



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 20, 1990

Locket Nos. 50-325
and 50-324

Mr. Lynn W. Eury
Executive Vice President
Power Supply
Carolina Power & Light Company
Post Office Box 1551
Raleigh, North Carolina 27602

Dear Mr. Eury:

SUBJECT: SAFETY EVALUATION FOR THE BRUNSWICK STEAM ELECTRIC PLANT,
UNIT NOS. 1 AND 2 - PROCEDURES GENERATION PACKAGE
(TAC NOS. 44287 AND 44288)

The staff has completed its review of your Procedures Generation Package (PGP) for the Brunswick Steam Electric Plant (BSEP), Units 1 and 2 submitted by letters dated August 17, 1983 and October 31, 1984, supplemented by a letter dated January 28, 1987. The enclosed safety evaluation discusses programmatic improvements which will enhance your ability to develop and maintain consistently high quality Emergency Operating Procedures (EOP). The majority of the findings are related to the writer's guide. The staff concludes that your PGP needs to be reviewed to address these programmatic improvements. For items you deem inappropriate or no longer applicable for inclusion in your PGP, you should develop and maintain documented justification in an auditable form.

In addition, during the period of September 26 through October 7, 1988, a team of NRC inspectors audited your Integrated Plant Emergency Operating Procedures (EOP); the team findings and comments were transmitted to you in the Inspection Report 50-325/88-200 and 50-324/88-200 dated February 23, 1989.

The staff recommends you consider both the enclosed Safety Evaluation and the results of the EOP inspection as stated in the Inspection Report and utilize them as appropriate in the next major revision to your PGP and EOP.

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Mr. Lynn W. Eury

-2-

February 20, 1990

The staff recognizes that your PGP may have been revised since the submittals, and requests that you maintain records of all revisions to your PGP and EOP in an auditable form. No further submittals are required.

Sincerely,

Original Signed By:

Ngoc B. Le, Project Manager
Project Directorate II-1
Division of Reactor Projects - 1/II
Office of Nuclear Reactor Regulation

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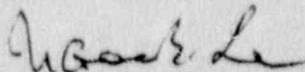
Mr. Lynn W. Eury

-2-

February 20, 1990

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Sincerely,



Ngoc B. Le, Project Manager
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Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

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BRUNSWICK FILE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO THE PROCEDURES GENERATION PACKAGE

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2
DOCKET NOS: 50-325/50-324

1. INTRODUCTION

The "TMI Action Plan" (NUREG-0660 and NUREG-0737) required licensees of operating reactors to reanalyze transients and accidents and to upgrade emergency operating procedures (EOPs) (Item I.C.1). The plan also required the NRC staff to develop a long-term plan that integrated and expanded efforts in the writing, reviewing, and monitoring of plant procedures (Item I.C.9). NUREG-0899, "Guidelines for the Preparation of Emergency Operating Procedures," describes the use of a "Procedures Generation Package" (PGP) to prepare EOPs. A PGP is required by Generic Letter 82-33, Supplement 1 to NUREG-0737, "Requirements for Emergency Response Capability." The generic letter requires each licensee to submit a PGP, which includes:

- (i) Plant-specific technical guidelines
- (ii) A writer's guide
- (iii) A description of the program to be used for the validation of EOPs
- (iv) A description of the training program for the upgraded EOPs.

This report is the review of the Carolina Power & Light Company (CP&L) submittals describing the development and implementation of EOPs for the Brunswick Steam Electric Plant, Units 1 and 2 (BSEP).

The review was conducted to determine the adequacy of the CP&L program for preparing, implementing, and maintaining upgraded EOPs for BSEP. This review was based on NUREG-0800, Subsection 13.5.2, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plant." Section 2 of this report briefly discusses the CP&L submittal, the NRC staff review, and the acceptability of the submittal. Section 3 contains the staff's conclusions.

The staff determined that the procedure generation program for BSEP has several items that must be satisfactorily addressed before the PGP is acceptable. CP&L should address these items in a revision of the PGP, or justify that revisions are not necessary. This revision and/or justification need not be submitted, but should be retained for subsequent review by the NRC staff. The revision of the PGP, and subsequently of the EOPs. The revision should be made in accordance with the BSEP administrative procedures and 10 CFR 50.59.

2. EVALUATION AND FINDINGS

In a letter dated August 17, 1983, from S. R. Zimmerman (CP&L) to H.R. Denton (NRC), CP&L submitted its PGP for BSEP. The NRC staff conducted a review of the BSEP PGP, and identified its findings in a Request for Additional Information (RAI), which was forwarded to CP&L in a letter dated July 27, 1984. CP&L provided responses to the RAI items in a letter from S. R. Zimmerman to D. B. Vassallo (NRC) in a letter dated October 31, 1984 and included a revision to the PGP that incorporated changes to address the identified items. The 1984 revision of the writer's guide that was submitted to the NRC was incomplete and was resubmitted by CP&L on January 28, 1987 in response to a conference call held on January 12, 1987. The revised PGP included an introduction and the following sections:

- EOP Upgraded Program
- Plant-Specific Technical Guidelines for EOPs
- Writer's Guide for EOPs
- Validation and Verification Program for EOPs
- Symptomatic EOP Training Program
- EOP Administrative Control

The review of the BSEP PGP follows:

- A. Because staff evaluation of Revision 4 of the generic technical guidelines is now complete, the P-STG program description should be revised to conform with Revision 4 of the General Electric Biling Water Reactor Owner's Group (BWROG) Emergency Procedure Guidelines (EPGs). Safety significant deviations from the BWROG Emergency Procedures Guidelines should be documented, justified, and archived for future reference.
- B. The writer's guide was reviewed to determine if it described acceptable methods for accomplishing the objectives stated in NUREG-0899. The BSEP EOPs consist of flowcharts for the immediate operator actions, and text procedures for the subsequent actions. The purpose of the writer's guide is to provide administrative and technical guidance on the preparation of EOPs to ensure that they are complete, accurate, convenient, readable and acceptable to the BSEP control room personnel. The writer's guide provides information on the organization of the EOPs, mechanics of style, typing format, and reproduction. The staff identified the following concerns in the review of the writer's guide:

1. Figure 1, page 12 does not use the path-to-path arrows for referencing the flowcharts as indicated in Section 3.9, page 15. The writer's guide should be revised so that text and examples are consistent.
2. Item 12, page 5 of Appendix III, indicates that path-to-path arrows on flowcharts will be color coded. Color coding is not discussed in the writer's guide.
3. Figure 1, page 12, has information or caution symbols placed at the end of flowpaths after action steps. The writer's guide should state that information or caution symbols should appear before the step to which they apply.
4. CP&L indicates that Figure 1, page 12, has been revised for clarity; however, this figure is illegible because it has been reduced. Further, Figure 6, page 29, is also difficult to read.
5. The writer's guide should be revised to address the following concerns regarding logic terms:
 - a. Section 4.8.2.b, page 33, states that "and" should not be emphasized as a logic term if it is used as single or compound conjunction. However, in Section 4.8.2.a, the "and" is the consequence of the logic term. It appears to be a conjunction, but is emphasized as a logic term. The writer's guide should specifically discuss the difference between conjunctions and logic terms. Examples should be revised so that they are consistent with this description.
 - b. The example in Section 4.8.2.b, page 33, the logic term IF is not underlined as required by Section 4.8.2, page 32.
 - c. The example in Section 4.8.2.b, page 33, does not follow the guidance for combining AND and OR that is given in Section 4.8.2.d, page 34.
 - d. Section 4.8.2.d, page 34, lists two possible meaning for a conditional statement containing both AND and OR. The first possible meaning reads:

IF both condition A AND condition B occur, THEN go to Step 5.3.6.

This statement is incomplete it should read:

IF both condition A AND condition B occur; THEN go to Step 5.3.6
OR

IF condition C occurs, THEN go to Step 5.3.6.

- e. The examples in Section 4.8.7, pages 36 and 37, and in Section 4.8.13, page 40, emphasize "cannot" as though it were a logic term. CANNOT is not included in the list of logic terms in Section 4.8.2, page 32. The writer's guide should be revised so that text and examples are consistent.
 - f. The caution Figure 6, page 29, shows "unless" emphasized as a logic term. When "unless" is used as a logic term, the condition will typically follow the action (e.g., "Open the valve UNLESS..."). For this reason, the writer's guide should be revised to indicate that "unless" will not be used in EOPs as a logic term.
6. The writer's guide should be revised to address the following concerns regarding referencin~~g~~ and branching:
- a. Section 4.8.7 of writer's guide, page 36, indicates procedure writers should use IF...THEN statements to format reference and branches. The validation and verification checklist, Figure 16, number 2.c, page 31, asks if referencin~~g~~ and branching instructions are correctly worded, using "go to" for branches and "refer to" for references. The writer's guide should be revised to specify a consistent format for references and branches. Specific, unambiguous information should be included in a reference or a branch, e.g. the step number, the section title and number, and the procedure title and number. The validation and verification program should be made consistent with the writer's guide or vice versa.
 - b. The writer's guide should discuss the specific criteria to be used when deciding whether necessary steps should be included in the text of the procedure or should be referenced. The length of the referenced segment is one possible criterion.
 - c. To aid in referencin~~g~~, the writer's guide should specify some method, such as tabbing, for easily identifying section or subsections in end path procedures.
7. The writer's guide should include instructions for writing the various types of action steps that an operator may take to cope with different plant situations:
- a. The writer's guide should define and discuss the format for the following types of action steps in flowcharts: time-dependent steps, concurrent steps, and diagnostic steps. Also the format for non-sequential, equally acceptable, and recurrent steps should be discussed. The writer's guide should include a means by which operators will be reminded to perform recurrent, continuous, time-dependent, and concurrent steps as well as a means of letting operators know when it is no longer necessary to perform these steps. Examples of each of these steps should be provided.

- b. The writer's guide should define and discuss the format for the following types of action steps in text procedures: time-dependent steps, concurrent steps, diagnostic steps, and high-level steps. Examples of diagnostic and equally acceptable steps in text procedures should be provided. The writer's guide should include a means by which operators will be reminded to perform recurrent, continuous, time-dependent, and concurrent steps as well as a means of letting operators know when it is no longer necessary to perform these steps.
 - c. Section 4.8.1.e, page 31, states that lists of three or more objects will include spaces for operator checkoffs. The example in Section 4.8.13, page 40, includes a sequence for opening SRVs which does not include spaces for operator checkoffs. The writer's guide should clarify when checkoffs are and are not required, and make examples consistent with that guidance.
8. The writer's guide should be revised to specify the location of printed operator aids (i.e., figures, tables, and attachments), in the procedures so that they can be easily located and identified by operators.
9. The discussion of flowcharts in the writer's guide should be revised with regard to the following:
- a. Because flowcharts cannot present as much detail as written procedures, the writer's guide should specifically address the level of detail to be included in flowcharts.
 - b. Section 3.10, page 15, discusses connecting lines in flowcharts, and mentions a wide line, the "Yellow Brick Road," (which represents the expected plant response) and narrow lines (which represent possible plant responses). Section 3.10 should discuss precise formatting instructions for these lines. An example should be provided.
 - c. The writer's guide should discuss placekeeping aids for flowcharts.
 - d. Section 3.27, page 22, states that flowcharts may be reproduced on a standard blueprint copier, but the validation/verification program, Item 12, page 5, Appendix III indicates that path-to-path arrows on flowcharts will be color coded. The writer's guide should be revised to indicate how this color coding will be maintained during reproduction.

- e. Section 3.25, page 22, states that flowchart steps should be typed in 12-pitch type. Section 3.26, page 22, states that completed flowcharts shall be reduced by 50%. Reducing flowcharts by 50% would reduce the pitch to an unreadable size. The writer's guide should ensure that the text is readable, taking into consideration the maximum distance at which the size of type can be read in both optimal and degraded lighting. An easy to use formula that is appropriate for flowcharts is:

Type size in inches in optimal lighting = 0.0044 X reading distance in inches

Type size in inches in degraded lighting = 0.0061 X reading distance in inches

- f. Section 3.18.j, page 17, states that tables can be used in flowcharts. The writer's guide should provide format instructions for such tables and indicate how they will be referenced and where they should be placed.
- g. Section 3.22, page 21, states that flowcharts will provide location information for equipment, controls and displays that are infrequently used. The writer's guide should discuss the format for this information and provide an example.

NOTE: For further guidance regarding flowchart design, see NUREG/CR-5228, "Techniques for Preparing Flowchart-Format Emergency Operating Procedures."

Some revisions in the writer's guide introduced new human factors concerns. The following comments address passages of the writer's guide that were added to the writer's guide since the previous revision was reviewed, or sections that were modified.

- 10. The discussion in the writer's guide of cautions and notes should be revised with regard to the following:
 - a. Section 3.8, page 15, and Section 3.16, page 16, have been revised to indicate that cautions in flowcharts are to be enclosed in information symbols. Cautions contain critical information and should be easily distinguishable from other types of less critical information. A unique method of highlighting cautions on flowcharts should be provided.
 - b. Items 8.f, 8.g, and 8.h of Figure 14, page 29, of the validation/verification program address precautions, but precautions are not discussed in the writer's guide. The writer's guide should be revised to include a discussion of precautions and their format.

11. The writer's guide should be revised to further address procedure titles:
 - a. Section 4.2, page 25, states that procedures will have cover sheets that will include a descriptive title to identify the procedure. The example of a cover sheet, Figure 4, page 26, does not include a descriptive title. This figure should be revised to be consistent with the instructions given in Section 4.2.
 - b. Section 4.7.2.a, page 28, has been revised to state that a procedure title "shall be stated for operator association with the entry conditions," and that "the example title (Figure 6) represents a title for an End Path Procedure." Figure 6, page 29, does not contain a descriptive title and should be revised to be consistent with the text.
12. The writer's guide should state that each caution statement should contain one and only one topic.
13. The following concerns were noted regarding emphasis techniques:
 - a. Section 4.8.6, page 36, describes acceptable uses of underlining, and states that underlining may also be used for "miscellaneous emphasis." The overuse of underlining will detract from emphasis throughout EOPs. Section 4.8.6 should state that the use of miscellaneous emphasis should be minimized.
 - b. To correspond to the examples given, Section 4.8.10 page 38, should specify that initial capitalization will be used for references to tables and figures within text material, and column headings within a table.
 - c. Action verbs are fully capitalized in examples in the writer's guide. This use of capitalization should be discussed in the writer's guide.
14. The following concerns were noted regarding vocabulary, syntax, and punctuation:
 - a. The writer's guide should be expanded to include a list of examples of words that should be avoided, e.g., ambiguous or confusing terms.
 - b. Section 5.4.d, page 42, instructs procedure writers to define key words that may be understood in more than one sense. Section 5.4.d, should state that key words with more than one meaning should be avoided in EOPs. Such terms should be included in the list of words to avoid. If ambiguous key words must be used in EOPs, they should be defined when they are used.

- c. The writer's guide should indicate that verbs from Table 1, pages 19-20, should be used wherever possible and that verbs that are not in Table 1 should only be used if no verb in Table 1 conveys the correct meaning.
 - d. The writer's guide should state that instruction steps in flowcharts and written procedures will be written as directives, in the imperative mode.
 - e. Section 5.2, page 40-41, discusses hyphenation. The fourth and fifth uses of hyphenation described in this section are not consistent with standard English usage, and the sixth usage described does not make these words less confusing. The writer's guide should be revised into indicate that hyphenation will not be used in these situations.
15. The following concerns were noted regarding action steps:
- a. The writer's guide should state that each action step will be wholly contained on a single page.
 - b. The writer's guide should be expanded to address the following concerns: (1) action steps should be structured to minimize the physical interference of personnel in the control room, (2) action steps should be structured to avoid unintentional duplication of tasks, (3) action steps should be structured to be consistent with the roles and responsibilities of operators, and (4) action steps should be structured to be executed by the minimum control room staffing required by the Technical Specifications. See NUREG-0899, Section 5.8 for additional information. The writer's guide should also make it clear that these concerns pertain to action steps in the end path procedures as well as those in flowcharts.
16. Section 6.5, page 43, discusses rules for page rotation. Having to rotate pages in the middle of an instruction makes a procedures difficult to follow, increases delays, and may lead to operator error. The writer's guide should state that page rotation will be minimized.
17. Section 3.23.d, page 21, instructs procedure writers to use limits to avoid calculations and to "avoid using+". This appears to be a typo; the section should read "avoid using ±."

With adequate resolution of the above items, the BSEP writer's guide should accomplish the objectives stated in NUREG-0899 and should provide adequate guidance for translating the technical guidelines, into EOPs that will be useable, accurate, complete, readable, convenient to use, and acceptable to control room operators.

C. Verification and Validation Program

The description of the verification and validation program was reviewed to determine if it described acceptable methods for accomplishing the objectives stated in NUREG-0899. The validation and verification program described in the PGP has six objectives:

- To confirm that the BSEP EOPs are technically correct; i.e., they accurately reflect the technical guidelines.
- To confirm that the BSEP EOPs are written correctly; i.e., they accurately reflect the writer's guide.
- To confirm that the BSEP EOPs are useable; i.e., they can be understood and followed without confusion, delay, or errors.
- To confirm that there is a correspondence between the EOPs and the BSEP control room/plant hardware; i.e., control/equipment indications that are referenced are available (inside and outside the control room), use the same designation, use the same units of measurement, and operate as specified in the procedures.
- To confirm that the language and level of information presentation in the BSEP EOPs is compatible with the minimum number, qualification, training, and experience of the plant operating staff.
- To confirm that there is a high level of assurance that the BSEP EOPs work; i.e., the procedures guide the operator in the mitigation of transients and accidents.

CP&L states that EOP validation and verification is accomplished by a combination of the following methods:

- Desk-top reviews
- Simulator exercises
- Walk-throughs
 - Phase I (operational scenarios)
 - Phase II (check of each step of EOP)
 - Back panel walk-through
 - Outside control room walk-throughs
- Pre-implementation review of Brunswick EOPs

- ° Documentation of technical guidelines (Appendix III, Attachments A, B, and C)
- ° Independent Human Factors Reviews (summary)

The staff identified the following concerns:

1. The description of the validation/verification program should be revised with regard to the following:
 - a. CP&L states that "the EOP committee will be responsible for EOP maintenance and will determine what verification and validation will be required for revised EOPs." The verification/validation program should clearly specify how the committee will maintain EOPs and should include the general criteria that the committee will use to determine when verification and validation is and is not necessary for revised EOPs.
 - b. The validation/verification program describes the validation and verification that was performed on existing EOPs but does not specify how the program will be followed in the future. The program should describe CP&L's plan for validating and verifying current as well as new or revised EOPs. For this reason, the validation/verification program should be presented as a detailed plan that CP&L has committed to follow for all future EOPs, rather than as a description of the validation and verification that occurred with the most recent set of EOPs.
2. The validation/verification program should indicate that the EOPs will be exercised during simulator exercises or control room walk-throughs with the minimum control room staff required by the Technical Specifications.
3. The description of the validation/verification program should be revised with regard to the following:
 - a. The validation/verification program should state that simulator exercises are the primary validation method.
 - b. The validation/verification program should state that when a plant-specific simulator becomes available, the full complement of EOPs will be re-validated on the plant-specific simulator. The validation plan should be followed during this re-validation.
4. NRC Validation/Verification Comment 6: The validation and verification program should be expanded to include a description of how technical differences between units will be handled in validation and verification. The validation and verification program should also state that walk-throughs should be conducted in each unit's control room in order to establish correspondence between the controls in each control room and the EOPs.

With adequate resolution of the above items, the BSEP verification and validation program should accomplish the objectives stated in NUREG-0899 and should provide assurance that the EOPs adequately incorporate the guidance of the writer's guide and the technical guidelines.

D. Training Program

The description of the operator training program on the BSEP upgraded EOPs was reviewed to determine if it described acceptable methods for accomplishing the objectives stated in NUREG-0899. BSEP described a training program that will provide classroom instruction for auxiliary operators and classroom instruction and simulator training for licensed operators and individuals in training for an operator's license. Daily exams are given during the classroom training and evaluations of the operators' performance are made during simulator exercises. The staff identified the following concerns:

1. The training program should be revised to indicate that all operators will be trained on the current version of all EOPs before going on shift.
2. The training program description should be expanded to discuss the method to be used to train the operators in areas where the simulator differs from the plant. In these situations and for the parts of the EOPs that cannot be run on the simulator, walk-throughs should be used for operator training. Classroom training alone is not an appropriate substitute for simulator or walk-through training.
3. The training program description should indicate that operators will be trained to use the EOPs as a team and that each operator will be trained in the role that he would be expected to take in an actual emergency.

Some revisions in the training program introduced new concerns. The following comments address portions of the training program that were added since the previous revision was reviewed, portions that were significantly modified.

5. The description of the training program should include the objectives of the program. This description should state that, at the conclusion of training:
 - a. Trainees will understand the philosophy behind the EOPs. That is, trainees will understand the EOPs' structure and the approach to transient and accident mitigation, including control of safety functions; accident evaluation and diagnosis; and the achievement of safe, stable, or shutdown conditions.

- b. Trainees will understand the mitigation strategy and technical bases of the EOPs. That is, trainees will understand the function and use of plant systems, subsystems, and components in mitigating transients and accidents.
- c. Trainees will have a working knowledge of the technical content of the EOPs. That is, trainees will understand and know how to perform each step in all EOPs to achieve EOP objectives.
- d. Trainees will be capable of executing the EOPs (as individuals and teams) under operational conditions. That is, trainees will be able to carry out an EOP successfully during transients and accidents.

With adequate resolution of the above items, the BSEP training program should accomplish the objectives stated in NUREG-0899 and should result in appropriate training for the BSEP operators on the upgraded EOPs.

3. CONCLUSIONS

The staff concludes that, the PGP submitted by CP&L for the BSEP, Units 1 and 2 by letters from CP&L to the NRC, dated August 17, 1983 and October 31, 1984, as revised by CP&L letter dated January 28, 1987 should be reviewed to address the programmatic improvements outlined in Section 2 of this evaluation. A PGP revision should not be submitted to the NRC. For items the licensee deems inappropriate or no longer applicable for inclusion in its PGP, it should develop and maintain documented justification in an auditable form. All revisions to the PGP should be reflected in plant EOPs within a reasonable period of time, e.g. the next planned revision of the EOPs.

Mr. L. W. Eury
Carolina Power & Light Company

Brunswick Steam Electric Plant
Units 1 and 2

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