



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO PROCEDURES GENERATION PACKAGE FOR

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

UNITS 1 AND 2

DOCKET NOS. 50-282 AND 50-306

1.0 INTRODUCTION

Following the Three Mile Island (TMI) accident, the Office of Nuclear Reactor Regulation developed the "TMI Action Plan" (NUREG-0660 and NUREG-0737) which 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," represents the NRC staff's long-term program for upgrading EOPs, and describes the use of a "Procedures Generation Package" (PGP) to prepare EOPs. Submittal of the PGP was made a requirement by Generic Letter 82-33, "Supplement 1 to NUREG-0737 - Requirements for Emergency Response Capability." The generic letter requires each licensee to submit to the NRC 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 describes the review of the Northern States Power Company (NSP) response to the generic letter related to development and implementation of EOPs (Section 7 of Generic Letter 82-33) for the Prairie Island Nuclear Generating Plant, Units 1 and 2 (Prairie Island).

Our review was conducted to determine the adequacy of the NSP program for preparing and implementing upgraded EOPs for Prairie Island. This review was based on NUREG-0800 (formerly NUREG-75/087), Subsection 12.5.2, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Section 2 of this evaluation briefly discusses the NSP submittal, the NRC staff review, and the acceptability of the submittal. Section 3 contains the conclusions of this review.

As indicated in the following sections, our review determined that the procedure generation program for Prairie Island has several items that must be satisfactorily addressed before the PGP is acceptable. NSP should address these items in a revision to the PGP or document justification for why such revision is 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 should not impact the schedule for the use of the EOPs. The revision should be made in accordance with the Prairie Island administrative procedures and 10 CFR 50.59.

2.0 EVALUATION AND FINDINGS

In a letter dated May 31, 1983, from David Musolf (NSP) to Director, Office of Nuclear Reactor Regulation (NRC), NSP submitted its PGP for Prairie Island. The PGP contained an introduction and several sections including:

- o Writing Procedures
- o Verification
- o Validation
- o Training.

The NRC staff conducted a preliminary review of the Prairie Island PGP, and identified its findings in a Request for Additional Information (RAI) which was forwarded to NSP in a letter dated May 11, 1984, from James R. Miller (NRC). NSP provided responses to the RAI items in a letter to NRC from David Musolf dated June 18, 1984. The NRC staff review of the Prairie Island PGP, including the response to the RAI items, is documented in the following subsections. The verification and validation program comments are combined in one subsection.

A. Plant-Specific Technical Guidelines (P-STG)

The P-STG program description was reviewed to determine if it described acceptable methods for accomplishing the objectives stated in NUREG-0899. NSP stated that the Westinghouse Emergency Response Guidelines (ERGs), Basic Revision, would be used for the initially drafted upgraded EOPs. NSP identified the following source documents for use in generating EOPs for Prairie Island.

- o Westinghouse ERGs
- o Updated Safety Analysis Report
- o Technical Specifications
- o Existing Emergency Procedures
- o Plant flow and logic diagrams.

Our review of the Prairie Island P-STG identified the following concerns:

1. The PGP should be expanded to include a description of the P-STG process (i.e., the adaptation of Westinghouse ERGs into Prairie Island EOPs). Appropriate items from the June 18, 1984, RAI response should be included.

2. The PGP states that the Basic Revision of the Westinghouse ERGs would be used to generate Prairie Island EOPs, and that as revisions are made to the Westinghouse ERGs, revisions will be made to the Prairie Island EOPs as appropriate.
 - a. The P-STG should commit to upgrading the Prairie Island EOPs using the Westinghouse Revision 1A ERGs, Low Pressure or High Pressure version as appropriate, as a technical basis.
 - b. The P-STG should state that all differences, including plant-specific means or set points, between the Westinghouse ERGs and the Prairie Island EOPs and the appropriate technical justification will be documented. The P-STG should further state that the safety significance of these differences will be determined; all safety-significant differences and their technical justification should then be included in the P-STG.

With adequate resolution of the above items, the Prairie Island plant-specific technical guidelines program should accomplish the objectives stated in NUREG-0899 and should provide adequate guidance for translating the Westinghouse ERGs into the Prairie Island EOPs.

B. Writer's Guide

The writer's guide was reviewed to determine if it described acceptable methods for accomplishing the objectives stated in NUREG-0899. The purpose of Prairie Island writer's guide is to provide administrative and technical guidance on the preparation of EOPs. It covers EOP designation and numbering, format, writing instructional steps, and mechanics of style. Our review of the Prairie Island writer's guide identified the following concerns:

1. Cautions and notes provide operators with critical or useful information concerning specific steps or sequences of steps in EOPs.
 - a. Section 4.3 should describe the methods that will be used to emphasize and differentiate cautions and notes in addition to referring procedure writers to the example in Figure 2.
 - b. Section 4.3 should state that each caution and note will be wholly contained on a single page, to ensure that the flow of information is uninterrupted.
 - c. Figure 2 shows an action step (a procedure transition) in the caution. As stated in Section 4.3, cautions or notes should not include any instructions, directions, or operator actions. Figure 2 should be revised accordingly.

- d. Section 4.3 should state that only the words CAUTION and NOTE will be presented in capitals and that the information in the body of the caution or note will be in standard mixed case. The overuse of capitalization will detract from emphasis throughout the EOP and text written in all capitals is more difficult to read than text written in mixed case. The example of a caution in Figure 2 should be revised accordingly.
 - e. Section 4.3 should state that each caution or note will contain only a single topic, as the importance of any one topic is obscured when a caution or note contains more than one topic.
2. Logic statements are used in EOPs to describe a set of conditions or a sequence of actions. Because of their importance and complexity, it is important to provide explicit guidance for their use.
- a. Section 4.2 states that OR will always be used in the inclusive sense, then discusses the exclusive OR in the next sentence. This section should be clarified (e.g., the sentence defining the use of the inclusive OR should state that "the inclusive OR will be indicated by the use of OR alone," and the sentence defining the exclusive OR should state that "To specify the exclusive OR, the following will be used:...") and appropriate examples should be provided.
 - b. Section 4.2, which discusses the logic term AND and a list format, should include an example of the list format to be used to join four or more conditions to ensure that procedures are consistently formatted.
 - c. Section 4.2 does not discuss the difference between conjunctions and logic terms. Furthermore, Figure 2 incorrectly presents OR as a logic term when, in fact, it is used as a conjunction. If the difference between the conjunctions "and" and "or" and the logic terms AND and OR is unclear, operators could mistake a conjunction for a logic term. Section 4.2 should specify the format of conjunctions and the examples should conform to the text.
 - d. Section 4.2 states that the use of AND and OR within the same action should be avoided. There are occasions when it is necessary to use AND and OR in the same sentence. Section 4.2 should provide guidance and an example of acceptable usage of AND and OR together.

3. Section 2.2.4 discusses functional restoration guidelines (FRGs) and critical safety functions. Critical Safety Function Status Trees (CSFSTs) are used in the ERGs to direct the operator to the appropriate FRG, but are not discussed in the writer's guide. The use and format of CSFSTs should be specified in the writer's guide and appropriate examples should be provided.
4. During the execution of EOPs it is often necessary to refer operators to other procedures or sections of procedures. Such referencing and branching can cause errors and unnecessary delays.
 - a. Section 4.6 should include a commitment to minimize the use of branching (where technical guidelines permit).
 - b. Section 4.6 provides an example of a branch; it should also provide the format of the branch to ensure that operators know where to start in the referenced procedure. As the example shows, the text should state that a branch will contain the key words "GO TO," the step number, the procedure title, and the procedure number.
 - c. Section 4.6 should provide the format to be used when referencing other procedures or steps. Operators must be able to quickly identify a reference to other steps within a procedure. Key words, such as "REFER TO," should be used to identify referencing, and the reference should contain the step number, the procedure title, and the procedure number. Examples should be provided that are consistent with the text.
 - d. Key words should be fully capitalized (e.g., REFER TO, GO TO) for emphasis.
 - e. The writer's guide should specify some method, such as tabbing, for easily identifying sections or subsections in the EOP, to help operators move rapidly from one part of the EOPs to another.
 - f. Figure 2 states that the right-hand column contains contingencies and transitions. Section 4.1 makes no mention of the use of transitions in either the left or right-hand column. Figure 2 and the text should be revised so they are consistent.
5. The proper use of emphasis techniques makes the procedures easier to understand.
 - a. Section 5.6 states that capitalization of abbreviations should be uniform. This section should include criteria for capitalization of both abbreviations and acronyms.

- b. Section 5.0 makes no mention of capitalization of actions in procedure steps, but the examples in Figure 2 include capitalization in Steps 1.a, 1.b, 1.b.1, 1.c, and 2.b. Similarly, Section 2.1 makes no mention of capitalization on the cover sheet, but Figure 1 is written primarily in caps. All of these examples should be revised to eliminate the overuse of capitalization, as the overuse of capitalization will detract from emphasis throughout the EOPs and text written in all capitals is more difficult to read than written in mixed case.
6. The proper use of vocabulary and syntax can create EOPs that are readily understood by operators. Simple, familiar, specific words most accurately convey the intended meaning.
 - a. Section 5.4 should specify that instructions in EOPs will be written as complete sentences, using a word order common to standard American English usage.
 - b. Section 5.4 instructs procedure writers to define key words that may be understood in more than one way. This section should be revised to instruct procedure writers to minimize the use of such words, particularly if their definition could be missed during procedure branching.
 - c. Adverbs such as "rapidly" or "slowly," or phrases such as "as appropriate" (used in Figure 2) are vague, do not describe specific actions, and should be included in a list of words to avoid. Alternately, these words can be used if they are appropriately qualified (e.g., cooldown RCS rapidly but less than 100°F/hr). The writer's guide should be modified accordingly.
 - d. A list of verbs, acceptable for use in the EOPs, and their definitions should be included in Section 5.4 and only those verbs should be used in EOPs.
 - e. Section 4.1 should state that instruction steps will be written as directives in the imperative mode.
 - f. Section 4.1 states that procedure steps "should deal with only one idea." Instruction steps which run actions together could be confusing to operators. Section 4.1 should state that procedure steps will contain only one action.
 - g. Section 5.3.4 notes that parentheses "should be used to indicate alternative items" and Section 4.2 indicates that the logic term OR shall be used to indicate alternatives. To be consistent with standard English usage and to minimize text complexity, all types of alternatives should be indicated by the use of the word "or."

7. Instructions should be written for various types of action steps that an operator may take to cope with different plant conditions.
 - a. Section 4.1 should address the definition and format of, and provide examples for; (1) verification steps, (2) equally acceptable steps, (3) recurrent steps, (4) time-dependent steps, (5) concurrent steps, and (6) diagnostic steps. See NUREG-0899, Section 5.7 for further information.
 - b. Section 4.1 should include a means by which operators are reminded to perform recurrent and time-dependent steps, as well as a means of letting operators know when the steps no longer apply.
 - c. Section 4.1 or Section 4.2 should include a commitment to present a single primary alternative in steps for which several alternatives are acceptable. The section should also discuss conditions for presenting other alternatives.
 - d. Section 3.3 should include a definition of high level steps as well as explicit instructions on how these steps should be written.
 - e. Wording a high-level step so that it sounds like an action step can mislead an operator. To avoid confusing the operators, high-level steps should be carefully worded. Lower-level steps should contain specific operator actions. For example, in Figure 2, high-level step 1, "Check RCS Average Temperatures" does not summarize the contingency actions in the right hand column. Section 3.3 should state that high-level steps will not contain operator actions if substeps are used.
8. To minimize confusion, delay, and errors in the execution of EOP steps, the following concerns should be addressed in the writer's guide:
 - a. Action steps should be structured so that they can be executed by the minimum control room staffing required by the facility Technical Specifications.
 - b. Action steps should be structured to be consistent with the roles and responsibilities of operators.
 - c. Action steps should be structured to minimize the movement of personnel in the control room (where technical guidelines permit).
 - d. Action steps should be structured to avoid unintentional duplication of tasks.

- e. Action steps should be structured to enable the control room supervisor to follow staff actions and monitor plant status.
9. Information should be presented so that interruptions in the flow of information are minimized.
 - a. Section 4.1 should state that each action step will be wholly contained on a single page. For those conditions where a step cannot be contained on a single page, the writer's guide should specify the format used to denote a step continuation and should state that the entire step number will be used on subsequent pages.
 - b. The text of the writer's guide does not discuss foldout pages, although the note in Figure 2 refers to a foldout page. Section 3.0 should specify the use and format of foldout pages (an alternative would be to place the information on the facing, left-hand, page of the procedure).
 - c. Section 3.0 should be revised to state that page rotation in the middle of an instruction will not be allowed as it makes the procedure difficult to follow, increases delays, and may lead to operator error.
 10. It is important that a consistent method of section heading and step numbering is used throughout EOPs. The manner in which the text is organized and divided should be evident through the use of headings and an alphanumeric numbering system, so that operators can keep track of where they are in the procedure and know how to move easily and quickly to other parts of the procedure.
 - a. Section 3.2 should describe a system of organization and headings to be used in the EOPs.
 - b. The step and substep numbering system described in Section 3.3 should be clarified. Procedure writers should be given adequate instruction and examples of how to write contingency actions for conditions which either directly correspond to or replace in total the expected action step(s).
 11. Acronyms and abbreviations used in EOPs should be understood easily and used consistently by operators. Section 5.6 should contain or reference an inclusive list of acceptable abbreviations, symbols, and acronyms to ensure consistency in the EOPs.

12. Figures and tables assist operators to make decisions and to locate information.
 - a. Section 4.9 should clarify what graphs, charts, tables, and figures will consist of, when they will be used, and where they will be located in the procedure. It is preferable to locate these operator aids in the procedure text, however, if they are large or are referred to in more than one step of the procedure they should be located at the end of the procedure steps.
 - b. Section 4.9 should be expanded to address such items as format, type style, and type size, and appropriate examples should be provided.
 - c. Section 4.9.2 should be revised to provide guidance regarding the use of titles when referring to figures and tables. The citation of Figure 1 does not include a title whereas the citation of Table 2 does include a title. The examples should be in accordance with the revised guidance.
13. It is important that the operators know where to find all of the instrumentation and controls that are referenced in the EOPs.
 - a. Section 4.7 states that "equipment, controls, and displays will be identified in operator language," but that these terms may not always match engraved names on panels. To ensure that an operator is able to easily recognize the referenced equipment or controls, the terms used in the EOPs should match panel engravings, or an approach should be adopted that allows common terms to be associated directly with the panel engravings (e.g., using common terms with the label information in parentheses).
 - b. Section 4.7 should provide an example of how to format location information consistent with the text.
14. Consistent, well-organized, and well-labelled EOPs increase the ease with which operators understand and use the procedures.
 - a. Section 2.1 specifies the elements to be included on the cover sheet. In addition to the descriptive title, this section should state that the cover sheet will contain the revision number, the revision date, the total number of pages, the review and approval signatures, the unit designation, and the facility designation. Figure 1, the example of a cover page, should be revised accordingly.

- b. Section 3.0 should specify that each procedure will include, in addition to the descriptive title, a statement of the scope of and a description of the entry conditions for the procedure.
 - c. Section 2.4 should state that each EOP page should also include the facility designation.
15. Place keeping aids can assist operators in keeping track of their location within a procedure. These aids are of particular importance when the operator performs steps or procedures concurrently, or when the operator's attention is diverted.
- a. Section 4.1 refers to "...a space provided for operator checkoff" when an instruction step involves "...an action verb relating to three or more objects..." Place keeping methods should allow for place keeping at any step or substep. The writer's guide should specify some type of place keeping system to be used for all action steps or substeps in the procedure text.
 - b. The writer's guide should provide examples consistent with the revised text.
16. Writers should be given sufficient information in the writer's guide to produce procedures that are consistently formatted.
- a. Section 5.0 should specify margins, line spacing, and pitch size requirements.
 - b. Section 5.3.1 states that brackets are not to be used. The writer's guide should describe how values for adverse containment conditions will be specified in the EOPs.
 - c. Section 5.5 states that acceptance values can "generally" be stated as limits. Section 4.1 states that limits should be expressed quantitatively "whenever possible." Both of these qualifications should be expanded to explain when EOP writers will not express acceptance values as limits, or will not express limits quantitatively in procedures. Examples of alternate acceptable methods should be provided.
 - d. Section 4.9.1 states that, in figures and tables, units of measure will accompany all observed, measured, or calculated numbers. The units of measure that are used in the text and in figures and tables should be familiar to operators, the units should correspond to units on instruments, and the units should not require any

conversions or mental manipulations. Sections 4.9 or 5.0 should state these three conditions on the usage of units of measure in the text and in printed operator aids.

- e. Figure 6 is intended to provide an example of an EOP page. It currently is a copy of a generic technical guideline page and contains several technical and human factors deficiencies. An example of a plant-specific EOP page that was prepared in accordance with the writer's guide should be used.
17. Because operators will use EOPs in stressful conditions and under time constraints, the procedures must be easily accessible to operators and should be uniquely identified to distinguish them from other plant procedures.
 - a. The PGP should include a description of where the EOPs will be located in the control room and how they will be used by operators.
 - b. The PGP should specify the quality of EOP copies. So that operators do not have difficulty reading EOPs, the quality of EOP copies (i.e., legibility, completeness, color) should equal the quality of the original procedure.
 - c. The PGP should describe a system that will ensure that the EOPs are promptly updated when changes occur in plant design, in Technical Specifications, in the technical guidelines, in the writer's guide, in the control room, or in other plant procedures that affect EOPs.
 18. Section 1.2 should include a statement of commitment to use the writer's guide in revising, as well as writing, all EOPs.

With adequate resolution of the above items, the Prairie Island writer's guide should accomplish the objectives stated in NUREG-0899 and should provide adequate guidance for translating the Westinghouse technical guidelines into EOPs that will be usable, 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. NSP states that verification will be conducted in order to assess the EOPs completeness, technical adequacy, and adherence to the intended structure of the guidelines, and that validation will be performed as part of the Control Room Design Review (CRDR) process. Our review of the Prairie Island verification and validation program description identified the following concerns:

1. The PSP should include a detailed description of the verification and validation program which NSP has committed to follow for all future EOPs, rather than a basic outline which briefly describes the verification and validation that occurred with the first set of EOPs. The program should represent NSP's plan for providing verification and validation on the current generation of Prairie Island's EOPs as well as for future generations of new and revised EOPs.
2. The program description should include an indication that the full complement of EOPs are verified and validated.
3. The verification and validation program should specify the types of personnel involved in the verification and validation process and their roles and responsibilities.
4. The validation program description states that table-top reviews, simulator exercises, and control room or simulator walk-throughs are used, but does not describe the conditions under which each method is used.
 - a. The validation program should be revised to state that plant-specific simulator exercises are the preferred validation method. The program should be expanded to include a description of the criteria that are used to select the scenarios to be run during the validation process. The criteria should be developed on the basis of what is needed to validate the procedures and should ensure that single, sequential, and concurrent failures are included.
 - b. A review of the capabilities and the limitations of the simulator should be completed to identify what can be validated on the simulator. For the parts of the EOPs that cannot be validated on the simulator, the validation program should describe the criteria for selecting additional validation that is needed and the methods to be used in that validation, such as a control room walk-through or a mock-up walk-through.
5. The verification and validation program should indicate that feedback from simulator exercises, control room walk-throughs, desk-top reviews, and operating team reviews are used to ensure the accuracy, readability, usability, and completeness of the EOPs. A plan for obtaining and using this feedback should be described.
6. It is necessary to verify and validate changes to EOPs, whether these changes result from the verification and validation program or from EOP revisions. RAI response 5.4 states that "Recommended changes will be processed in accordance with our normal plant administrative control directive for procedure control." The

verification and validation program should include a description of the plan for correcting and revising EOPs as a result of the verification and validation.

7. The verification and validation program should describe how the process accounts for the differences between Units 1 and 2.
8. The EOPs will require a certain number of operators to carry out the various activities and steps as specified. The validation program description should indicate that the EOPs are exercised, during simulator exercises or control room walk-throughs, with the minimum control room staff size required by the facility Technical Specifications.

With adequate resolution of the above items, the Prairie Island 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 and will guide the operator in mitigating emergency conditions.

D. Training Program

The description of the operator training program on the Prairie Island upgraded EOPs was reviewed to determine if it described acceptable methods for accomplishing the objectives stated in NUREG-0899. The training program addresses format familiarization and the scope of the procedures. Our review of the Prairie Island training program description identified the following concerns:

1. The PGP should include a detailed description of the training program which NSP has committed to follow for all future EOPs, rather than as a basic outline which briefly describes the training that occurred with the first set of EOPs. The program should represent NSP's plan for providing training on the current generation of Prairie Island's EOPs as well as for future generations of new and revised EOPs.
2. The training program description should state that, at the conclusion of training, trainees will meet the following objectives:
 - a. Trainees will understand the philosophy behind the approach to 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. 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. Trainees must 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. Trainees must be able to carry out an EOP successfully during transients and accidents.
3. The training program description states that simulator exercise will be used.
- a. The training program description should indicate the use of a wide variety of scenarios, including simultaneous and sequential failures, to fully exercise the EOPs on the plant-specific simulator, thus exposing the operators to a wide variety of EOP uses.
 - b. The training program description should be expanded to discuss the method used to train the operators in areas where the simulator does not react like the plant and in parts of the EOPs that cannot be run on the simulator. Under these situations, walk-throughs should be used for operator training. Classroom training is not an appropriate substitute for simulator or walk-through training.
 - c. The training program description should indicate that operators are trained to use the EOPs as a team and that each operator will be trained in the role that he or she would be expected to take in an actual emergency.
4. The training program should specifically state that all operators are trained on all EOPs and their revisions. This training should occur before EOPs, including revised EOPs, are implemented.
5. The training program should state that each operators' performance with the EOPs is evaluated after training; that evaluation will follow any training on revisions to the EOPs; and that evaluation will follow refresher training.

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

3.0 CONCLUSIONS

The staff concludes that, the PGP submitted by Northern States Power Company for the Prairie Island Nuclear Generating Plant Unit Nos. 1 and 2 in letters from David Musolf to the NRC, dated May 31, 1983 and June 18, 1984 should be reviewed to address the programmatic improvements outlined in Section 2 of this report. 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.

Principal Contributor: Greg S. Galletti

Date: September 19, 1989