NUREG/CR-3632
PNL-4927

Methods for Implementing Revisions to Emergency Operating Procedures

Final Report

Prepared by L. B. Myers, A. J. Bell

Battelle Columbus Laboratories

Pacific Northwest Laboratory

Prepared for
U.S. Nuclear Regulatory
Commission

Availability of Reference Materials Cited in NRC Publications

Most documents cited in NRC publications will be available from one of the following sources:

1. The NRC Public Document Room, 1717 H Street, N.W.
   Washington, DC 20555
2. The NRC/GPO Sales Program, U.S. Nuclear Regulatory Commission,
   Washington, DC 20555
3. The National Technical Information Service, Springfield, VA 22161

Although the listing that follows represents the majority of documents cited in NRC publications, it is not intended to be exhaustive.

Referenced documents available for inspection and copying for a fee from the NRC Public Document Room include NRC correspondence and internal NRC memoranda; NRC Office of Inspection and Enforcement bulletins, circulars, information notices, inspection and investigation notices; Licensee Event Reports; vendor reports and correspondence; Commission papers; and applicant and licensee documents and correspondence.

The following documents in the NUREG series are available for purchase from the NRC/GPO Sales Program: formal NRC staff and contractor reports, NRC-sponsored conference proceedings, and NRC booklets and brochures. Also available are Regulatory Guides, NRC regulations in the *Code of Federal Regulations,* and *Nuclear Regulatory Commission Issuances.*

Documents available from the National Technical Information Service include NUREG series reports and technical reports prepared by other federal agencies and reports prepared by the Atomic Energy Commission, forerunner agency to the Nuclear Regulatory Commission.

Documents available from public and special technical libraries include all open literature items, such as books, journal and periodical articles, and transactions. *Federal Register* notices, federal and state legislation, and congressional reports can usually be obtained from these libraries.

Documents such as theses, dissertations, foreign reports and translations, and non-NRC conference proceedings are available for purchase from the organization sponsoring the publication cited.

Single copies of NRC draft reports are available free upon written request to the Division of Technical Information and Document Control, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

Copies of industry codes and standards used in a substantive manner in the NRC regulatory process are maintained at the NRC Library, 7920 Norfolk Avenue, Bethesda, Maryland, and are available there for reference use by the public. Codes and standards are usually copyrighted and may be purchased from the originating organization or, if they are American National Standards, from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

GPO Printed copy price: $3.75

NUREG/CR-3632
PNL-4927

Methods for Implementing Revisions to Emergency Operating Procedures

Final Report

Manuscript Completed: March 1984
Date Published: May 1984

Prepared by
L. B. Myers, A. J. Bell

Battelle Columbus Laboratories
505 King Avenue
Columbus, OH 43201

Under Contract to:
Pacific Northwest Laboratory
Richland, WA 99352

Prepared for
Division of Human Factors Safety
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
NRC FIN B2360

ABSTRACT

In response to the Three Mile Island (TMI) accident, the U.S. Nuclear Regulatory Commission (NRC) has published the TMI Action Plan. The TMI Action Plan Item I.C.1 called for the upgrading of Emergency Operating Procedures (EOPs) at nuclear power plants. The program developed from this Action Plan item has resulted in utility efforts to 1) revise EOPs, 2) train personnel in the use of the EOPs, and 3) implement the revised EOPs.

The NRC supported the study presented in this report to identify factors which influence the effectiveness of training and implementation of revised EOPs. The NRC's major concern was the possible effects of negative transfer of training. The report includes a summary of existing methods for implementing revisions to procedures based on interviews of plant personnel, a review of the training literature applicable to the effect of previously learned procedures on the learning of and performance with revised procedures (i.e., negative transfer) and recommendations of methods and schedules for implementing revised EOPs. While the study found that the concern over negative transfer of training was not as great as anticipated, several recommendations were made. These include (1) overtraining of operators to reduce the effect of observed negative transfer, and (2) implementation of the revised EOPs as soon as possible after training to minimize the time operators must rely upon the old EOPs after having been trained on the revised EOPs. The results of the study should be useful both to the utilities and the NRC in the development and review of EOP implementation programs.

TABLE OF CONTENTS

APPENDIX A

LIST OF TABLES

GLOSSARY

Emergency Operating Procedures: EOPs are plant procedures that direct operators' actions necessary to mitigate the consequences of transients and accidents that have caused plant parameters to exceed reactor protection system set points or engineered safety feature set points, or other established limits.

Event-Oriented EOPs: Event-oriented EOPs require the operator to diagnose the specific event causing the transient or accident in order to mitigate the consequences of that transient or accident.

Function-Oriented EOPs: Function-oriented EOPs provide the operator guidance on how to verify the adequacy of critical safety functions and how to restore and maintain these functions when they are degraded. Function-oriented Emergency Operating Procedures are written in a way that the operator need not diagnose an event, such as a LOCA, to maintain a plant in a safe condition.

Implementation of EOPs: The process of installing a new or revised set of EOPs into the plant's control room, removing the old, and requiring the new or revised set to be used by the operators.

Mediation (Mediate): The terms mediation and mediate refer to the reduction or elimination of Negative Transfer through some type of intervention such as extensive training.

Mediation Techniques: The term mediation techniques refers to the methods used to reduce or eliminate Negative Transfer.

Negative Transfer: Negative Transfer is the detrimental impact of previously learned knowledge and experience on the learning of new information or a new task.

1. INTRODUCTION AND OBJECTIVE

In response to the Three Mile Island (TMI) accident and the subsequent evaluation, the U.S. Nuclear Regulatory Commission (NRC) published the TMI Action Plan, NUREG-0660 "NRC Action Plan Developed as a Result of the TMI-2 Accident", 2 volumes (May 1980). The TMI Action Plan Item I.C.1 called for upgrading of Emergency Operating Procedures. The NRC published NUREG-0899 "Guidelines for the Preparation of Emergency Operating Procedures" (August 1982) which was directed toward the preparation and, in part, implementation of EOPs. Supplement 1 to NUREG-0737, "Clarification of TMI Action Plan Requirements" also requires utilities to prepare a Procedures Generation Package (PGP) to include Plant-Specific Technical Guidelines, Plant-Specific Writer's Guide, Verification/Validation Program Plan, and a description of the training to be given on the revised EOPs.

As a result of the requirements and guidance, utilities are currently preparing PGPs, revising EOPs, verifying and validating EOPs, training their personnel in the revised EOPs, and implementing or preparing to implement the revised EOPs.

The NRC, however, has been concerned about the revision and implementation process. The concerns are:

- That Negative Transfer could occur during training and after implementation due to the learning and use of revised procedures which may be quite different than the existing procedures
- That there may not be methods to reduce or eliminate Negative Transfer should it occur
- That the revised procedures may not be implemented soon after training and therefore cause the operator to rely on existing procedures, rather than on the revised EOPs.
- That utilities may not recognize these potential problems.

As a result of these concerns, NRC supported a study whose objective was to develop methods for implementing revisions to EOPs. The study investigated how the implementation of revised EOPs is currently being accomplished at utilities, how it is done in related industries, whether professional standards existed for revising procedures, and whether the possibility of Negative Transfer could occur and how to reduce or eliminate it. The results of these efforts were used to generate methods which would be helpful to utilities in their efforts to implement EOPs.

The methods generated are presented in this report as Conclusions and Recommendations in Section 2. The remainder of the report describes the approach to the study and presents the results of the study which formed the basis for the conclusions and recommendations.

2. CONCLUSIONS AND RECOMMENDATIONS

This section of the report presents the conclusions and recommendations of the study based on the results of the interviews with nuclear power plant representatives, as discussed and described in Section 4., Results. The conclusions and recommendations presented in this Section cover the management responsibilities in the process of training operators in the use of revised EOPs and their implementation; the actual training of operators in the revised EOPs; the matter of negative transfer with respect to training and implementation; and the implementation process itself.

2.1 Management Responsibilities

The responsibilities that management staff should take, and their support, in the process of training operators on, and implementation of, revised EOPs are:

- Planning, scheduling and coordinating the training of operators in revised EOPs, and the implementation process
- Allocating manpower, time and resources to the training and implementation activities.

Further, our survey of plant representatives stated that the management staff can expect to spend a large amount of their time involved in the above bulleted activities along with attending internal and owner group coordination and planning activities.

2.2 Training on Revised EOPs

Although all aspects of the implementation process are important in their own right, training is particularly important, because:

- All operators must be trained in the revised EOPs to ensure proficiency
- Training is needed to overcome any Negative Transfer effects which may occur because of operator knowledge and experience with the old EOPs, and
- Training can provide feedback to EOP writers as deficiencies appear.

Further, plant representatives interviewed have reported that the training effort has a significant impact on plant resources, operator time and training staff.

2.2.1 Training Content

Although the basic training content is the set of revised EOPs, there are certain aspects which should be emphasized:

- The background and reasoning behind the change from event-oriented to function-oriented EOPs needs to be explained

- The background and reasoning behind the change in EOP format needs to be described

- The teamwork necessary on the part of the operators to fully execute the EOPs needs to be re-emphasized

- The functional orientation of the procedures needs to be discussed

- The step-by-step nature of the procedures and the logical reasoning behind the steps to solve each problem needs to be explained

- The problem and confusion areas the operators experience as training progresses should become the focus of the training program to overcome the difficulties.

2.2.2 Training Techniques

The typical training techniques used to instruct operators in procedures should be a combination of classroom, simulator exercises (site-specific or generic) and control room walkthroughs. Each technique should be used for a different purpose. The classroom setting should be used to provide an overview of the procedures, to describe each step to be taken and to verbally walkthrough each procedure. The classroom is also used to explain and describe EOP philosophy, format and technical basis, and plant policies with regard to EOP use*. Simulator exercises are used initially to demonstrate the procedures, but then used to provide operator practice and team work experience. Those plants with site-specific simulators should find that classroom and simulators are sufficient for revised EOP training and practice. Where plants can use a generic simulator which is somewhat like their plant and control room, additional practice in the control room may be necessary to overcome the differences between the control room and the simulator. Finally, those plants with no simulators should use more extensive control room walkthroughs to provide operator experience and practice.

2.2.3 Operator Proficiency

The operators should be considered sufficiently trained when they demonstrate a "high degree of proficiency" in their written work, simulator exercises and control room walkthroughs. In general, for examinations utilities use the criteria of 80% overall and 70% average on every aspect; on simulator exercises a pass/fail criteria are used; and for control room walkthroughs examinations are not normally given.

2.2.4 Training Time and Scheduling

One of the most difficult aspects of training is determining how much time will be needed to train the operators and to schedule the training sessions. In general, utilities find that one to two weeks of combined classroom and simulator training on revised EOPs is minimal to train a group of operators. Utilities should initially plan on this minimal time and once training begins adjust the time according to operator progress and proficiency.

---

* At some nuclear power plants part-task simulators are used in the classroom to provide instruction and practice to the operators.

The scheduling of the training is more difficult and the following guidelines are recommended:

- Start training after all reviews and revisions have been made so that the EOPs are essentially in final form. Operators will find the EOPs less acceptable and less credible if errors are still present and revisions are necessary

- End training of all operators prior to implementation and implement revised EOPs as soon after training as reasonably possible. Operators should not be expected to use implemented procedures when they are not trained on them and operators should not be expected to use old procedures when they have just been trained on the new procedures.

- Train operators and implement during refueling, if possible. The advantages are that the revised EOPs can be implemented at the end of refueling, and all operators will be trained prior to implementation during a time when there is less chance that the old EOPs will need to be relied upon. The majority of plants, however, use their operators during refueling in varying capacities and thus the operators do not have time for training. But, our survey indicated that those plants which can train during refueling would not do it any other way.

- Train operators during the regular training schedule and/or during requalification. Since these periods of time may be somewhat inflexible, it is possible that the goals of implementation immediately after training and having all operators trained before implementation cannot be met.

- Train operators according to a specially developed time schedule for EOP training which is independent of the regular or requalification schedule. In this case special courses for training operators only in revised EOPs are scheduled. There are several advantages to this approach. First, the revised EOPs will receive special attention that will enhance the learning process. Second, the operators can focus their attention on the revised EOPs without having to attend to other training which may also be scheduled during regular and requalification training sessions. Third, the training personnel can focus their attention on revised EOP training and thus be better able to attend to problem areas or individualized training. Finally, the plant can schedule training to end just prior to implementation.

There are a variety of options available to plants in scheduling operator training on the revised EOPs. Individual plants will need to select the option which best fits its needs. However, whichever option is selected the following goals should be met:

- All operator training should be completed prior to implementation

- Implementation should be completed as soon as possible after training.

2.2.5 Training Feedback Impact on EOP Development

As training progresses some deficiencies and inaccuracies in the EOPs may be noted. A mechanism should exist to handle the feedback of EOP deficiencies and inaccuracies discovered during the training process. This information should be reported using this mechanism. These corrections should be made prior to implementation, and on a timely basis to avoid delays in implementation. The deficiencies and inaccuracies noted during training may be of a minor nature and thus would not require verification/validation or any further operator training. However, if major problems are being corrected then the rewritten material should be verified and validated, and the operators should receive additional training prior to implementation.

2.3 Negative Transfer

2.3.1 Negative Transfer and Training

It is very important that utilities understand that when operators are trained in the revised EOPs that Negative Transfer can occur and has been noted by some utilities. Negative Transfer can occur when operators are trying to learn the new revised EOPs, but have difficulties because of their knowledge, experience, and training in the old procedures. In other words, the knowledge, experience, and training in the old procedures can interfere with the learning of the new procedures. Negative Transfer during training can be suspected when:

- An operator takes what appears to be an excessive amount of time to learn a new task
- An operator seems to be making an excessive number of errors when learning a new task
- An operator's errors consist of previously learned tasks and knowledge (training personnel will need to have some familiarity with the old procedures to judge these types of errors)
- An operator appears hesitant about learning the new task and may complain about learning it. The operator may claim that the old tasks were adequate
- An operator, during practice, may suddenly revert to the previously learned tasks instead of performing the new tasks.

If Negative Transfer is suspected its visibility and substantiation can be enhanced through exercises at a simulator while placing the operator under a relatively heavy taskload and time stress.

Some utilities have experienced what appears to be Negative Transfer in their training of operators in the revised EOPs. These experiences were reported by plant representatives as follows:

- "Operators were hesitant to perform some functions because the tasks were contrary to previous actions."

- "It was difficult to switch operator thinking from old to new."
- "Older operators were resistant to the change."
- "It took time for the operators to get used to the new procedures."

Utilities should also realize that operators hired from other plants will be trained on different EOPs, thus Negative Transfer can be a problem for these operators. Further, operators may have transferred from one utility's unit to another unit where the control room and the implemented EOPs are very similar. Operators may experience negative transfer during their training of the control room and EOP differences. If the operators are not trained in the differences, then they may experience negative transfer or cause errors when using control room instrumentation or the EOPs. The training staff should be sensitive to these concerns.

To overcome Negative Transfer during training and later after implementation, the following methods are strongly recommended:

- The operators should be trained extensively in the newly revised EOPs. In fact, utilities should consider "overtraining" the operators in the EOPs. This means that operators are trained beyond the standard level of proficiency.
- Wherever possible this extensive training and practice should be done on site-specific simulators. The use of these simulators can provide operators with extensive practice and experience in realistic settings which can reduce Negative Transfer.
- Involve all or most operators in the EOP revision process in a variety of capacities such as writers, reviewers, testers, etc. This early introduction to the revised procedures enhances operator acceptance.
- Training personnel should be sensitive to Negative Transfer effects during the training process and when it appears focus in on the problem area and "overtrain" the operators in that area of the procedures.

2.3.2 Negative Transfer After Implementation

There is concern that, during transients, operators may experience stress and thus Negative Transfer can be created and affect operator use of emergency procedures. Stress may be created because of the seriousness of the accident, the task load on the operator, the time pressures on the operator, fatigue, and possibly a degraded environment. The newly implemented procedures will be different from the old procedures (e.g., differences due to function versus event orientation and to changes in format) and it is conceivable that during a transient the operator may experience stress and react to the transient with actions learned as part of the old procedure instead of reacting with the newly implemented procedure. However, there is no direct evidence at nuclear power plants to substantiate or disprove this concern. Yet, because Negative Transfer appears to occur due to stress in other situations, the concern here

cannot be dismissed. As previously indicated, extensive training and practice is necessary to help assure that Negative Transfer does not occur due to operator stress during a transient.

2.4 Implementation of Revised EOPs

The purpose of this section is to review the implementation process and schedules. At the present time, utilities are in varying stages of implementing EOPs, consequently it is difficult to present a set of typical plant activities, sequences and schedules. However, it is possible to construct a logical sequence of activities and goals that would result in well trained operators and well-prepared and tested EOPs prior to implementation.

2.4.1 Implementation Activities

After verification and validation, and subsequent revisions, the revised EOPs should be ready for implementation. However, all operators should be trained prior to implementation. This training should be as short as possible without compromising operator proficiency so that there is a short period of reliance on the old EOPs. After all operators are trained, the EOPs should be implemented. The time period between training and implementation should also be kept as short as possible so that operators are not relying on an old set of procedures after being trained on the new ones. The only procedures related activities during this period should be revisions due to problems noted during training and publishing the revised EOPs.

The implementation step itself is basically the removal of the old procedures from the control room and placing a copy or copies of the new EOPs in the appropriate place. There are, of course, other implementation activities with respect to administration procedures (such as updating "effective procedures" lists), and distribution of copies to other personnel and depositories, but these activities are very utility dependent. At this time it is also important to explain to operators the plant policy concerning EOP use.

Further, all revised EOPs should be implemented at the same time. Partial implementation of EOPs as they are completed should not be done. Operators should have a full set of EOPs, old or new, but not both, to use during a transient or accident.

Finally, all operators should be told that the new procedures have been placed in the control room.

2.4.2 Implementation Scheduling

Implementation activities as discussed above need to be integrated into other utility activities. Since all of these activities and schedules differ from one utility to another, it is not possible to present any recommended schedule. However, Table 1 presented in Section 4 Results may be helpful in the scheduling effort. Whatever schedule is planned by a plant to fit its purposes, certain goals need to be met:

- Training of all operators should be completed prior to implementation so that all the operators can effectively use the revised EOPs prior to implementation

- Implementation should occur as soon as possible after training so that the operators need not rely on old procedures after being trained on the revised EOPs.

- Training and implementation activities should be kept as short as possible without compromising operator proficiency or EOP quality so that reliance on the old procedures can be kept to a minimum.

3. APPROACH

This section of the final report describes the overall approach to the study. Three tasks are involved: (1) evaluate methods for implementing revisions to EOPs, (2) evaluate applicable training literature to determine the best methods for reducing negative transfer of training, and (3) develop methods and model schedules for implementing revised procedures.

3.1 Summarize Existing Methods and Standards for Implementing Revisions to Emergency Operating Procedures

The primary purpose of this task was to collect information from utilities on their current plans, procedures, experiences, and schedules with respect to their efforts to revise and implement EOPs. To identify the nuclear power plants and their representatives to interview, and to collect the information, the four vendor representatives of the Procedures Subcommittees were contacted. These sources provided a list of nuclear power plants actively involved in EOP revisions, and specifically the individual or representative at each plant to be contacted. The plants are listed in Appendix A.

A small group of companies in related industries which used emergency procedures were also contacted. The companies were:

- Dow Chemical
- DuPont
- General Electric - Spent Fuel Storage Facility
- U.S. Air Force - Titan/Minute Man Missile Site

The individuals interviewed represented the plants and related industries, and mainly were in charge of EOP revision and implementation. A few individuals were plant managers or other administrative personnel. They all were interviewed over the telephone using an interview protocol. Although the interview protocol was used to structure the interviews, the interviewer "probed" the interviewee on particularly important and sensitive issues, problems identified by the plant representative or areas of concern. Further, plant representatives were re-contacted several times to discuss issues which arose during data analysis, interpretation and reporting. The interview protocol consisted of a comprehensive and overlapping set of questions covering all aspects of EOP revisions, training, and schedules. In addition, there were questions asked relating to various aspects of Negative Transfer.

Another aspect of this task was to review professional standards applicable to the revision of procedures. A search for military and civilian sources was initiated, but no useful reports or documents were found. Consequently, there is no discussion of professional standards.

3.2 Review Training Literature Applicable to Reducing Negative Transfer of Training

The purpose of this task was to investigate the potential of Negative Transfer affecting operator learning and performance of the newly revised procedures due to their experience with the old procedures. A literature review of Negative Transfer was accomplished through automated data bases including

Defense Technical Information Center, Psychological Abstracts, National Technical Information Service, and Education Research Information Center. The literature from these sources was then analyzed to determine the potential of Negative Transfer, and if present, how to reduce its effects.

3.3 Develop Methods and Model Schedules for Implementing the Revised Emergency Operating Procedures

The purpose of this task was to determine the best type(s) of scheduling for implementing the revised EOPs so that retraining time, Negative Transfer, and implementation delays are minimized. Also, included in this task was a determination of criteria and procedures to be used when serious safety-related problems were discovered in currently implemented EOPs.

To achieve the purpose of this task, the plant representatives contacted in Task 1 were asked about their revision and EOP implementation schedules, operator requalification, and refueling schedules. The plant schedules for these separate activities were then examined to develop integrated model schedules for implementing revised EOPs which could be adapted to specific plant requirements. These schedules are discussed in the Results section of this report.

4. RESULTS

The results of the three tasks are presented below.

4.1 Summary of the Existing Methods and Standards for Implementing Revisions to Emergency Operating Procedures

This section presents the results of our interviews with the various plant representatives and nonnuclear organizations in an anonymous manner, i.e., specific plants are not identified with respect to any responses. The results are presented for each question asked. No attempt has been made to summarize the information at this point (except for the interviews with the nonnuclear organizations). The information obtained was used to prepare the conclusions and recommendations presented in Section 2 of this report.

In the results of these interviews we are reporting the answers to our questions as given by the plant representatives. Many of the questions were purposely direct and pointed. There may be some answers that representatives simply did not wish to reveal, because they felt NRC sponsorship of the project implied future regulatory requirements, and the fact that in the future NRC personnel along with NPP personnel at other facilities would be reviewing the information obtained.

4.1.1 Interviews with Nuclear Power Plant Personnel

Question

1 (a) Have you performed revisions to your EOPs prior to your recent or current revisions?

Most had previously revised their EOPs, usually during an annual review.

(b) What did you learn then to help you later with regard to plant activities, training, writing, simulator practice or walkthrough, operator time and role, management time and role?

A variety of answers were received to this question, including:

- More intensive training was needed
- Human factors needed to be incorporated
- Clarity in presentation was needed

2 What is your implementation and revision schedule?

As expected, there was a large variety of different responses to this question, because schedules are very plant-specific. The results of this question were taken into account in Task 3 to prepare the schedules. However, here is a brief, but typical schedule:

- Month 1 - Submit revised EOPs for internal approval
- Month 4 - Submit Procedures Generation Package (PGP) to NRC
- Month 7 - Start operator training
- Month 11 - End operator training
- Month 12 - Implement revised EOPs immediately after training

Question

3 Where are you in the overall process of revising and validating your EOPs?

As expected, plants are in varying stages of revision, validation and completion, and PGP preparation. Consequently, no consistent pattern or completion deadlines can be noted.

4 (a) What has been the effect on training as a result of revising the EOPs?

The consensus among all the plant representatives is that revising EOPs will have a significant effect on training. They report that their training program has been affected or they definitely anticipate an effect. Most realize that "extra" training would be involved and some were "preparing" the operators for the training through pretraining and seminar sessions.

(b) What has been the effect on simulator practice as a result of revising the EOPs?

In general, plant representatives did not express concern about the use of simulators for new EOP training. About a third stated there was no effect, another third simply stated that simulators would be used, and the remaining third gave a wide variety of responses. Plants with no site-specific simulators will, of course, face the same problems as before, namely, the simulator tests are neither accurate, nor complete. Although one plant representative said that the new diagnostic procedures could now be more effectively tested on a generic simulator.

(c) What has been the effect on procedures management as a result of revising the EOPs?

The majority of the plant representatives said there was no effect on Procedures Management or they did not yet know. It would appear that EOPs would be handled within the existing Procedures Management System as other procedures without undue impact.

(d) What has been the effect on operator time as a result of revising the EOPs?

Only a few of the plant representatives contacted suggested that their operators' time was not significantly affected by the EOP revision. Most of the plants whose operators will not be affected are conducting training during spare shifts or have minimized the operator's participation in the revision process.

The majority of the plant representatives indicated that their operators' time was already being affected by the EOP revision, or that they definitely expected their time to be affected when training began. At some of the plants the operators have been involved in the revision process all along. One plant utilized the operators

Question

extensively during validation and estimated 200 man-hours were spent on this alone (five operators x 40 hours each). Another plant used only one operator on the revision but, of course, all the operators will be involved in training. A majority opinion could be summed up as: all the operators' time will be affected, but most of them will be involved primarily in training with a few working on the actual revision, the validation and the verification.

(e) What has been the effect on management time as a result of revising the EOPs?

Most respondents said there was an effect. About half said that a great amount or even burdensome amounts of management time had to be spent in the revision process. The remaining half said there was definitely management time involved, but not a large amount. Those who said that there was a great or burdensome effect explained that the primary problem was the amount of management time spent in EOP reviews, development, meetings and procedures subcommittee meetings, and owner's group meetings (constant change in owner's group directions created many time consuming meetings). The remaining said there was little effect.

5 (a) Do you involve operators in the EOP revision process?

The overwhelming majority of the plants involve their operators in EOP revisions. They find the approach useful, and operator insight and experience a valuable input. (Further, they are being trained at the same time.)

Even among the plants that do not directly use the operators in the revision process, their comments and criticisms are encouraged. At one plant the operators are involved in the revision only for any problems they notice and bring to their supervisor's attention. So, even at the plants where the operators' involvement is not as formalized, they do have some input.

(b) How many operators are involved?

Of those who use operators to assist in EOP revisions, most try to get <u>all</u> operators involved. The remainder use some portion of their operators who appear to be senior level operators.

(c) What is the impact of EOP revision on operator time?

Of those who use operators to help revise their procedures, most all find the impact neither burdensome nor an interference with their regular duties. Operators are not used full time on any one activity. Some operators rewrite, some review, and some test, so that no one operator is used extensively.

Question

(d) How are operators used for EOP review or validation?

Most respondents said that operators were used for walkthrough and simulation tests. Others commented that their use was primarily for review and comment. Only a few said that they were doing the actual writing.

(e) How many operators are involved in this process?

Most plant representatives said that all or most operators are used in one capacity or another in revisions and validating EOPs. Some plants said their operators are primarily used to validate the procedures on a simulator rather than revision per se. Only a few plants assign a separate crew to check out the EOPs.

(f) Do you use contractors to revise the EOPs?

Only a few use outside contractors to prepare the EOPs. Nearly all rewrite the EOPs themselves.

(g) How important is it to use operators in the revision process?

The importance of utilizing operators while revising the EOPs was emphasized by all the plants. Most plants reported that the operator's participation is absolutely crucial. More acceptance of the revised EOPs by the operators was a frequently cited reason for involving them in the revision. Another comment was that the technical writer does not know how the least experienced and the most qualified operators think. Many things can be missed by the technical writers that the operators will note and correct. It is vital to use operators to get experience and feedback into the process.

(h) Is review and critique a sufficient role for operators, or should they also be involved in rough draft preparation?

Most of the plant representatives indicated that review and critique is a sufficient role for the operator. Plants simply cannot afford to sacrifice operators to work on writing. At a few of the plants senior licensed operators are working full-time on writing the new EOPs. For most of the plants it is best if operators work primarily on review and critique instead of writing.

6 What can or should management do to speed up and assist in EOP revisions?

The most common response here was to allocate manpower and resources. They want management to select technically qualified people and to make the revision process as simple as possible by not clogging up the process with "red tape". Overall the plants want management to provide the necessary people, material, and resources.

Question

7 (a) Describe your intended training process, classroom training, simulator practice, and control room training for revised EOPs.

All of the plants combine classroom and simulator training and pointed out the importance of balancing simulator work with classroom lecture and discussion. The lectures are primarily to give an overview of the EOPs, to describe each step to be taken, and to verbally walkthrough each procedure. The simulator exercise is used to strengthen the lecture through walkthroughs and practice to gain proficiency.

(b) Should training operators on new EOPs take palce during the normal schedule of activities and training or should special and unique scheduling be made?

Half of the plant representatives think EOP training should take place during the normal schedule of activities. The consensus among these representatives was that by doing this they avoid undesirable interruptions. Several indicated that training can occur during both the normal training schedule and also during special sessions. The remaining favor a special and unique training period separate from normal training. One reason for this is to emphasize the importance of the change that is being made.

(c) When should training of operators on new emergency procedures take place in the overall implementation schedule?

All of the plant representatives agreed with the NRC requirement that operator training should occur prior to implementation. When it should occur prior to implementation did vary, however. Several representatives indicated that implementation should immediately follow training in order to reduce memory loss and reduce confusion resulting from the use of old procedures after training on the new procedures. A few representatives said that they completed training 3 months before implementation and mentioned that this time gap allowed for final adjustments and minor changes. Many, however, were not far enough along to know the time gap.

(d) What should be stressed during training?

The comments covered a wide range of topics and concerns and are highlighted here:

- The background and reasoning behind the change from event to sympton/function oriented procedures should be explained.
- The technical basis for procedure accident analysis needs to be described.
- The logical steps and available equipment to solve the problem needs to be explained along with the logical reasoning behind the steps taken.
- The actual performance of the operator should be stressed -- simulator practice is a must.

Question

- The step-by-step nature of the procedures should be discussed.
- The two-column format of the procedures needs to be described along with the philosophy behind its use.
- The procedures should be walked through immediately prior to implementation.
- The problem and confusion areas the operators are experiencing with the procedures should become the focus.
- The classroom and simulator practice should focus on the teamwork involved.

(e) Should training be strictly lecture and discussion or should there be more practice or simulator work in the control room?

The importance of combining both classroom and simulator training was noted by all the plant representatives. Some, however, were more concerned that simulator practice be emphasized. The skill, training, and experience of the individual operator is a consideration when deciding how much of each type of training is needed. While the importance of simulator training was stressed by the plant representatives, a combination of lecture, simulator work, and discussion seems to be the best approach.

(f) During this training how should, or how are you going to handle changes with regard to old procedures?

About two-thirds of the plants will start from scratch when teaching the new EOPs. They will ignore old EOPs and teach the new ones as a completely new approach. The remaining plants will emphasize the changes that have been made. One plant representative remarked that the new procedures will basically accomplish the same things that the old ones did, so why start over?

(g) Are all operators trained before implementing the revised EOPs?

Essentially all plant representatives said that all operators would be trained before EOP implementation. Only one plant of the sample said no. Their new EOPs went into effect over a year ago and, at that time training overlapped implementation.

(h) If all were not trained before implementation, what would happen if there were an incident; which procedures, old or new, would be used by the crew?

The old procedures would have to be used until all operators were trained on the new EOPs.

Question

(i) How much time is needed to train an operator on revised EOPs?

The amount of time for training varied somewhat. The majority reported one to two weeks of combined classroom and simulation. The rest were considerably longer.

(j) When do you know the operators are fully trained?

When they have demonstrated a high degree of proficiency in their written work, exams, discussions, and simulator exercises.

(k) Is there an exam?

The vast majority said, "yes".

(l) What is passing criteria on the exam?

On the written exam the vast majority said, "80 percent overall and 70 percent on every aspect". On simulator tests the majority said, "pass/fail". On control room tests the majority said, "none", i.e., there was no testing in the control room.

(m) When in the overall schedule should training be done?

The majority of the plant representatives did not state any particular time period. Most simply stated that training should occur after the first draft or when the procedures are finished and prior to implementation. Others stated more specifically, that training should occur during the regular training schedule. Only a few answered "during refueling".

(n) Is there time enough during refueling for this training?

The vast majority of the plant representatives responded "no". They indicated that there would not be enough time to do a good job. Some said that training would have to take place prior to refueling during off-shifts.

8 (a) What is your typical "refueling" scheduling?

A wide range of responses resulted from this question and the answers were considered in preparing the schedules in Task 3. For the vast majority, the plant is down for 6 to 12 weeks every 18 months.

(b) In terms of your "refueling" schedule what are the typical milestones and time schedule?

Again, a variety of times were used in stating the typical milestones and these were used to prepare the schedules in Task 3.

Question

(c) How should EOP implementation and training fit into this activity?

The majority of the plant representatives are not in favor of training during refueling. For some refueling is the busiest time for the operators. Several indicated that the EOP implementation and training should not be tied to refueling in any way.

The minority of plant representatives that favor tying the EOP implementation and training to refueling would like to start up after the outage with the new EOPs in place. Ideally, training would take place during the outage and the implementation would occur at start-up.

(d) Would training extend the outage during "refueling"?

The plant representatives were essentially unanimous that the outage would not be extended (under any circumstances).

(e) If not done during "refueling", when should EOP implementation and training be done?

Most favor working the implementation and training into the normal schedule of off-shifts. The few plants that train during refueling would not do it any other way.

9 (a) How long is the "requalification training period"?

The length of the requalification training period varies greatly at the plants contacted. There is no one time frame most prevalent.

(b) When will all the operators be trained?

At nearly half of the plants, all of the operators are already trained. The latest date set by any of the plants was June 1984. All of the plants contacted will have trained all of their operators by that date.

(c) Will they use this requalification time period to train on new EOPs?

Every one of the plant representatives contacted does in part use the requalification period to train on the new EOPs. It was generally agreed that requalification is a good time to train the operators on the revised procedures.

10 Were there Negative Transfer effects as a result of the switch from old to new EOPs? Did Negative Transfer effects occur during training on the new EOPs? If so, why did it occur and how was it evident?

The majority of the plant representatives indicated that Negative Transfer should not be a problem. The reasons given were:

Question

- New EOPs were not much different from the old EOPs
- Training would overcome the problem
- Old procedures were inadequate
- Operators were new and/or had little experience with the old procedures

A few did anticipate some Negative Transfer problem due to the format change from the old to the new procedures.

Upon further probing into this important issue, the majority of plant representatives maintained that Negative Transfer had not become evident. Some (about 5) had experienced what appeared to be Negative Transfer effects during training. (It must be pointed out that Negative Transfer could be observable only during an emergency or during training. Since emergencies are rare, training would be the only other observable operator experience where Negative Transfer would be evident.) The observed problems included:

- During simulator practice, operators were hesitant to perform some functions because they were contrary to previous actions.
- During training, it was difficult to switch operator thinking from old to new.
- During training, it took time for operators to become used to the new procedures.
- During training, the more experienced operators were resistant to the change.

Several plant representatives offered the following solutions:

- Operators must be made aware of plant policy that EOPs must be followed exactly and operators are not to do it their way. Scenarios must be carefully selected to illustrate the importance of following EOPs faithfully.
- Operators who were involved in writing the new EOPs did not have a problem adapting to the new procedures.
- Operators must receive extensive training to gain acceptance of new EOPs and to follow procedures faithfully.

11 (a) Do you validate or verify revised EOPs on site-specific simulators?

About 50 percent of the sample used site-specific simulators.

(b) If not, do you use generic simulators or none at all?

The remaining 50 percent of the sample use a generic simulator.

12 Is the simulator used for review only?

All the plants use their simulator for more than review. Many of the plants use their simulator for training -- both initial and requalification. Other functions include validation, verification, and development.

Question

13 (a) During simulator or control room walkthrough training is every aspect of a revised procedure checked out?

About half of the respondents said "yes". In general, those who have site-specific simulators are able to check out the procedures completely, and those who do not are not able to completely check out the procedures. In short, if all plants had site-specific simulators the completeness and accuracy of the EOPs could be more adequately tested.

(b) For instance are control, display/indicator nomenclature, operator roles, and the completeness and accuracy of the procedures checked out during the walkthrough?

Those plants who are able to check out every aspect of EOPs answered "yes" to this part of the question. Many of these plant representatives said this was done during validation and/or verification.

14 (a) How much time should be devoted to simulator or control room walkthrough to check out procedures?

About 50 percent of the plant representatives agreed that one working week was sufficient. The rest gave varying answers, including depend-dency on the complexity of the procedures.

(b) How about time for operator training?

About 50 percent of the plant representatives agreed that 1 to 2 weeks would be sufficient. Although some favored 2 to 3 days, others felt that training should continue until the operators were competely comfortable with the procedures.

15 (a) Were the current operators well trained on the old procedures or were they only familiar with them?

The vast majority of the plant representatives answered that the operators were well trained on the old EOPs and had to be for the requalification tests. Only a few answered that the operators were not well trained, because the old EOPs were "unlearnable" or "hodge-podge".

(b) Were the operators trained a long time ago on the old EOPs, and were they unfamiliar with them?

In general, plant representatives said that operators received continuous training on old EOPs, during refresher or requalification training.

16 (a) How do the operators feel about the old procedures?

The vast majority of the plant representatives reported that operators <u>did not</u> like and had <u>negative attitudes</u> toward the old procedures.

Question

(b) Are they positive, negative or neutral about the new EOPs and are they against the change?

The vast majority of the plant representatives reported operators are very positive about the procedures and the changes made. There was virtually no indication of negative feelings among the operators about the change.

17 (a) Will the operators find the new procedures similar to the old in terms of: (1) format and style, (2) basic steps, (3) sequence of activities?

(1) Format and style:	No	- 70%
	Yes	- 15%
	Not Applicable	- 15%
(2) Basic steps:	No	- 45%
	Yes	- 40%
	Not Applicable	- 15%
(3) Sequence of activities:	No	- 35%
	Yes	- 50%
	Not Applicable	- 15%

(b) What are the differences?

The major difference is that the old EOPs were narrative, event-oriented procedures and the new EOPs are function-oriented and written in a two-column or flowchart format. In the new EOPs the same procedure is followed for a small problem or a major disaster. The new procedures are more accurate to actual operator responses. The new EOPs are not blind to other possible problems as the old ones were. The old procedures assumed all parts of the plant were operable but the new ones provide alternatives. All the differences noted are seen as improvements by the plant representatives contacted.

18 Is the switch to "functional procedures" causing any problems or impacts? How is diagnosis being handled in the EOPs and is there concern about "immediate diagnosis" with respect to "functional procedures"?

The majority of the plant representatives reported that the use of "functional procedures" will have a positive impact or, at least, a neutral one. In general, for most the switch to "functional procedures" has been minimal in terms of problems created and impact. None of the plant representatives expressed concern about "immediate diagnosis" with respect to functional procedures.

19 (a) Are the emergency procedures formatted and styled to match other plant procedures or are they deliberately made different? Why?

Nearly 75 percent of the plant representatives said they have a different format for their EOPs than for their regular operating

Question

procedures. The change by many plants to a two-column format for the EOPs is a major reason. Also a deliberate contrast makes the distinction obvious to the operators. The EOPs are purposely structured to be used in a stressful situation. One plant manager said the EOPs are similar in that there is no intentional change in sentence structure, but different because immediate, automatic actions are required. At most plants the EOPs are different in style and format.

(b) Do you see any problems because of the different format of EOPs, compared to the other procedures?

The majority of the plant representatives do not see the differences as a problem. Some see it as an advantage. The contrast will be helpful because the distinction between the EOPs and normal operating procedures will be obvious. The new format is an improvement because it is much easier to follow than the other procedure format. However some representatives did express concern that the operators may have learning and reading problems, because of format change.

20 Does it bother you that you must currently rely on the old procedures until the new ones are completed?

About half of the plant representatives were not bothered about relying on the old procedures until the new ones were in place. The primary reason for the lack of concern was that the old EOPs were adequate and could be used, if necessary. Two of the plants were shut down and, consequently, the representatives were not concerned. The rest of the plant representatives expressed concern about the reliance because the new procedures would be such an improvement that they did not want to rely on the old.

21 What recommendation would you have to other plants with respect to revising EOPs and the impact of this revision on other plant activities?

- Recognize that the writing and training of the new EOPs will be a huge effort -- demanding attention, time, and resources.
- Plan the effort so that there is plenty of time for revisions and the changes that will occur. In-depth evaluation of needs and applications is essential. Each step must be analyzed and tested. Do not try to write final procedures too soon. They should be written, reviewed, tested and revised before they can be considered final.
- Involve operators and supervisors in the EOP development process (rather than contractors) because they know the individual nature of the plant. Involvement of these people will improve their acceptance and understanding of the new procedures. Their involvement should be, at least, as reviewers and testers, and writers, if appropriate.
- Train operators in the new EOPs during refueling, if this can be done within the scheduled outage.

Question

- Train when the procedures are essentially finished. This improves operator credibility and provides continuity to training and implementation.
- Every plant should be required to have a site-specific simulator because they are a tremendous aid for training.

22 (a) Do you have any comments on Preparation of Procedures Generation Package?

The majority of the plant representatives were supportive or neutral about the preparation of the PGP. Most seemed to think it was a good idea and that it was necessary. One comment was that it provides a nice structure for doing the job of preparing the EOPs. Other comments agreed that the PGP forces the plant to organize its efforts. The general response was that the preparation of the PGP is worthwhile and important. Those four plants not supportive of PGPs found the preparation effort to be "useless:, "unnecessary", and a "waste of time".

(b) Do you have any comments on the requirements to revise EOPs?

All of the plant representatives were in favor of the EOP revision. There were no negative comments and the overwhelming response was that the EOP revision was definitely needed. One plant manager said that standardization was a good idea and that everyone needed to "tighten-up".

4.1.2 Interviews with Nonnuclear Organizations

Presented below is a summary of the responses to our questions to the nonnuclear organizations contacted.

- Most do not involve operators in the revision process although criticism is encouraged.
- All operators and crews are trained on new EOPs prior to implementation.
- Most would use old EOPs in an emergency prior to implementation of new EOPs, but the General Electric, Spent Fuel Storage Facility noted that their management knew the new EOPs and could employ them if necessary.
- The amount of time required to train operators on the new EOPs varies but is usually a week or less.
- Training during the entire schedule is favored by the contacts. They feel that working the EOP training into the regular training cycle is advantageous because disruptions are avoided and less time is used.
- Those who test for emergency procedure knowledge and proficiency use 70 percent as a passing criteria for written exams and pass/fail for simulator or hands-on tests.

Recommendations made by nonnuclear organizations:

- There should be a procedure where changes to EOPs can be made rapidly. This procedure should also address the method for publishing the revised procedure and dispersing them to the operators. Before publishing, however, the changes should be evaluated for accuracy and workability.

- There should be management approval on each revision. The line management should pass the information on revisions on to the operators.

- There should be efforts to make operators aware of the uniqueness of this industry and its safety record. Whenever a new group of employees is brought in, safety must be stressed.

4.2 Review of the Training Literature Applicable to Reducing Negative Transfer of Training

4.2.1 Problems and Definitions

The revised EOPs at a plant may be quite different from the old EOPs. This difference may be in format, diagnostic approach, writing style, systems used to mitigate the transient, sequence of actions, etc. Thus the operators may have to learn a completely new set of procedures and basically forget the old. On the other hand, revised procedures may be similar to the old with only a few changes perhaps just in format. In any case, there may be a range of revisions and it is possible that the operators may have problems learning the new EOPs because of knowledge of, and experience with, the old EOPs. In other words, there may be a detrimental impact of previous knowledge and experience on learning new information. This is known as Negative Transfer. Further, during an emergency the operator may revert to using old EOPs, particularly if he or she is not reading directly from the new EOPs. In this instance, there has been a detrimental effect of prior knowledge and experience of the old procedures versus the recall of the new procedures. This is called "Proactive Inhibition". Note that the distinction is that Negative Transfer refers to interference during the learning process, and Proactive Inhibition refers to interference during the recall process. Since these two concepts are very similar in nature, closely related, and in the literature rarely distinguished, the term Negative Transfer will be used to indicate both concepts. This task investigated whether Negative Transfer and/or Proactive Inhibition could occur as a result of the revised EOPs, and if so, how to reduce or mediate their effect on learning and recall of the new EOPs. To perform this task, literature was reviewed to determine those conditions which cause Negative Transfer; and those conditions were compared to conditions existing at NPPs with respect to EOPs (determined during Task 1). These comparisons indicate the potential for the Negative Transfer, and its possible extent or seriousness. Finally, the literature was reviewed to determine how Negative Transfer could be reduced or mediated. The terms "mediate", "mediating", or "mediation" refer to the reduction or elimination of Negative Transfer through some type of intervention. The term "mediating techniques" refers to methods used to intervene on Negative Transfer and reduce or eliminate it.

The literature review was relatively extensive and yielded a large number of references; the relevant ones were ordered and reviewed. NRC had supported a previous literature review in 1981-1982, namely, "Nuclear Control Room Modifications and the Role of Transfer of Training Principles: A Review of Issues and Research", (NUREG/CR-2828). Although this review was oriented toward control room modifications and their potential for causing Negative Transfer, the basic principles of Negative Transfer were reviewed and discussed in the report. Consequently, NUREG/CR-2828 was used as the primary source of information for the review although other sources were also considered. The reader is referred to this source for a full discussion of Negative and Positive Transfer. This report focuses only on relevant Negative Transfer effects and their mediations.

4.2.2 Conditions for Negative Transfer

The causes of Negative Transfer and the conditions under which it can occur have been reasonably agreed upon in the literature. The causes and conditions can be explained in the following manner:

- When the response to situations is different from, or conflicts with, the original response, then Negative Transfer can occur. The largest Negative Transfer effect occurs when the responses are reversed. For example, suppose when going to work one turns right at a particular intersection. If one changes job location resulting in a left turn at the same intersection, then Negative Transfer will have a large effect. The effect is the difficulty in learning to always turn left (Negative Transfer) and another possible effect is the momentary inability to recall which way to turn (Proactive Inhibition).
- In the above discussion the responses to the same situation are different. If, however, the situation changes along with the responses, then Negative Transfer is reduced if not eliminated altogether. Thus, with reference to Negative Transfer we need to be concerned only when the response to the same or similar situations are different.
- There is evidence that, when people are subjected to stress, Negative Transfer can occur and affect their performance. The usual example used to demonstrate this effect is the situation where aircraft pilots have learned to operate an aircraft whose controls and configuration are different from an aircraft previously learned. When these pilots are subjected to stress (such as when being fired upon or a safety-related emergency) control misoperation can occur. In this case, the previously learned set of control responses interferred with the new set of learned control responses due to the stress of the situation. Although this example considers changes in controls and their configuration, it is conceivable that changes in procedures and their format could also create confusion and errors when operators are under stress.
- When one's attitude is positive and accepting of a new response and negative toward the old, then there may be a learning and performance enhancement. Again, there is little data or objective evidence for this possible effect.

The above cases are the basic causes of Negative Transfer of interest to this study. Of course, other possible causes, are not of concern here. The causes discussed are sufficient to demonstrate the possibility of Negative Transfer and the required mediating techniques.

4.2.3 Conditions at NPPs and the Revised EOPs

The question addressed here is, "Do conditions exist at NPPs with respect to revised EOPs which could cause Negative Transfer during the learning of the new EOPs and their recall during use?" To answer this question we need to examine what can change as a result of revising EOPs. The following are the major anticipated effects:

- Initiating symptoms, alarms, indicators, etc., may <u>not</u> change considerably; although at some plants they may because of new Technical Guidelines.
- Initial operator response to transient symptoms will change as a result of going from event-oriented to function-oriented procedures.
- Once an event has been diagnosed, operator actions in response to the event will <u>not</u> change considerably, although these actions may occur in parallel with the actions required by the functional procedures which are different.
- Format, style, and contents of the new EOPs will change from the old.

Clearly, the biggest change in EOPs will be the shift from event-oriented procedures to function-oriented. It is here that Negative Transfer could occur. Operators could have a harder time learning the new approach and recalling it during a transient (if mediating techniques are not used). Another possible change is that of format, style, and contents of the new EOPs. These changes can also affect learning and procedure use. This is particularly true if the format and style is greatly different from the other plant procedures that are commonly used by operators. Although there is little evidence for its effect at NPPs, we can propose that operator stress during a transient could hamper new procedures recall. Further one may speculate that a change in operator attitude toward revised EOPs may increase or decrease Negative Transfer.

These are examples, in which Negative Transfer could affect operators with respect to the revised EOPs. However, mediating circumstances and techniques can reduce Negative Transfer and its effect.

4.2.4 Mediation of Negative Transfer

Certain conditions and techniques can help to offset, reduce, or eliminate Negative Transfer effects. The list presented below highlights the conditions and techniques applicable to NPPs.

- If the original responses have not been well-learned, or have not been taught and practiced for a long time, then Negative Transfer will be lessened.

- If the original responses have been over-learned and well-practiced, then Negative Transfer will be lessened. (In this case, it is as if over-learning helps people to differentiate the original responses from the new responses. It is as if the two sets of responses are cognitively separated.)
- If the new set of responses are over-learned and well-practiced, then Negative Transfer will be reduced and finally eliminated.
- If new people are being trained to learn and recall the new responses only, then Negative Transfer will not occur. However, if these people are learning new responses to a situation they have experienced in the past, then Negative Transfer can still occur.
- The use of simulators in the training process to provide instruction and practice is an excellent method to enhance learning, and reduce Negative Transfer. Trainees can receive extensive practice on simulators which can result in over-learning of the new responses, and thus, reduce Negative Transfer.
- The approach of telling people to "forget" the previous responses does have an effect, i.e., recall of the new responses. But, this effect is only temporary and thus, unreliable.

4.2.5 Application of Mediation to Negative Transfer Resulting from Revised EOPs

As stated previously, Negative Transfer effects can occur as a result of revising EOPs from event-oriented to function-oriented procedures. There are conditions at NPPs that may cause the effects and those that may mediate the effect.

- If the operators are well-trained and able to perform the old EOPs, then negative Transfer can be a problem. Our discussions with plant representatives show that they believe the operators were well-trained. Most stated that their operators were well-trained and practiced on the old procedures. Further, some plants experienced difficulties during training on new procedures because of operator knowledge of old procedures. Thus, from this evidence, Negative Transfer may be a problem during training and perhaps during an emergency.
- Where operators have a negative attitude toward the old procedures and a positive attitude toward the new procedures, then Negative Transfer may be moderated. Our survey showed that operators are negative toward the old EOPs and recognize the need for improvements. Further, our survey showed that operators have positive attitudes toward the new procedures.

Another area of concern is the change in format and style compared to that for the old procedures. Our survey showed that the format of the new procedures will be different from the old ones and that the format will be distinctly different from the standard plant procedures (operating procedures, abnormal procedures, etc.). Consequently, Negative Transfer is possible due to this change. However, it is conceivable that the operators might be considered over-trained and well-practiced using the format and style of the standard plant procedures, because of the extensive training and experience operators have with all plant procedures.

Here the mediation of "overtraining" may reduce whatever Negative Transfer that might occur. During our survey, most plant representatives stated that they saw no problem in using the new format. Their reason was that the new format was easier to read and follow than the old format and would be easier to learn because the format is distinctively different from the other plant procedures. They saw this difference as an advantage. Conceivably, the new procedures appear so different from the old, that the operators cognitively separate the two, lessening the Negative Transfer effect.

The primary method to reduce and, hopefully, eliminate Negative Transfer is through training on the new responses. It is through training and practice that the influence of the old responses on the new is mediated. Further, the use of simulators to enhance learning and provide practice has been shown to be an excellent method to mediate Negative Transfer (when the actual equipment cannot be used). A site-specific simulator, of course, would be ideal, but these are not always present for some NPPs. Generic simulators can also be used for teaching and practicing procedural material, but are less usable for learning diagnostic and decision-making tasks. Consequently, one recommendation to the plants will be to use extensive training and practice and to use simulators, not just to teach the new procedures, but also to overcome any Negative Transfer effects that might be present.

As new operators are employed they will be trained in the new EOPs, thus avoiding Negative Transfer. However, operators being hired from other NPPs or military reactor programs may have some difficulty learning and recalling the plant's EOPs because of their previous knowledge and experience with their previous plant's EOPs. Also, operators who transfer from a utility's unit to another where the control rooms are similar but not identical may experience Negative Transfer. Here again extensive training and practice (on simulators) will be necessary to overcome whatever Negative Transfer effects may be present.

There is concern that, during stressful transients, Negative Transfer can be created and affect operator use of emergency procedures. The newly implemented procedures will be different from the old procedures (function-oriented versus event-oriented and format differences) and it is conceivable that during stress the operator may react to a transient with actions learned as part of the old procedures instead of reacting with the newly implemented procedures. For example, during a transient, the stress may cause the operator to diagnose the event-oriented procedure, rather than controlling the critical safety functions as now expected. Extensive training and practice will be necessary to help assure that Negative Transfer does not occur due to operator stress during a transient.

In conclusion, Negative Transfer could occur as the result of revising and implementing new EOPs. The change from event-oriented to function-oriented procedures, and possibly the change in format could contribute to Negative Transfer occurring during training and during a transient. Further, there is concern that, during transients, Negative Transfer may be created because of operator stress. However, due to the mediating conditions of operator's negative attitudes toward the old procedures and their positive attitudes toward the new procedures; and the mediating techniques of extensive training and practice (preferably on site-specific simulators) the Negative Transfer effects can be reduced.

4.3 Development of Methods and Model Schedules for Implementing the Revised Emergency Operating Procedures

During our interviews with the various plants we investigated the EOP development process and implementation schedules. As expected, the plants varied considerably in terms of activities and schedules. Consequently, it is difficult to present and discuss typical plants' activities, sequences, and schedules. However, based on plants' responses we have been able to construct a logical sequence of activities and schedules that would result in well-prepared and tested EOPs, and trained operators prior to implementation. This process is presented in Table 1 as milestones/activities.

As shown in Table 1, the plants would first prepare a Procedures Generation Package (PGP) to include the Plant-Specific Technical Guidelines, the Writer's Guide, the Verification/Validation Plan and the Training Plan. Based on the Plant-Specific Technical Guidelines and the Writer's Guide, a first draft of the new EOPs would be generated. This first draft may be a revision of old procedures or may be a totally new set of procedures. The first draft would then be revised and refined through committee reviews, operator reviews, simulator checkouts, etc. At this point the operators could receive some preliminary training on the EOPs to simply introduce and demonstrate the new EOP approach. This, of course, is optional, although some plants did mention the use of this preliminary training period. During this training, problems with the EOPs may be noted and the new EOPs would then be revised to form a second draft. This draft is then tested through Verification and Validation procedures. Finally, based on the outcome of these tests, a final draft would be completed. This draft would be used by the training program to formally train the operators. Ideally all operators would be trained over a short time (6-12 weeks) so that there would be a limited period of reliance on the old EOPs. Soon after all the operators are trained, the EOPs would be implemented in the control room. A short, interim period between the training and implementation would be planned so that any final revision could be completed and the EOP published.

It must be remembered that presently the process described above may not be followed by all NPPs. In fact, some activities are not performed at all and some activities are performed in a different order than presented in Table 1. The process presented constitutes a representative model, as constructed by the representatives interviewed at the plants sampled.

Table 1 also indicates operator training periods. Three optional training periods have resulted from our discussion with the various plant representatives. The first and the one most used by the plants is the requalification training period. This time varies from plant to plant and, at a plant, can extend over several months. If the requalification period is used to train operators on the new EOPs, it is possible for a crew to be trained in the new EOPs many months prior to implementation. This is not desirable because the crew would be trained in new procedures, yet use the old procedures during a transient. Thus, from the viewpoint of training all operators on new EOPs just prior to implementation, reliance on the normal requalification schedules may not be ideal. However, a plant that can schedule a requalification training period (where all operators are trained over a 6- to 12-week period) and can implement the new EOPs directly after the training will be able to effectively use the requalification period.

TABLE 1. SCHEDULE FOR EOP DEVELOPMENT OR UPGRADE, AND IMPLEMENTATION

Milestones	Activities	Training Periods			Alternative Time Schedules 1 (Preferred)	Alternative Time Schedules 2 (Minimal)
1	Preparation of Procedures Generation Package				Undetermined Time Period (Varies by plant) - can be submitted anytime 3 months prior to training	Undetermined Time Period (Varies by plant) - can be submitted anytime 3 months prior to training
2	Write First Draft of Plant-Specific EOPs (may be new or a revision) Revise and Refine Procedures - Through committee and operator reviews, simulator checkout, etc.				6 Months	4 Months
3	Preliminary Training (Optional): Familiarize Operators with New EOP Philosophy and Approach Explain Each Step	Requalification Training 6-week cycle 1-2 days per crew	Special Preliminary Training 6-week cycle 1-2 days per crew	Special Preliminary Training 6-week cycle 1-2 days per crew	6 Weeks	6 Weeks
4	Incorporate Results of Preliminary Training Complete Second Draft of Plant-Specific E.O.P.s				3 Months	2 Months
5	Verify EOPs Validate EOPs				1 Month	2 Weeks
6	Incorporate Results of Verification/Validation Complete Third Draft of Plant-Specific EOPs				1 Month	2 Weeks
7	Intensive Operator Training: Classroom Lecture Discussion Written/Oral Tests Simulator/Control Room Practice and Testing Written/Oral Exams Simulator Tests	Requalification Training* 6-week cycle 1 week per crew	Refueling Outage* 6-week cycle 1 week per crew	Special EOP Training* 6-week cycle 1 week per crew	6 Weeks to 2 Months	6 Weeks
8	Implementation Control Room placement Official Use by Operators				Following Training	Following Training

* The 6-week cycle is considered minimal. A 12-week cycle (2 weeks per crew - 1 week lecture - 1 week simulator/control room) would enable greater assurance that all operators had received adequate training.

The second training period is the refueling outage period. Only a few plants use this time for training. At most plants the operators are very busy with refueling activities. It is an ideal period for training operators on the new EOPs, because the plant can start up with a newly implemented set of EOPs, and newly trained operator crews after the outage. Consequently, it is desirable to use this period, if it occurs close to the completion of the final draft of the EOPs and there is sufficient time during the outage to properly train all of the operators.

The third alternative time period is a special time set aside to train operators or crews on the newly revised EOPs just prior to implementation. This period would be devoted exclusively to EOP training and, thus not interfere with other training, e.g., during requalification. Further, it emphasizes the importance of the new EOPs. During our survey some plants discussed such a training period, although others seemed against any disruption of normal scheduling. Such a time is conceivable, and it is an option available to the plants. It is ideal in that all the operators can be trained in a relatively short time prior to implementation.

Table 1 also presents two alternative time schedules which are representative of typical time periods mentioned by the plants. The first alternative is preferred because it provides sufficient time to do a thorough job on each activity. The second alternative provides a minimum of time for each activity. These schedules are only workable examples.

4.3.1 Criteria and Procedures for Correcting Problems in Current EOPs

During the EOP revision process it is possible that plant personnel may discover serious, safety-related problems in the old procedures. These problems could cause operator errors, inaccuracies, misdiagnoses, or inability to control or mitigate a transient (or some part of it). Consequently, revisions and corrections will be necessary to solve the problems. However, a utility may be hesitant about expending effort on making corrections, since revised procedures may be implemented soon anyway.

To obtain plant opinion, a sample of the participating utilities were asked these questions, "During the EOP revision, if serious errors are found in the old EOPs, what should be done? ... What would you do at your plant? ... How timely should revisions be made?" Their answers can be summarized as follows:

> In the unlikely event that a serious, obvious safety problem was discovered in the old EOPs the plants would take immediate action. The problem would be reviewed on the spot by authorized personnel. This immediate action would be followed by a more intensive administrative review and the issuance of a "Reportable Occurrence". Then the operators would receive some manner of training and walkthrough of the revision. However, more than likely the problem discovered would be small and relatively unimportant. In this more likely case, the review and revision would take place in a more routine manner.

If the error or problem noted in the old procedures is serious, i.e., would cause operator error or cause inability to diagnose or mitigate a transient, then it is desirable to change the old EOPs immediately. If the new EOPs would not be implemented until some time in the future and the old procedures will be relied upon, then the revisions should also take place immediately. The following approach is suggested:

- Alert the operators to the error or problem and the changes to be made.
- Issue a "Reportable Occurrence", as needed.
- Revise the currently implemented EOPs, reimplement immediately and mark the changes*.
- Perform administrative reviews according to plant policy.
- Discuss the changes with the operators in a training setting.
- Provide simulator exercises or control room walkthrough, if deemed appropriate.

This approach will assure that the operators will have accurate and reliable procedures to use before the newly revised EOPs are implemented.

---

* If the changes are major or radically different from the old procedure, the plant may want to implement the changes after the operators have been trained. In this case, the approach step would be listed last.

APPENDIX A
LIST OF PARTICIPANTS

APPENDIX A

LIST OF PARTICIPANTS

Name	Vendor
Arkansas Nuclear One - 1	B&W
Brunswick	GE
Maine Yankee	CE
Nine Mile Point - 1	GE
Peach Bottom	GE
San Onofre - 1	West
Surry	West
Susquehanna - 1	GE
Yankee Rowe	West
Farley	West
River Bend	GE
Shoreham	GE
Millstone - 1,2	GE, CE
Davis Besse 1	B&W
Trojan	West
Salem	West
Ginna	West
Seabrook	West
Sequoyah	West
Point Beach	West
Oyster Creek	GE
Indian Point	West

NRC FORM 335 (6-83) U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

1. REPORT NUMBER (Assigned by TIDC, add Vol. No., if any)
NUREG-CR-3632
PNL-4927

2. Leave blank

3. TITLE AND SUBTITLE
Methods for Implementing Revisions to Emergency Operating Procedures

4. RECIPIENT'S ACCESSION NUMBER

5. DATE REPORT COMPLETED
MONTH March YEAR 1984

6. AUTHOR(S)
L.B. Myers, A. J. Bell

7. DATE REPORT ISSUED
MONTH May YEAR 1984

8. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)
Battelle Columbus Laboratories
505 King Ave.
Columbus, OH 43201
Under contract to: Pacific Northwest Laboratory
Richland, WA 99352

9. PROJECT/TASK/WORK UNIT NUMBER

10. FIN NUMBER
B-2360

11. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)
Division of Human Factors Safety
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

12a. TYPE OF REPORT
Final Report

12b. PERIOD COVERED (Inclusive dates)

13. SUPPLEMENTARY NOTES

14. ABSTRACT (200 words or less)

In response to the Three Mile Island (TMI) accident, the U.S. Nuclear Regulatory Commission (NRC) has published the TMI Action Plan. The TMI Action Plan Item I.C.1 called for the upgrading of Emergency Operating Procedures (EOPs) at nuclear power plants. The program developed from this Action Plan item has resulted in utility efforts to 1) revise EOPs, 2) train personnel in the use of the EOPs, and 3) implement the revised EOPs.

The NRC supported the study presented in this report to identify factors which influence the effectiveness of training and implementation of revised EOPs. The NRC's major concern was the possible effects of negative transfer of training. The report includes a summary of existing methods for implementing revisions to procedures based on interviews of plant personnel, a review of the training literature applicable to the effect of previously learned procedures on the learning of and performance with revised procedures (i.e., negative transfer) and recommendations of methods and schedules for implementing revised EOPs. While the study found that the concern over negative transfer of training was not as great as anticipated, several recommendations were made. These include (1) over-training of operators to reduce the effect of observed negative transfer, and (2) implementation of the revised EOPs as soon as possible after training to minimize the time operators must rely upon the old EOPs after having been trained on the revised EOPs. The results of the study should be useful both to the utilities and the NRC in the development and review of EOP implementation programs.

15a. KEY WORDS AND DOCUMENT ANALYSIS

15b. DESCRIPTORS

Nuclear Power Plant Procedures
Emergency Operating Procedures
Procedures Training
Procedures Implementation
Negative Transfer of Training

16. AVAILABILITY STATEMENT
Unlimited

17. SECURITY CLASSIFICATION (This report) Unclassified

18. NUMBER OF PAGES

19. SECURITY CLASSIFICATION (This page) Unclassified

20. PRICE
$

NUREG/CR-3632

METHODS FOR IMPLEMENTING REVISIONS TO EMERGENCY OPERATING PROCEDURES

MAY 1984