, did not update some of the lesson material, and did not sufficiently consider trainee critiques when performing program evaluation.

Several follow-up inspections of the operator training programs were conducted at Hope Creek to assess the issues associated with the poor quality of examinations and poor written test outcomes which were initially identified in February 1998 but remained a problem in December 1998. The

summary of findings was documented in Inspection Report 50-354/98-302-Supplemental, dated October 13, 1999. The follow-up inspections conducted in 1999 at Hope Creek focused on the adequacy of the training programs in light of the repeat problems, several of which were attributed to inadequate use of SAT. Among the SAT issues were ineffective reviews of the examinations by the training staff prior to administration of the test due to inadequate staff skill in the area of testing. In addition, a deficient trainee analysis process resulted in marginal performers being allowed to take the NRC licensing examination. The license candidates were further affected by a change in format of testing from open reference to closed reference. This change was made without adequate analysis of possible impacts on performance.

From an industry-wide perspective, inspections of licensed operator examination activities identified three recurring issues. The industry continues to be challenged in the areas of written exam quality, use of repetitive examination questions, and the validation of job performance measures. The follow-up review of the inspection findings confirmed site specific weaknesses but did not indicate any programmatic weaknesses. The implementation of SAT-based training in the operator programs was adequate to assure public health and safety.

INDICATOR 3: Monitoring the Accreditation Process

Observing Accreditation Activities and Coordinating Activities with INPO

The NRC monitors INPO accreditation activities as an indicator of the overall effectiveness of the industry's use of the systems approach to training. The NRC monitors accreditation in lieu of conducting inspections to assess the level of compliance with the SAT requirements contained in 10 CFR 50.120 and 10 CFR Part 55. Monitoring training program effectiveness through a review of the accreditation process increases NRC efficiency by focusing Agency resources on the inspection of licensee training programs only when problems have been identified through routine monitoring.

Observing Accreditation Activities

The NRC uses observations of the National Nuclear Accrediting Board (NNAB) meetings as a means of assuring that training programs accredited and implemented in accordance with the INPO objectives would be in compliance with the SAT requirements contained in 10 CFR 50.120 and 10 CFR Part 55. NRC staff attended nine meetings of the NNAB during calendar year 1999. The NRC observed the presentation of training programs from 22 sites to the Board for accreditation renewal. During those 22 sessions, the Accrediting Board reviewed technical programs from 15 of the sites, operator training programs at five sites, and all of the accredited training programs at one site. The NRC staff observers were drawn from various levels of the NRC staff and included representatives from headquarters and three of the four NRC regions.

INPO consolidated plant evaluation and accreditation evaluation activities into a single team during 1999. The accreditation objectives and criteria used to evaluate the training programs were unaffected by the team consolidations. The changes to the team structure and the underlying reasons for them were discussed at the INPO/ NRC coordination meeting held in Atlanta on February 25, 1999. NRC is monitoring the implementation of this approach to ensure that results continue to provide a favorable view of accreditation.

The NRC observers also noted several positive aspects of the Board’s review activities. Among those aspects were the NNAB member efforts to establish the relationship between past problems and current ones. Several of the observers noted that the scope and quality of the accreditation

self-evaluations conducted by the utilities varied. However, the observers noted that the Board adequately probed areas which should have been identified by the utility in their self-evaluation but were only found by the accreditation team. In addition, observers noted the depth of questioning by the Board in the areas of follow-through and corrective actions. Observers from several different meetings noted issues related to the implementation of the systems approach to training which were probed by the Board. SAT issues were related to the areas of Analysis, Design, Trainee Evaluation, and Program Evaluation. The range of SAT-related issues probed by the Board reflected the same types of weaknesses identified by the NRC during for-cause training inspections conducted since 1996. A summary of NRC Accrediting Board observations, particularly those comments related to implementation of SAT was discussed at the February 25, 1999, INPO/NRC coordination meeting on training. Based on the range of questions and the depth to which weaknesses were probed, the training programs accredited by the National Nuclear Accrediting Board continue to be generally effective and the NRC continues to have a favorable assessment of the accreditation process.

Licensees generally provide the results of their Accrediting Board to the NRC's resident inspector. However, the licensees are not required to do so. Additionally, NRC resident inspectors continued to review INPO plant evaluation and accreditation reports in accordance with the NRC's Field Policy No. 9, "NRC Review of INPO Documents," to ensure that significant safety issues receive appropriate follow-up. No safety-significant training issues were identified in calendar year 1999 as a result of resident inspectors' reviews of accreditation reports.

Coordinating Activities with INPO

The IOHS staff meets with INPO's Training and Education organization at least once each year to exchange information related to training in the nuclear industry. During these meetings, NRC representatives also discuss the observations made by NRC observers to the NNAB. The 1999 meeting was held in Atlanta, Georgia on February 25, 1999. Discussion topics included a description of changes being made to the accreditation review process, the potential need for changes to the Memorandum of Agreement, performance of control manipulations, and experience and eligibility of licensed operator candidates. A follow-up meeting was held in May to discuss, in more detail, issues related to the licensing of reactor and senior reactor operators and included

performance of control manipulations, quality of examinations, operator fatigue, generic fundamentals, and eligibility of licensed operator candidates.

INPO and the NRC met at NRC Headquarters on February 28, 2000, to discuss training-related topics identified during 1999. The discussion topics included a proposed supplement to revision number 8 to the NRC's licensed operator examination standard, operator eligibility, INPO accreditation and training initiatives, and a review of the SAT issues identified by the NRC during inspections as well as the SAT implementation issues raised by observers to the National Nuclear Accrediting Board. The minutes for the 2000 INPO/NRC training-related meeting can be found in ADAMS, the NRC's document management system, at ML003701239 .

CONCLUSIONS

The 1999 IOHS monitoring of industry performance in the area of training provided some indications of specific weaknesses in training programs. Effective use of the systems approach to training continues to challenge the industry as a whole with greater emphasis needed in program evaluation. The 1999 activities monitoring the effectiveness of training in the industry continued to provide confidence that the training requirements contained in 10 CFR Parts 50 and 55 are being met.