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Checklist for Evaluating Emergency Procedures Used in Nuclear Power Plants

Prepared by R. L. Brune, M. Weinstein

HPT, Inc.

Sandia National Laboratories

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U.S. Nuclear Regulatory Commission

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ABSTRACT

This document describes a checklist to be used by U.S. Nuclear Regulatory Commission Office of Inspection and Enforcement inspectors during their evaluation of emergency procedures. The objective of the checklist is to aid inspectors in identifying characteristics of the procedures that can lead to operator performance deviations. Explanations of the procedures evaluation criteria comprising the checklist are provided. Methods of performing the evaluations are described and suggestions for applying the checklist to increase the effectiveness of the inspection process are made. A companion document, Development of a Checklist for Evaluating Emergency Procedures Used in Nuclear Power Plants, NUREG/CR-1970, SAND81-7070, describes the methodology used to develop the checklist and presents the study findings on which the procedures evaluation criteria are based.

ACKNOWLEDGEMENTS

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CHAPTER I

INTRODUCTION

U.S. Nuclear Regulatory Commission Office of Inspection and Enforcement (I & E) inspectors are currently responsible for evaluating plant operating procedures, including maintenance, test, calibration, and normal operating procedures* as well as the emergency procedures for which the checklist described in this report has been prepared. Furthermore, the evaluation of procedures is only one of many tasks that I & E inspectors must perform. It would require a very lengthy and cumbersome checklist to enable an inspector to identify all of the procedural deficiencies that can result in operator performance deviations. The resulting procedures evaluation process would be an extremely time-consuming task. In fact, the most thorough-going method for evaluating procedures would be to assess their compliance with a comprehensive, detailed procedures specification.

In contrast, the checklist presented in this document can be thought of as a screening device to aid inspectors in identifying the procedural deficiencies that are most important in terms of their impact on the quality of operator performance. The most important procedural deficiencies are those that have contributed to operator performance deviations. To identify these performance deviations, an analysis of 890 Licensee Event Reports (LERs) dealing with operator errors during the four-year period from 1975 through 1978 was performed. The specific kinds of errors that are amenable to procedures solutions were determined. Each of the procedures evaluation criteria comprising the checklist items is aimed at correcting one or more kinds of operator performance deviations. To further assist the inspectors to use their time efficiently, each checklist item is rated according to its probable impact upon the quality of operator performance. This feature allows the inspectors to make selective use of the checklist.

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*Brune, R.L. and Weinstein, M., Development of a Checklist For Evaluating Maintenance, Test, and Calibration Procedures Used in Nuclear Power Plants, NUREG/CR-1368, HPT Inc., Thousand Oaks, CA, May 1980.

Brune, R.L. and Weinstein, M., Procedures Evaluation Checklist for Maintenance, Test, and Calibration Procedures, NUREG/CR-1369, HPT Inc., Thousand Oaks, CA, May 1980.

Two procedures evaluation processes are described: 1) the Document Review Method consisting of a desk-top review of the emergency procedures and related documents, and 2) the Operator Walk-Through Method, consisting of observing an experienced operator simulate the tasks prescribed by the procedure and, in addition, making an assessment of the completeness of the symptoms and automatic actions information in the procedure by querying the operator. The appropriate evaluation process to use is identified for each item on the checklist.

The checklist is presented in Chapter II. Chapter III discusses the checklist and provides explanations of selected procedures evaluation criteria constituting the checklist items. Suggestions for using the checklist are described in Chapter IV. A companion document, Development of a Checklist for Evaluating Emergency Procedures Used in Nuclear Power Plants, NUREG/CR-1970, SAND81-7070, presents the study methodology and findings on which the checklist is based.

CHAPTER II

EMERGENCY PROCEDURE EVALUATION CHECKLIST

Procedure Title/No.____

Revision________Reviewed by__________________________Date__________

Review the procedure for each of the following characteristics. If it possesses the characteristic, check Yes; if it lacks the characteristic, check No. Check N/A (Not Applicable) if the characteristic does not apply to the procedure.

The ratings A, B, C, and D indicate the relative impact of a characteristic on the reliability of operator performance under various levels of stress. If a procedure is deficient in a characteristic rated A, performance deviations are most likely; if a procedure is deficient in a characteristic rated D, performance deviations are least likely.

Perform Document Review Evaluation for Items #1—#38.

Item	Rating	Yes	No	N/A
1. Does the title describe the emergency for which the procedure is provided?	C	___	___	___
2. Does each page provide the following identification information? 1. Procedure number and/or title 2. Date of issue 3. Revision number 4. Page number	D	___	___	___
3. Is the last page of the procedure clearly identifiable by marking, e.g., Page___of___; Final Page?	D	___	___	___
4. If this is a temporary procedure, is it clearly marked with the expiration date?	C	___	___	___
5. Do the immediate operator actions avoid referencing operators to other procedures for instructions?	B	___	___	___

Item	Rating	Yes	No	N/A
6. Are the titles and numbers of all referenced documents identified correctly? (If the procedure refers personnel to other procedures for instructional information, each reference must be evaluated as an independent procedure starting with Item #1 of the checklist.)	C	___	___	___
7. If this is a multiple unit site, does the procedure refer to one unit only?	B	___	___	___
8. If more than one person is required to perform the procedure, is the procedure written to one 'primary' user? That is, is it clear from the way that instructions are written that one person is responsible for coordinating the activity?	B	___	___	___
9. When communication between personnel is required, does the procedure specify how and to whom?	B	___	___	___
10. Does the procedure contain provisions for coordinating the activities of others? For example, is there a checklist for recording that someone has been directed to take an action and for recording that the action has been completed?	B	___	___	___
11. Does the procedure contain provisions for verifying that symptoms associated with the emergency were actually observed? For example, is there a checklist for recording that a symptom was observed?	B	___	___	___
12. Does the procedure contain provisions for verifying that automatic actions associated with the emergency were actually observed? For example, is there a checklist for recording that an automatic action was observed?	B	___	___	___
13. Does the procedure contain provisions for verifying that critical immediate operator actions performed from memory were actually performed? For example, is there a checklist for recording that an immediate action was performed?	B	___	___	___
14. Are the instructions typed in both upper and lower case letters (as conventionally used) as opposed to all upper case letters?	C	___	___	___
15. Are instructions written in short, concise, identifiable steps as opposed to multi-step paragraphs?	A	___	___	___

Item	Rating	Yes	No	N/A
16. Are steps that must be performed in a fixed sequence clearly identified to the user? For example, are the steps marked with asterisks or is the sequence marked "Mandatory" or "Step-by-Step", etc.?	B	___	___	___
17. If a step contains more than two objects of action, are they listed rather than imbedded in the sentence? For example, if an operator is directed to close three or more valves, they should be listed rather than strung out in a sentence.	B	___	___	___
18. If cautions are applicable to the performance of specific steps or series of steps, are they placed immediately ahead of the step(s) to which they apply?	B	___	___	___
19. Are cautions separate and easily discriminable in appearance from instructional steps? For example, are they enclosed in boxes, typed in bold face letters, headed with the word CAUTION, etc.?	B	___	___	___
20. Do cautions avoid the use of action statements? (Statements directing personnel to perform actions must not be imbedded in cautions. Cautions should be expressed in the passive voice.)	B	___	___	___
21. Are cautions provided to inform personnel when displays are based on secondary sensing modes?	A	___	___	___
22. If explanations, i.e., notes, are applicable to the performance of specific steps or series of steps, are they placed immediately ahead of the step(s) to which they apply?	C	___	___	___
23. Are explanations separate and easily discriminable in appearance from instructional steps? For example, are they enclosed in boxes, typed in bold face letters, headed with the word NOTE, etc.?	C	___	___	___
24. Do explanatory notes avoid the use of action statements? (Statements directing personnel to perform actions must not be imbedded in explanatory notes.)	B	___	___	___
25. Are acceptance criteria and limits expressed in quantitative terms when possible?	B	___	___	___
26. Are quantitative acceptance criteria and limits expressed as ranges as opposed to point values?	C	___	___	___
27. Are the acceptance criteria and limits compatible with the limits stated in requirements documents?	A	___	___	___

Item	Rating	Yes	No	N/A
28. Does the procedure provide instructions for all reasonable contingencies? For example, if equipment is operating outside the range specified by the procedure, is the operator instructed what action to take?	A	___	___	___
29. Are the contingencies provided for in the procedure based upon engineering failure analyses?	A	___	___	___
30. Are contingency instructions expressed so that the contingency precedes the action statement? For example, a contingency instruction should be written "If____, do___.", not "Do____ if____."	A	___	___	___
31. Are contingency instructions easy to understand? For example, if three or more contingencies must be met before action is directed, the contingencies should be listed separately from the action statement and ahead of the action statement.	A	___	___	___
32. If calculations are required, is space provided in the procedure to perform the computations and to record the results?	C	___	___	___
33. Are computations based on technically accurate, complete, and up-to-date formulas?	A	___	___	___
34. Are graphs, charts, and tables adequate for readability and interpolation or extraction of values?	A	___	___	___
35. Complexity Index (CI): Evaluate the complexity of the instructions by determining the average number of actions per step that the user is directed to perform. Use all steps to calculate the average. Is the average number of actions per step 1.5 or less?	B	___	___	___
36. Specificity Index (SI): Evaluate the level of specificity of the instructions by determining the percent of steps in the procedure that meet all of the following criteria. Use all steps in calculating the percent. 1. The action to be taken is specifically identified (open, close, rotate, etc.). 2. Limits are expressed quantitatively, e.g., 2 turns, 80 (75-85) in. lbs. 3. Equipment and parts are identified completely (HPCI-MO-17, etc.). Do 90% of the steps meet the above criteria?	B	___	___	___

Item	Rating	Yes	No	N/A
37. Do the alignment instructions in the procedure meet all of the following criteria? 1. Each item requiring alignment is individually specified. (It is not acceptable to refer personnel to previous steps.) 2. Each item is identified with a unique number or nomenclature. 3. The position in which the item is to be placed is specified. 4. The position in which the item is placed is verified.	B	___	___	___
38. If the procedure specifies an action that must be performed at a later time or repeated at periodic intervals, does it contain provisions for flagging the operator to perform the action? For example, if an action must be repeated every 15 minutes, are there spaces to record the times at which the action must be performed?	A	___	___	___

Perform Operator Walk-Through for Items #39—#46.

Item	Rating	Yes	No	N/A
39. Does the procedure identify all likely symptoms or combinations of symptoms associated with the emergency? (If an engineering analysis is not available, determine whether the operator can describe symptoms or combinations not identified by the procedure.)	A	___	___	___
40. Does the procedure specify automatic actions associated with the emergency adequately? (Determine whether the operator can describe automatic actions not specified by the procedure.)	A	___	___	___
41. Does the procedure specify all critical actions required to respond to the emergency? (Observe whether the operator performs critical actions not specified by the procedure.)	A	___	___	___
42. If the procedure contains sequence-critical actions, is the sequence specified by the procedure correct? (Observe whether the operator performs sequence-critical actions in the sequence specified.)	A	___	___	___

Item	Rating	Yes	No	N/A
43. Does the procedure allow enough time to perform time-critical actions? (Observe whether the operator can perform time-critical actions in the time allowed, i.e., by equipment response, distances involved, etc.)	A	___	___	___
44. Are equipment numbers and/or nomenclature used in the procedure identical to those displayed on the equipment?	B	___	___	___
45. If the answer to Item #44 is Yes, is equipment nomenclature typed in upper case letters in the procedure?	C	___	___	___
46. Does the procedure identify the location of each item of equipment adequately? (Observe whether the operator can locate switches, gauges, etc. in a timely manner.)	A	___	___	___

Action: ____

____

____

Disposition: ____

____

____

CHAPTER III

DISCUSSION OF CHECKLIST

The checklist has several features that serve to promote the efficiency with which it can be employed. They are described below.

Format of Checklist Items

All of the checklist items are written so that they can be answered Yes, No, or Not Applicable. They are uniformly phrased so that a Yes answer is a positive evaluation. That is, a Yes answer indicates that the procedure possesses a desirable attribute and a No answer means that it lacks a desirable attribute. Not Applicable means the attribute is not relevant to the procedure. For example, a procedure cannot be evaluated regarding the accruacy with which it identifies referenced documents if it does not refer to other documents.

Weighting of Checklist Items

The checklist items are rated A, B, C, or D. These ratings indicate the relative impact of the characteristic described in the item on the reliability of operator performance. The relative magnitude of impact under various levels of stress is shown in the table below.

	Probability of Performance Deviation Under:		
Rating	Low Stress*	Moderate Stress*	High Stress*
A	Moderate	High	High
B	Moderate	Moderate	High
C	Low	Moderate	Moderate
D	Low	Low	Moderate

*These terms are defined with descriptions and examples in Swain, A.D. and Guttmann, H.E., Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications, NUREG/CR-1278, United States Nuclear Regulatory Commission, Washington, D.C., October 1980.

Each checklist item is rated to convey to the inspectors its relative value in reducing the frequency of performance deviations reported in LERs. These ratings, integrated with an inspector's own judgment of the level of stress likely to be associated with a particular emergency condition and knowledge of the consequences of error associated with the performance of a specific procedure or action, should enable the inspector to assess the importance of correcting a particular procedural deficiency.

Evaluation Methods

The checklist items are grouped according to the evaluation method to be employed in reviewing a procedure for the characteristics described by the items. Two different evaluation methods are prescribed in the checklist; the Document Review Method and the Operator Walk-Through Method.

Document Review Method

The evaluation of a procedure on Items #1 through #38 is accomplished by means of a desk-top document review. This method consists of obtaining the procedures of interest and their related documents and evaluating them with respect to the criteria contained in these items. Typically, related documents consist of: 1) drawings, procedures, schematics, etc. specifically referenced by the procedure, and 2) technical specifications, Final Safety Analysis Reports (FSARs), and other basic requirements documents that affect the content of the procedures. In some cases, it might be necessary to examine corporate policies and station directives having an impact on procedures contents. For example, valve alignment, logging, and tagging activities might be described in a directive rather than a procedure. The inspector should review the documents describing these processes in order to determine whether or not any of this information should be contained in the emergency procedure itself rather than in a less immediately accessible document.

These documents in combination comprise the information system affecting the content of procedures and, consequently, the performance of emergency responses. If an inspector cannot evaluate a procedures characteristic from the available documents alone when a document review is specified by the checklist, it can be assumed that the information system is deficient with respect to completeness or with respect to organization. Either deficiency will affect the quality of procedural content adversely.

Operator Walk-Through Method

Items #39 through #46 are evaluated by means of an operator walk-through of the procedure. The performance of this evaluation requires the direct support of a senior reactor operator. The objective of this method is to judge whether or not the amount and kind of information provided by the procedure is complete with respect to the information needs of the operators. That is, the inspector seeks to evaluate the adequacy of the "level of detail" of the procedure. This attribute of a procedure is the most difficult of all procedural characteristics to evaluate. Judgments of adequacy of level of detail are based on assumptions about the qualifications of the personnel for whom the procedure is provided. Such assumptions are often tenuous at best because of the wide differences between groups of operators with respect to training for emergencies and the relatively unknown effects of these differences in training.

Partial evidence of the completeness or level of detail of a procedure can be obtained with the assistance of an experienced operator. The operator must perform a walk-through of the procedure, simulating the actions specified in the instructions. During this process, the completeness of the symptoms and automatic actions sections of the procedure can be determined insofar as possible by means of discussions with the operator.

The technical accuracy of the procedure can be ascertained for the most part only by means of engineering analyses. The walk-through can address a limited number of procedural characteristics for accuracy. For example, some evaluations, such as determining the correspondence between equipment nomenclature or identification numbers used in a procedure and the nomenclature or numbers actually displayed on equipment, can be performed by walking through the facility with the procedure in hand and comparing the two. During the walk-through it might also be desired to make selected human factors observations of the work environment, the facility layout and the equipment, all of which bear upon the effectiveness and safety of personnel performance. For example, the inspector might wish to assess the readability of legends and displays from the perspective of the person performing the procedure. Also, distances between operator stations and control positions should be noted to evaluate the efficiency of task sequences and their compatibility with job requirements such as imposed by time-critical tasks.

Explanation of Checklist Items

This section lists the procedures evaluation criteria in the same sequence in which they appear on the checklist. In cases where the relationship between a criterion and the quality of human performance might not be apparent, an explanation is provided.

1. Does the title describe the emergency for which the procedure is provided?

Explanation. Several LERs have occurred because operators selected and used a wrong procedure to perform an activity. The use of descriptive titles will increase the probability of selecting the correct procedure.

2. Does each page provide the following identification information?
    1. Procedure number and/or title
    2. Date of issue
    3. Revision number
    4. Page number

Explanation. None.

3. Is the last page of the procedure clearly identifiable by marking, e.g., Page____of____; Final Page, Last Page?

Explanation. The last page of a procedure is most vulnerable to becoming detached and lost. It should be made obvious to the user if the last page is missing.

4. If this is a temporary procedure, is it clearly marked with the expiration date?

Explanation. None.

5. Do the immediate operator actions avoid referencing operators to other procedures for instructions?

Explanation. One of the most frequently voiced complaints of operators about procedures is the overuse of references to other procedures for instructional information. In some cases the other procedures may not be obtained and used. To ensure the ready availablility of information for the learning and performance of immediate operator actions, all critical information should be provided by one procedure only.

6. Are the titles and numbers of all referenced documents identified correctly? If the procedure refers personnel to other procedures for instructional information, each reference must be evaluated as an independent procedure starting with Item #1 of the checklist.

Explanation. None.

7. If this is a multiple unit site, does the procedure refer to one unit only?

Explanation. The practice of providing one procedure containing multiple sets of equipment identification numbers for use with two or more units is quite common. This practice increases the difficulty of reading and comprehending the procedure, particularly during stressful circumstances. It also increases the probability of performing a procedure on the wrong unit.

8. If more than one person is required to perform the procedure, is the procedure written to one 'primary' user? That is, is it clear from the way that instructions are written that one person is responsible for coordinating the activity?

Explanation. The findings from the several TMI-2 studies underlined the need for more structured coordination of crew responses to emergencies. The study on which the checklist is based disclosed considerable variability among plants and among shift supervisors within a given plant with respect to training and skills in coordinating crew responses. Procedural formats to structure multi-man activities have been developed and used effectively for many years. The application of a similar procedural structure to nuclear power plant emergency procedures would reduce the number of errors in communication and in omissions of actions that currently result from relatively unstructured, uncoordinated crew responses. Because the emergency procedures are used for training as well as on-the-job application, they could also contribute to the development of relevant skills.

9. When communication between personnel is required, does the procedure specify how and to whom?

Explanation. See explanation for Item #8.

10. Does the procedure contain provisions for coordinating the activities of others? For example, is there a checklist for recording that someone has been directed to take an action and for recording that the action has been completed?

Explanation. High-stress conditions are conducive to errors in communications and omission of actions, particularly when the activities of several individuals, sometimes remote from each other, must be coordinated. A checklist or other device will aid in the early detection of these errors.

11. Does the procedure contain provisions for verifying that symptoms associated with the emergency were actually observed? For example, is there a checklist for recording that a symptom was observed?

Explanation. See explanation for Item #13.

12. Does the procedure contain provisions for verifying that automatic actions associated with the emergency were actually observed? For example, is there a checklist for recording that an automatic action was observed?

Explanation. See explanation for Item #13.

13. Does the procedure contain provisions for verifying that critical immediate operator actions performed from memory were actually performed? For example, is there a checklist for recording that an immediate action was performed?

Explanation. The observation of symptoms and automatic actions and the performance of immediate operator actions are typically accomplished before a procedure is obtained. As a result, reliance must be placed upon operator memory (unless automatic recording equipment is available and operable) to reconstruct the course of an event. The checklists are intended to enable the operators to record the occurrence of symptoms, automatic actions, and immediate operator actions directly after obtaining the procedure and before stress further degrades accurate recall. The checklists enhance the detection of errors of omission.

14. Are the instructions typed in both upper and lower case letters (as conventionally used) as opposed to all upper case letters?

Explanation. Studies have shown that conventional printing can be read faster and more accurately than text printed entirely in upper case lettering. In addition, upper case lettering in the body of the text should be reserved for equipment nomenclature to aid in detecting references to equipment.

15. Are instructions written in short, concise, identifiable steps as opposed to multi-step paragraphs?

Explanation. Studies have shown that the speed of reading and the comprehension of written instructions are improved if the instructions are presented in short, concise sentences. Ideally, an instruction should consist of an action verb and the object of the action—plus action limits and object identifiers, and, if necessary, object locators. Additional information, such as that contained in explanations and descriptions, that is intended to aid the user to accomplish the action more effectively should ordinarily be presented in the form of a note preceding the action instruction.

16. Are steps that must be performed in a fixed sequence clearly identified to the user? For example, are the steps marked with asterisks or is the sequence marked "Mandatory" or "Step-by-Step", etc.?

Explanation. By its very nature, a written procedure presents steps in a sequence. In many cases, the actions can be performed in a variety of sequences to accomplish the same operation. In some operations, however, the sequence in which the actions are performed is critical. That is, only a single sequence of actions will result in acceptable accomplishment of the operation. Yet, the study team encountered only one plant in which sequence-critical steps were identified. As a result, the operators are generally required to make this distinction—even in high-stress conditions. A related consequence is that inspectors or other personnel cannot assess operator knowledge of sequence-critical operations. Identification of sequence-critical steps would aid operator training and performance evaluation.

17. If a step contains more than two objects of action, are they listed rather than imbedded in the sentence? For example, if an operator is directed to close three or more valves, they should be listed rather than strung out in a sentence.

Explanation. This format (tabular or columnar) can be read faster and more accurately than conventional sentence structure. For example:

This		Not This
Open following valves:		Open valves XXU, XXV, XXW, XXX, XXY, and XXZ.
XXU	XXX	
XXV	XXY	
XXW	XXZ	

18. If cautions are applicable to the performance of specific steps or series of steps, are they placed immediately ahead of the step(s) to which they apply?

Explanation. Instructional information must be presented in the order in which it is needed. If the user needs cautionary information before performing a specific action, it must be presented before the statement directing the action. Otherwise, there is a high probability that the action will be performed without the cautionary information being taken into consideration.

19. Are cautions separate and easily discriminable in appearance from instructional steps? For example, are they enclosed in boxes, typed in bold face letters, headed with the word CAUTION, etc.?

Explanation. None.

20. Do cautions avoid the use of action statements? (Statements directing personnel to perform actions must not be imbedded in cautions. Cautions should be expressed in the passive voice.)

Explanation. Cautions should not be expressed in terms of directing users to take or not take actions. Instead, the cautions should describe the conditions or consequences of actions. The passive voice should be used. All actions should be directed in the instructional steps only. Failure to observe this rule consistently will result in the overlooking of critical actions by the operators.

21. Are cautions provided to inform personnel when displays are based on secondary sensing modes?

Explanation. In the TMI-2 event, individuals interpreted a display of switch position as if it were a display of valve position. An optimum solution to this human factors problem is to replace secondary sensing systems with primary sensing systems. A less effective, but readily available, solution is to insert cautions or notes in procedures to identify displays based on secondary sensing.

22. If explanations, i.e., notes, are applicable to the performance of specific steps or series of steps, are they placed immediately ahead of the step(s) to which they apply?

Explanation. See explanation for Item #18.

23. Are explanations separate and easily discriminable in appearance from instructional steps? For example, are they enclosed in boxes, typed in bold face letters, headed with the word NOTE, etc.?

Explanation. None.

24. Do explanatory notes avoid the use of action statements? (Statements directing personnel to perform actions must not be imbedded in explanatory notes.)

Explanation. See explanation for Item #20.

25. Are acceptance criteria and limits expressed in quantitative terms when possible?

Explanation. In this and other studies, reactor operators have expressed a need for more quantitative limits in procedures. It has also been found that operators vary among themselves with regard to their interpretation of qualitative modifiers, e.g., slow, fast, rapidly. Finally, high-stress conditions can distort an individual's perception of slow, fast, etc. Use of quantified limits will promote standardization of responses.

26. Are quantitative acceptance criteria and limits expressed as ranges as opposed to point values?

Explanation. When equipment does not permit the setting of point values, or when a range of values is acceptable, the acceptance criteria should be expressed in terms of ranges. However, they should be expressed in a form to avoid errors of addition, subtraction, or conversion. Example:

Preferable	Not Preferable
______ to ______	______ $\pm$ ______
(Best) ______ (__________ — __________)	______ $\pm$ ______ %(Worst)
midpoint lower limit upper limit	

27. Are the acceptance criteria and limits compatible with the limits stated in requirements documents?

Explanation. None.

28. Does the procedure provide instructions for all reasonable contingencies? For example, if equipment is operating outside the range specified by the procedure, is the operator instructed what action to take?

Explanation. Many procedures are written as though all acceptance criteria and limits will be met. They do not address the exceptions. In the study on which the checklist is based, it was found that the procedures preceded by a formal engineering analysis covered 4.5 times as many contingencies as the emergency procedures that were not derived from engineering analyses. The implication of this finding is that the typical emergency procedure is probably incomplete with respect to contingency information. If the inspector finds that no engineering analysis was performed, the completeness of the procedure is doubtful. It is impractical for the inspector to perform an engineering analysis of the magnitude required to identify all contingencies that can be reasonably expected. Therefore, it may be necessary to make a partial evaluation of the procedure with the aid of the control room operating staff using an approach similar to the walk-through process described for evaluating Items #39 through #42.

29. Are the contingencies provided for in the procedure based upon engineering failure analyses?

Explanation. See explanation for Item #28.

30. Are contingency instructions expressed so that the contingency precedes the action statement? For example, a contingency instruction should be written "If_____, do_____.", not "Do_____ if_____."

Explanation. If the action instruction precedes the contingency statement, there is an increased probability that the operator will perform the action before reading the qualifying condition.

31. Are contingency instructions easy to understand? For example, if three or more contingencies must be met before action is directed, the contingencies should be listed separately from the action statement and ahead of the action statement.

Explanation. Frequently, the instruction to perform an action depends upon the presence of several conditions or combinations of conditions. In these instances the majority of the procedures reviewed provided this information in lengthy, hard-to-understand sentences. Essential contingency information could be overlooked or misinterpreted in complex sentences, particularly during high-stress conditions conducive to the impairment of comprehension. A tabular or columnar format promotes ease of comprehension. Example:

This	Not This
If any of the following conditions exist: __________ __________ __________, do__________.	If________or__________ or_________exist, do______.

32. If calculations are required, is space provided in the procedure to perform the computations and to record the results?

Explanation. This provision is intended to increase the accuracy of performing calculations and to facilitate verification of the results by others.

33. Are computations based on technically accurate, complete, and up-to-date formulas?

Explanation. None.

34. Are graphs, charts, and tables adequate for readability and interpolation or extraction of values?

Explanation. Misinterpretation of graphs, charts, and tables has resulted in performance errors. It is often traceable to poor readability of these materials—which, in turn, is attributable to 1) inadequate original construction, or 2) inadequate reproduction. The following guidelines are provided to evaluate readability.

Original construction. Letters and numbers should be typed rather than handwritten. Lines on graph paper should be reproducible on licensee reproduction equipment. On graphs, units of measurement used in plotted values should be compatible with divisions on graph paper. That is, if plotted values progress in units of five, e.g., 5, 10, 15, etc., it is better to separate the values by five lines than by four lines. To facilitate accuracy of locating values in charts and tables, look for such aids as 1) partitioning tables with lines, 2) arranging values in subgroups, e.g., inserting spaces between subgroups of five values, and 3) placing connecting lines between values or between nomenclature and values.

Reproduction. In some cases, copies are so many generations removed from the original or master copy that lines in graphs, charts, and tables have deteriorated or disappeared, making it difficult to track or interpolate values. Letters and numbers can undergo similar deterioration. Also, materials have sometimes been reduced in size so that readability is impaired. Letters and numbers should be at least 1/8 in. in height, unbroken and unfilled. All lines in the reproductions should be as visible as they are in the orginal master copies. First, compare the reproductions to the original or master copies. Then, evaluate the readability of the reproductions under the conditions of illumination in which personnel use them.

35. Complexity Index (CI): Evaluate the complexity of the instructions by determining the average number of actions per step that the user is directed to perform. Use all steps in calculating the average. Is the average number of actions per step 1.5 or less?

Explanation. The complexity index (CI) of a procedure is defined as the average number of actions stated in the instructional steps or paragraphs. The average is computed by sampling all steps or paragraphs in a procedure.

$$CI = \frac{\text{Number of Actions in Procedure}}{\text{Number of Steps or Paragraphs in Procedure}}$$

The greater the number of actions that are directed by a step, the more likely an action is to be overlooked or forgotten. Ideally, a step should contain only one action unless the actions are related, in which case up to three actions are acceptable. Related actions are actions that, in combination, accomplish a single end-result. In the example of related actions shown below, the single result is an adjusted volume.

Example of Three Related Actions (Acceptable):

"5. Start pump PL-16. Observe gauge WL-16. When level is 62 (60-64) in., stop pump."

Example of Two Unrelated Actions (Not Acceptable):

"8. Close switch LAC-1781. Close valve HVC-23."

36. Specificity Index (SI): Evaluate the level of specificity of the instructions by determining the percent of steps in the procedure that meet all of the following criteria. Use all steps in calculating the percent.
    1. The action to be taken is specifically identified (open, close, rotate, etc.).
    2. Limits are expressed quantitatively, e.g., 2 turns, 80 (75-85) in. lbs.
    3. Equipment and parts are identified completely (HPCI-MO-17, etc.).

    Do 90% of the steps meet the above criteria?

Explanation. The above criteria list the basic characteristics of a specific (versus general) instruction. Fewer errors of interpretation or omission result from instructions with high specificity.

37. Do the alignment instructions in the procedure meet all of the following criteria?
    1. Each item requiring alignment is individually specified. (It is not acceptable to refer personnel to previous steps.)
    2. Each item is identified with a unique number or nomenclature.
    3. The position in which the item is to be placed is specified.
    4. The position in which the item is placed is verified.

Explanation. Two of the primary contributors to misalignment are lack of specificity of instructions and lack of physical verification of position. The criteria listed above are aimed at improving specificity and verification. In some procedures, it was found that instructions were adequate for initial alignment but shortchanged realignment by simply directing personnel to "Reposition valves listed in Step 5." In this instance, personnel were not provided a means within the procedure for verifying valve position. The instruction should have relisted the valves, their new positions, and provided signoff for each valve.

38. If the procedure specifies an action that must be performed at a later time or repeated at periodic intervals, does it contain provisions for flagging the operator to perform the action? For example, if an action must be repeated every 15 minutes, are there spaces to record the times at which the action must be performed?

Explanation. Some emergency procedures require that an action such as checking a pressure or flowrate be performed at set intervals, e.g., every 15 minutes. In the past, failure to observe timing requirements has resulted in LERs describing overflows, excessive draining, etc. Provisions within the procedure for recording times at which time-critical actions must be performed will enable operators to comply with timing requirements more consistently and more accurately.

39. Does the procedure identify all likely symptoms or combinations of symptoms associated with the emergency? (If an engineering analysis is not available, determine whether the operator can describe symptoms or combinations not identified by the procedure.)

Explanation. See explanation for Item #41.

40. Does the procedure specify automatic actions associated with the emergency adequately? (Determine whether the operator can describe automatic actions not specified by the procedure.)

Explanation. See explanation for Item #41.

41. Does the procedure specify all critical actions required to respond to the emergency? (Observe whether the operator performs critical actions not specified by the procedure.)

Explanation. Items #39, #40, and #41 deal with the completeness of an emergency procedure. As described earlier (see explanation for Item #28), the completeness of a procedure is a function of the quality of the engineering analyses on which the procedure is based. It is likely that, in many cases, the inspector will find that no engineering analyses were performed as part of the development of the procedure being evaluated. It is also possible that some of the analyses that were performed were inadequate. Study findings comparing the amount of contingency information in procedures not derived from engineering analyses against procedures derived from engineering analyses (see Item #28) underline this possibility. The inspector is not in a position to perform engineering analyses to determine the completeness of the information in a procedure. However, a partial evaluation can be made with a relatively small investment of time with the assistance of members of the operating staff. Discussions with and observations of experienced operators performing a walk-through of the procedure should disclose procedural omissions of highest probability events.

42. If the procedure contains sequence-critical actions, is the sequence specified by the procedure correct? (Observe whether the operator performs sequence-critical actions in the sequence specified.)

Explanation. The inspector will encounter some procedures in which sequences of actions are not critical and other procedures in which sequences are critical to successful accomplishment of an operation. In many cases, the licensee will not make this distinction obvious. As a first step, the licensee should be required to identify sequence-critical steps. The inspector can then determine the accuracy of the sequences as part of the walk-through evaluation process.

43. Does the procedure allow enough time to perform time-critical actions? (Observe whether the operator can perform time-critical actions in the time allowed, i.e., by equipment response, distances involved, etc.)

Explanation. Some actions specified in emergency procedures are time-critical. Time-critical steps should be identified by the licensee along with the time allowed to perform a step or the time allowed to intervene between steps. The inspector should then determine whether or not the operator or crew of operators can perform these steps within the allowed time limits.

44. Are equipment numbers and/or nomenclature used in the procedure identical to those displayed on the equipment?

Explanation. None.

45. If the answer to Item #44 is Yes, is equipment nomenclature typed in upper case letters in the procedure?

Explanation. It is a technical writing practice to print equipment nomenclature in capital letters. Use of this guideline enables personnel to locate and identify procedural references to equipment quickly. It also informs personnel that this is the nomenclature displayed on the equipment itself.

46. Does the procedure identify the location of each item of equipment adequately? (Observe whether the operator can locate switches, gauges, etc. in a timely manner.)

Explanation. Findings from TMI-2 and other studies suggest that procedures sometimes fail to provide enough location information to the operators. This deficiency can be particularly serious in an emergency during which search time might be limited. Emergency procedures should be evaluated for this characteristic as part of the walk-through.

CHAPTER IV

APPLICATION OF CHECKLIST

The checklist can be applied to serve either or both of two distinctly different purposes. They are:

1. to identify deficiencies in a sample of procedures with the objective of correcting the deficiencies in that specific sample of procedures, and/or
2. to identify deficiencies in a sample of procedures with the objective of correcting the process that produced the deficient procedures.

In the first case, the inspector is basically performing the function of an editor, and, as a result, the impact of the inspection process will be confined to the procedures being evaluated. The rate at which existing procedures are modified and new procedures are prepared far outpaces the rate at which they can be evaluated by inspectors. Therefore, if only changes in identified deficiencies are sought, the objective of improving the effectiveness and safety efficiency of the inspection process will not be attained.

In the second case, the impact of the inspector on the quality of licensee procedures will be maximized. Here, the procedures are viewed primarily as indicators of the quality of the procedures development process. Although the inspector should also seek to have the specific procedures that are reviewed corrected, the main objective of the inspection is to determine the overall quality of the licensee's procedures development process. If the samples of procedures exhibit particular deficiencies in common with each other, a change in the process used by the licensee to prepare or revise procedures, or a change in the licensee's specification governing the format or content of the procedures is required. This kind of corrective action, coupled with periodic inspections, will effectively improve the quality of all of the emergency procedures, rather than just the procedures selected for review. If the checklist is used in this manner, the objective of improving the effectiveness and safety efficiency of the inspection process will be advanced.

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16. ABSTRACT (200 words or less)

This document describes a checklist to be used by U.S. Nuclear Regulatory Commission Office of Inspection and Enforcement inspectors during their evaluation of emergency procedures. The objective of the checklist is to aid inspectors in identifying characteristics of the procedures that can lead to operator performance deviations. Explanations of the procedures evaluation criteria comprising the checklist are provided. Methods of performing the evaluations are described and suggestions for applying the checklist to increase the effectiveness of the inspection process are made. A companion document, Development of a Checklist for Evaluating Emergency Procedures Used in Nuclear Power Plants, NUREG/CR-1970, SAND81-7070, describes the methodology used to develop the checklist and presents the study findings on which the procedures evaluation criteria are based.

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NUREG/CR-2005
SAND81-7074
Rev. 1

Checklist for Evaluating Emergency Operating Procedures Used in Nuclear Power Plants

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HPT, Inc.

Sandia National Laboratories

Prepared for
U.S. Nuclear Regulatory Commission

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Checklist for Evaluating Emergency Operating Procedures Used in Nuclear Power Plants

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ABSTRACT

This document describes a checklist to be used by U.S. Nuclear Regulatory Commission (NRC) Office of Inspection and Enforcement inspectors during their evaluation of emergency operating procedures. The objective of the checklist is to aid inspectors in identifying characteristics of the procedures that can lead to operator performance deviations. Explanations of the procedures evaluation criteria comprising the checklist are provided. Methods of performing the evaluations are described and suggestions for applying the checklist to increase the effectiveness of the inspection process are made. A companion document, Development of a Checklist for Evaluating Emergency Procedures Used in Nuclear Power Plants, NUREG/CR-1970, describes the methodology used to develop the checklist and presents the study findings on which the procedures evaluation criteria are based.

Revision 1 of the checklist, presented herein, is the result of a one-year field test by NRC inspectors in all five NRC regions. It incorporates improvements that were suggested by inspectors based on their experience with the checklist in performing evaluations of licensee procedures.

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CONTENTS

CHAPTER I

INTRODUCTION

U.S. Nuclear Regulatory Commission Office of Inspection and Enforcement (I & E) inspectors are currently responsible for evaluating plant operating procedures, including maintenance, test, calibration, and normal operating procedures* as well as the emergency operating procedures for which the checklist described in this report has been prepared. Furthermore, the evaluation of procedures is only one of many tasks that I & E inspectors must perform. It would require a very lengthy and cumbersome checklist to enable an inspector to identify all of the procedural deficiencies that can result in operator performance deviations. The resulting procedures evaluation process would be an extremely time-consuming task. In fact, the most thorough-going method for evaluating procedures would be to assess their compliance with a comprehensive, detailed procedures format specification and applicable emergency operating procedures technical guidelines.

In contrast, the checklist presented in this document can be thought of as a screening device to aid inspectors in identifying the procedural deficiencies that are most important in terms of their impact on the quality of operator performance. The most important procedural deficiencies are those that have contributed to operator performance deviations. To identify these performance deviations, an analysis of 890 Licensee Event Reports (LERs) dealing with operator errors during the four-year period from 1975 through 1978 was performed. The specific kinds of errors that are amenable to procedures solutions were determined. Each of the procedures evaluation criteria comprising the checklist items is aimed at correcting one or more kinds of operator performance deviations. To further assist the inspectors to use their time efficiently, each checklist item is rated according to its probable impact upon the quality of operator performance. This feature allows the inspectors to make selective use of the checklist.

Two procedures evaluation processes are described: 1) the Document Review Method consisting of a desk-top review of the emergency procedures and related documents, and 2) the Operator Walk-Through Method, consisting of observing an experienced operator simulate the tasks prescribed by the procedure and, in addition, making an assessment of the completeness of the symptoms and automatic actions information in the procedure by querying the operator. The appropriate evaluation process to use is identified for each item on the checklist.

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*Brune, R.L. and Weinstein, M., Development of a Checklist For Evaluating Maintenance, Test, and Calibration Procedures Used in Nuclear Power Plants, HPT Inc. and Sandia National Laboratories, NUREG/CR-1368, U.S. Nuclear Regulatory Commission, Washington, DC, May 1980.

Brune, R.L. and Weinstein, M., Procedures Evaluation Checklist for Maintenance, Test, and Calibration Procedures, HPT Inc. and Sandia National Laboratories, NUREG/CR-1369, Revision 1, U.S. Nuclear Regulatory Commission, Washington, DC, September 1982.

After it was completed, the checklist was distributed to the NRC regional offices for a field test by NRC inspectors who used it in evaluating licensee emergency operating procedures. As a result of inspector experiences with the checklist in field situations, the regional offices suggested a number of changes in its content and application. Their suggestions have been incorporated in Revision 1 of the checklist, described herein, resulting in an improved checklist and a more efficient procedure evaluation process.

The checklist is presented in Chapter II. Chapter III discusses the checklist and provides explanations of selected procedures evaluation criteria constituting the checklist items. Suggestions for using the checklist are described in Chapter IV. A companion document, Development of a Checklist for Evaluating Emergency Procedures Used in Nuclear Power Plants, NUREG/CR-1970, SAND81-7070, presents the study methodology and findings on which the checklist is based.

CHAPTER II

EMERGENCY OPERATING PROCEDURE EVALUATION CHECKLIST

Procedure Title/No.____

Revision__________Reviewed by__________________________Date__________

Review the procedure for each of the following items. If it possesses the characteristic described in the item, check Yes; if it lacks the characteristic, check No. Check N/A (Not Applicable) if the characteristic does not apply to the procedure. An example given in a checklist item is only one way of meeting the evaluation criterion and should not be interpreted as the only way of meeting the criterion.

The ratings A, B, C, and D indicate the relative impact of a characteristic on the reliability of operator performance under various levels of stress. They are described as follows:

A - Errors are likely to occur during low stress (normal) operating conditions and will occur frequently under moderate and high stress conditions.

B - Errors are likely to occur during low and moderate stress conditions and will occur frequently under high stress conditions.

C - Errors are not very likely under low stress but could occur readily under moderate and high stress conditions.

D - Errors are not very likely to occur under low and moderate stress but could occur readily during high stress conditions.

Perform Document Review Evaluation for Items #1 - #41.

Item	Rating	Yes	No	N/A
1. Is the procedure format consistent for all emergency operating procedures?	C	___	___	___
2. Are page margins adequate?	C	___	___	___
3. Is the title short and descriptive of the emergency condition or purpose for which the procedure is applicable?	C	___	___	___
4. If the purpose of the procedure is not clear from the title, is there a statement of scope or purpose?	C	___	___	___

Item	Rating	Yes	No	N/A
5. Does the procedure cover or first page provide the following identification information? a. Title b. Procedure number c. Revision number and date d. Unit number (if applicable) e. Approval signature and date f. Number of pages	D	___	___	___
6. If this is a multiple unit site, does the procedure refer to one unit only and is it readily identifiable to that unit?	B	___	___	___
7. Does each page provide the following identification information? a. Title or number b. Revision number and date c. Unit number (if applicable) d. Page___ of ___	D	___	___	___
8. Is the location of page identification information consistent?	D	___	___	___
9. Is the last page of the procedure clearly identified by marking, e.g., Page___ of___ or Final Page?	D	___	___	___
10. If this is a temporary procedure, is it clearly marked with the expiration date?	C	___	___	___
11. Do the immediate operator actions avoid referencing operators to other procedures for instructions?	B	___	___	___
12. Are the titles and numbers of all referenced documents identified correctly and consistently?	C	___	___	___
13. If more than one person is required to perform the procedure, is the procedure written to one 'primary' user? That is, is it clear from the way that instructions are written that one person is responsible for coordinating the activity?	B	___	___	___
14. Does the procedure contain provisions for coordinating the activities of others? For example, is there a checklist for a coordinator to record that an action has been completed?	B	___	___	___

Item	Rating	Yes	No	N/A
15. Does the procedure provide a means to check off that the following were observed or performed? a. Symptoms b. Automatic actions c. Immediate operator actions	B	___	___	___
16. Are instructions written in short, concise, numbered steps as opposed to multi-step paragraphs?	A	___	___	___
17. Are the instructions typed in both upper and lower case letters as conventionally used as opposed to all upper case letters? (Capitalization can be used to emphasize individual words in a sentence, and must be used when referring to labels on equipment.)	C	___	___	___
18. Is there consistent use of the following? a. Abbreviations, acronyms, and symbols b. Methods of emphasis	C	___	___	___
19. Are the steps that must be performed in a fixed sequence clearly distinguishable from steps that do <u>not</u> have to be performed in a fixed sequence?	B	___	___	___
20. Does each instructional step direct only one action?	B	___	___	___
21. Does each instructional step meet the following criteria? a. The action to be taken is specifically identified (open, turn, shut). b. Limitations are expressed quantitatively, e.g., 2 turns, 80 (75-85) gpm. c. Equipment and parts are identified clearly and unambiguously.	B	___	___	___
22. If a step contains three or more objects of an action, are they listed rather than imbedded in the sentence? For example, if an operator is directed to close three or more valves, they should be listed rather than strung out in a sentence.	B	___	___	___

Item	Rating	Yes	No	N/A
23. Do the alignment instructions in the procedure meet all of the following criteria? a. Each item requiring alignment is individually specified. (It is not acceptable to refer personnel to previous steps.) b. Each item is identified with a unique number or nomenclature. c. The position in which the item is to be placed is specified. d. The position in which the item is placed is verified.	B	___	___	___
24. If cautions are applicable to the performance of specific steps or series of steps, are they placed immediately ahead of the step(s) to which they apply?	B	___	___	___
25. Are cautions separate and easily distinguishable in appearance from instructional steps? For example, are they enclosed in boxes, typed in bold face letters, headed with the word CAUTION, etc.?	B	___	___	___
26. Can the text of a caution be read without interruption by intervening steps or page turning?	C	___	___	___
27. Do cautions avoid the use of action statements? (Statements directing personnel to perform actions must not be imbedded in cautions. Cautions should be expressed in the passive voice.)	B	___	___	___
28. Are cautions provided to inform personnel when displays are based on secondary sensing modes? For example, is a caution provided when a light indicates only that a circuit is energized rather than the position of the valve?	A	___	___	___
29. If explanations, i.e., notes, are applicable to the performance of specific steps or series of steps, are they placed immediately ahead of the step(s) to which they apply?	C	___	___	___
30. Are explanations separate and easily distinguishable in appearance from instructional steps? For example, are they enclosed in boxes, typed in bold face letters, headed with the word NOTE, etc?	C	___	___	___

Item	Rating	Yes	No	N/A
31. Do explanatory notes avoid the use of action statements? (Statements directing personnel to perform actions must not be imbedded in explanatory notes.)	B			
32. Are instrument readings, control values, and other limits used to guide operator actions expressed in quantitative terms when possible?	B			
33. Are quantitative limits expressed as ranges rather than single values?	C			
34. Are limits compatible with those stated in the emergency operating procedure technical guidelines?	A			
35. Are the contingencies provided for in the procedure consistent with those specified in the emergency operating procedure technical guidelines?	A			
36. Are contingencies written in a consistent style and expressed so that the conditional statement precedes the action statement?	A			
37. Are contingency instructions easy to understand? For example, if three or more conditions are associated with an action, they should be listed separately from and ahead of the action statement.	A			
38. If calculations are required, is space provided in the procedure to perform the computations and to record the results?	C			
39. Do required calculations use formulas and values that are compatible with the emergency operating procedure technical guidelines?	A			
40. Do graphs, charts, tables, and figures meet all of the following criteria?	A			

a. They are compatible with the procedure.
b. They are legible and readable under expected conditions of use.
c. Values can be extracted or interpolated easily and with required accuracy, e.g., non-linear scales are not used.
d. Units of scale and measurement are readily available and usable to the operator.
e. Titles are descriptive of contents and use.

Item	Rating	Yes	No	N/A
41. If the procedure specifies an action that must be performed at a later time or repeated at periodic intervals, does it provide a means to assist the operator in performing the step(s) within the required time frame? For example, if an action must be repeated every 15 minutes, are there spaces for the operator to record the times at which the action must be performed?	A	___	___	___
Perform Operator Walk-Through for Items #42 - #52.				
42. Are the emergency operating procedures readily identifiable and easily accessible?	B	___	___	___
43. Does the procedure identify all major symptoms or combinations of symptoms associated with the emergency? (Determine whether the operator can describe major symptoms or combinations not identified by the procedure.)	A	___	___	___
44. Does the procedure specify automatic actions associated with the emergency adequately? (Determine whether the operator can describe automatic actions not identified by the procedure.)	A	___	___	___
45. Does the procedure specify all critical actions required to respond to the emergency? (Observe whether the operator performs critical actions not specified by the procedure.)	A	___	___	___
46. If the procedure contains sequence-critical actions, is the sequence specified by the procedure correct? (Observe whether the operator performs sequence-critical actions in the sequence specified.)	A	___	___	___
47. Does the procedure allow enough time to perform time-critical actions? (Observe whether the operator can perform time-critical actions in the time allowed, i.e., by equipment response, distances involved, etc.)	A	___	___	___
48. Does the procedure identify equipment adequately? (Determine whether the operator can readily identify all equipment and items referred to in the procedure.)	A	___	___	___

Item	Rating	Yes	No	N/A
49. Are references to equipment in the procedure identical to the labels displayed on the equipment?	B	___	___	___
50. If the answer to Item #49 is Yes, are references to equipment labels typed in upper case letters in the procedure?	B	___	___	___
51. Are the units of measurement used in the procedure the same as those displayed on instruments?	A	___	___	___
52. Does the procedure identify the location of each item of equipment adequately? (Observe whether the operator can locate switches, guages, etc. in a timely manner.)	A	___	___	___

CHAPTER III

DISCUSSION OF THE CHECKLIST

The checklist has several features that serve to promote the efficiency with which it can be employed. They are described below.

Format of Checklist Items

All of the checklist items are written so that they can be answered Yes, No, or Not Applicable. They are uniformly phrased so that a Yes answer is a positive evaluation. That is, a Yes answer indicates that the procedure possesses a desirable attribute and a No answer means that it lacks a desirable attribute. Not Applicable means the attribute is not relevant to the procedure. For example, a procedure cannot be evaluated regarding the accuracy with which it identifies referenced documents if it does not refer to other documents.

Ratings of Checklist Items

The ratings A, B, C, or D indicate the impact of an item on the quality of human performance. If a procedure is deficient with respect to the characteristic referred to by the item, a performance deviation is more likely to occur than if the procedure possesses the characteristic. The absence of some procedural characteristics is more likely to result in performance deviations than the absence of others. It is therefore necessary to develop a method of rating the checklist items to indicate to the evaluator the relative importance of the characteristic stated in the item. The rating considerations are shown in Table 1. These ratings, integrated with the inspector's own knowledge of the consequences of error associated with the performance of a specific procedure or action, should enable the inspector to assess the importance of correcting a particular procedural deficiency. In general, it should be considered mandatory to correct a deficiency rated A or B. Correction of a deficiency rated C may or may not be considered mandatory, depending upon the inspector's judgment regarding the consequences of error and situational stress factors associated with use of the procedure. A rating of D would not ordinarily be regarded as a mandatory change. However, correction is desirable if the intent is to reduce the frequency of performance error to the minimum rate attainable by means of procedures. Descriptions of the ratings are summarized in Table 2.

Evaluation Methods

The checklist items are grouped according to the evaluation method to be employed in reviewing a procedure for the characteristics described by the items. Two different evaluation methods are prescribed in the checklist; the Document Review Method and the Operator Walk-Through Method.

Table 1. Rating Scale for Procedural Deficiencies

Rating	Probability of Performance Deviation Under: Low Stress*	Moderate Stress*	High Stress*
A	Moderate	High	High
B	Moderate	Moderate	High
C	Low	Moderate	Moderate
D	Low	Low	Moderate

*These terms are defined with descriptions and examples in Swain, A.D. and Guttmann, H.E., Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications, Sandia National Laboratories, NUREG/CR-1278, U.S. Nuclear Regulatory Commission, Washington, DC, May 1983.

Table 2. Description of Ratings

A—Errors are likely to occur during low stress (normal) conditions and will be frequently made under moderate and high stress conditions.
B—Errors are likely to occur during low and moderate stress conditions and will occur frequently under high stress.
C—Errors are not very likely under low stress but could occur readily under moderate and high stress.
D—Errors are not very likely to occur under low and moderate stress but could readily occur during high stress.

Document Review Method

The evaluation of a procedure on Items #1 through #41 is accomplished by means of a table-top document review. This method consists of obtaining the procedures of interest and their related documents and evaluating them with respect to the criteria contained in these items. Typically, related documents might consist of 1) the emergency operating procedure technical guidelines, 2) drawings, procedures, schematics, etc. specifically referenced by the procedure, and 3) technical specifications, Final Safety Analysis Reports (FSARs), and other plant-specific documents that affect the content of the procedures. In some cases, it might be necessary to examine corporate policies and station directives having an impact on procedures contents. For example, valve alignment, logging, and tagging activities might be described in a directive rather than a procedure. The inspector should review the documents describing these processes in order to determine whether or not any of this information should be contained in the emergency operating procedure itself rather than in a less immediately accessible document.

These documents in combination comprise the information system affecting the content of procedures and, consequently, the performance of emergency responses. If an inspector cannot evaluate a procedures characteristic from the available documents alone when a document review is specified by the checklist, it can be assumed that the information system is deficient with respect to completeness or with respect to organization. Either deficiency will affect the quality of procedural content adversely.

Operator Walk-Through Method

Items #42 through #52 are evaluated by means of an operator walk-through of the procedure. The performance of this evaluation requires the direct support of a senior reactor operator. The objective of this method is to judge whether or not the amount and kind of information provided by the procedure is complete with respect to the information needs of the operators. That is, the inspector seeks to evaluate the adequacy of the "level of detail" of the procedure. This attribute of a procedure is the most difficult of all procedural characteristics to evaluate. Judgments of adequacy of level of detail are based on assumptions about the qualifications of the personnel for whom the procedure is provided. Such assumptions are often tenuous at best because of the wide differences between groups of operators with respect to training for emergencies and the relatively unknown effects of these differences in training.

Partial evidence of the completeness or level of detail of a procedure can be obtained with the assistance of an experienced operator. The operator must perform a walk-through of the procedure, simulating the actions specified in the instructions. During this process, the completeness of the symptoms and automatic actions sections of the procedure can be determined insofar as possible by means of discussions with the operator.

The technical accuracy of the procedure can be ascertained for the most part only by means of comparing it with the emergency operating procedure technical guidelines. The walk-through can address a limited number of procedural characteristics for accuracy. For example, some evaluations, such as determining the correspondence between equipment nomenclature or identification numbers used in a procedure and the nomenclature or numbers actually displayed on equipment, can be performed by walking through the facility with the procedure in hand and comparing the two. During the walk-through it might also be desired to make selected human factors observations of the work environment, the facility layout and the equipment, all of which bear upon the effectiveness and safety of personnel performance. For example, the inspector might wish to assess the readability of legends and displays from the perspective of the person performing the procedure. Also, distances between operator stations and control positions should be noted to evaluate the efficiency of task sequences and their compatibility with job requirements such as imposed by time-critical tasks.

Explanation of Checklist Items

This section lists the procedures evaluation criteria in the same sequence in which they appear on the checklist. In cases where the relationship between a criterion and the quality of human performance might not be apparent, an explanation is provided.

Perform Document Review Evaluation for Items #1 - #41.

1. Is the procedure format consistent for all emergency operating procedures? (C)

Explanation. A consistent format for all of the licensee's emergency operating procedures will aid operators in reading and locating information in them.

2. Are page margins adequate? (C)

Explanation. Page margins should be wide enough to prevent cutting off information due to mispositioning during the copying process. Pages with pre-printed borders would aid the operators in verifying that page content was complete. Margins at binding edges should be large enough to ensure that printed matter is easily visible.

3. Is the title short and descriptive of the emergency condition or purpose for which the procedure is applicable? (C)

Explanation. LERs have occurred because operators selected and used a wrong procedure to perform an activity. The use of descriptive titles will increase the probability of selecting the correct procedure.

4. If the purpose of the procedure is not clear from the title, is there a statement of scope or purpose? (C)

Explanation. None.

5. Does the procedure cover or first page provide the following identification information? (D)

   a. Title
   b. Procedure number
   c. Revision number and date
   d. Unit number (if applicable)
   e. Approval signature and date
   f. Number of pages

Explanation. None.

6. If this is a multiple unit site, does the procedure refer to one unit only and is it readily identifiable to that unit? (B)

Explanation. The practice of providing one procedure containing multiple sets of equipment identification numbers for use with two or more units is quite common. This practice increases the difficulty of reading and comprehending the procedure, particularly during stressful circumstances. It also increases the probability of performing a procedure on the wrong unit. These problems can be avoided by providing a separate set of emergency operating procedures for each unit. They should be readily identifiable (by color of binder, etc.) as to which unit they belong.

7. Does each page provide the following identification information? (D)

   a. Title or number
   b. Revision number and date
   c. Unit number (if applicable)
   d. Page___of___

Explanation. None.

8. Is the location of page identification information consistent? (D)

Explanation. None.

9. Is the last page of the procedure clearly identified by marking, e.g., Page___of___or Final Page? (D)

Explanation. The last page of a procedure is most vulnerable to becoming detached and lost. It should be made obvious to the user if the last page is missing.

10. If this is a temporary procedure, is it clearly marked with the expiration date? (C)

Explanation. None.

11. Do the immediate operator actions avoid referencing operators to other procedures for instructions? (B)

Explanation. One of the most frequently voiced complaints of operators about procedures is the overuse of references to other procedures for instructional information. In some cases the other procedures may not be obtained and used. To ensure the ready availability of information for the learning and performance of immediate operator actions, all critical information should be provided by one procedure only.

12. Are the titles and numbers of all referenced documents identified correctly and consistently? (C)

Explanation. Procedure references are sometimes in error due to the deletion of referenced documents or changes in their identification information (e.g., procedure number, title, revision number). Therefore, all references to other documents should be checked for accuracy. Consistency of formating references should also be determined. If the procedure refers operators to other procedures for instructional information, the quality of the referenced procedure should be evaluated, starting with Item #1 of the checklist.

13. If more than one person is required to perform the procedure, is the procedure written to one 'primary' user? That is, is it clear from the way that instructions are written that one person is responsible for coordinating the activity? (B)

Explanation. The findings from the several TMI-2 studies underlined the need for more structured coordination of crew responses to emergencies. The study on which the checklist is based disclosed considerable variability among plants and among shift supervisors within a given plant with respect to training and skills in coordinating crew responses. Procedural formats to structure multi-man activities have been developed and used effectively for many years. The application of a similar procedural structure to nuclear power plant emergency operating procedures would reduce the number of errors in communication and in omissions of actions that currently result from relatively unstructured, uncoordinated crew responses. Because the emergency operating procedures are used for training as well as on-the-job application, they could also contribute to the development of the relevant coordination skills.

14. Does the procedure contain provisions for coordinating the activities of others? For example, is there a checklist for a coordinator to record that an action has been completed? (B)

Explanation. High-stress conditions are conducive to errors in communications and omission of actions, particularly when the activities of several individuals, sometimes remote from each other, must be coordinated. A checklist or other device will aid in the early detection of these errors.

15. Does the procedure provide a means to check off that the following were observed or performed? (B)

   a. Symptoms
   b. Automatic actions
   c. Immediate operator actions

Explanation. The observation of symptoms and automatic actions and the performance of immediate operator actions are typically accomplished before a procedure is obtained. As a result, reliance must be placed upon operator memory (unless automatic recording equipment is available and operable) to reconstruct the course of an event. The checklists are intended to enable the operators to record the occurrence of symptoms, automatic actions, and immediate operator actions directly after obtaining the procedure and before stress further degrades accurate recall. The checklists enhance the detection of errors of omission.

16. Are instructions written in short, concise, numbered steps as opposed to multi-step paragraphs? (A)

Explanation. Studies have shown that the speed of reading and the comprehension of written instructions are improved if the instructions are presented in short, concise sentences. Ideally, an instruction should consist of an action verb and the object of the action—plus action limits and object identifiers, and, if necessary, object locators. Additional information, such as that contained in explanations and descriptions, that is intended to aid the user to accomplish the action more effectively should ordinarily be presented in the form of a note preceding the action instruction.

17. Are the instructions typed in both upper and lower case letters as conventionally used as opposed to all upper case letters? (Capitalization can be used to emphasize individual words in a sentence, and must be used when referring to labels on equipment.) (C)

Explanation. Studies have shown that conventional printing can be read faster and more accurately than text printed entirely in upper case lettering. In addition, upper case lettering in the body of the text should be reserved for equipment labels to aid in detecting references to them.

18. Is there consistent use of the following? (C)

a. Abbreviations, acronyms, and symbols
b. Methods of emphasis

Explanation. None.

19. Are the steps that must be performed in a fixed sequence clearly distinguishable from steps that do not have to be performed in a fixed sequence? (B)

Explanation. By its very nature, a written procedure presents steps in a sequence. In many cases, the actions can be performed in a variety of sequences to accomplish the same operation. In some operations, however, the sequence in which the actions are performed is critical. That is, only a single sequence of actions will result in acceptable accomplishment of the operation. Yet, the study team encountered only one plant in which sequence-critical steps were identified. As a result, the operators are generally required to make this distinction—even in high-stress conditions. A related consequence is that inspectors or other personnel cannot assess operator knowledge of sequence-critical operations. Identification of sequence-critical steps would aid operator training and performance evaluation.

20. Does each instructional step direct only one action? (B)

Explanation. The greater the number of actions that are directed by a step, the more likely an action is to be overlooked or forgotten. In the case of emergency operating procedures, a step should generally contain only one action. However, if actions are logically related, up to three actions in a step are acceptable. Related actions are actions that, in combination, accomplish a single end-result. They are interdependent in the sense that performing one action enhances the likelihood of performing the next action. In the example of related actions shown below, the single result is an adjusted volume.

Example of Three Related Actions (Acceptable):

> "5. Start pump PL-16. Observe gauge WL-16. When level is 62 (60-64) in., stop pump."

Example of Two Unrelated Actions (Not Acceptable):

> "8. Close switch LAC-1781. Close valve HVC-23."

21. Does each instructional step meet the following criteria? (B)

   a. The action to be taken is specifically identified (open, turn, shut).
   b. Limitations are expressed quantitatively, e.g., 2 turns, 80 (75-85) gpm.
   c. Equipment and parts are identified clearly and unambiguously.

Explanation. The above criteria list the basic characteristics of a specific (versus general) instruction. Fewer errors of interpretation or omission result from instructions with high specificity.

22. If a step contains three or more objects of an action, are they listed rather than imbedded in the sentence? For example, if an operator is directed to close three or more valves, they should be listed rather than strung out in a sentence. (B)

Explanation. This format (tabular or columnar) can be read faster and implemented more accurately than conventional sentence structure. For example:

This	Not This
Open following valves: XXU XXX XXV XXY XXW XXZ	Open valves XXU, XXV, XXW, XXX, XXY, and XXZ.

23. Do the alignment instructions in the procedure meet all of the following criteria? (B)

    a. Each item requiring alignment is individually specified. (It is not acceptable to refer personnel to previous steps.)
    b. Each item is identified with a unique number or nomenclature.
    c. The position in which the item is to be placed is specified.
    d. The position in which the item is placed is verified.

Explanation. Two of the primary contributors to misalignment are lack of specificity of instructions and lack of physical verification of position. The criteria listed above are aimed at improving specificity and verification. In some procedures, it was found that instructions were adequate for initial alignment but shortchanged realignment by simply directing personnel to "Reposition valves listed in Step 5." In this instance, personnel were not provided a means within the procedure for verifying valve position. The instructions should have relisted the valves, their new positions, and provided for checkoff for each valve.

24. If cautions are applicable to the performance of specific steps or series of steps, are they placed immediately ahead of the step(s) to which they apply? (B)

Explanation. Information must be presented in the order in which it is needed. If the user needs cautionary information before performing a specific action, it must be presented before the statement directing the action. Otherwise, there is a high probability that the action will be performed without the cautionary information being taken into consideration.

25. Are cautions separate and easily distinguishable in appearance from instructional steps? For example, are they enclosed in boxes, typed in bold face letters, headed with the word CAUTION, etc? (B)

Explanation. None.

26. Can the text of a caution be read without interruption by intervening steps or page turning? (C)

Explanation. Presenting the cautionary message as a single unit aids comprehension. Also, if the caution is broken by other material or pages, it is possible that the operator will overlook the remainder of the message.

27. Do cautions avoid the use of action statements? (Statements directing personnel to perform actions must not be imbedded in cautions. Cautions should be expressed in the passive voice.) (B)

Explanation. Cautions should not be expressed in terms of directing users to take or not take actions. Instead, the cautions should describe the conditions or consequences of actions. The passive voice should be used. All actions should be directed in the instructional steps only. Failure to observe this rule consistently will result in the overlooking of critical actions by the operators.

28. Are cautions provided to inform personnel when displays are based on secondary sensing modes? For example, is a caution provided when a light indicates only that a circuit is energized rather than the position of the valve? (A)

Explanation. In the TMI-2 event, individuals interpreted a display of switch position as if it were a display of valve position. An optimum solution to this human factors problem is to replace secondary sensing systems with primary sensing systems. A less effective, but readily available, solution is to insert cautions or notes in procedures to identify displays based on secondary sensing.

29. If explanations, i.e., notes, are applicable to the performance of specific steps or series of steps, are they placed immediately ahead of the step(s) to which they apply? (C)

Explanation. See explanation for Item #24.

30. Are explanations separate and easily distinguishable in appearance from instructional steps? For example, are they enclosed in boxes, typed in bold face letters, headed with the word NOTE, etc.? (C)

Explanation. None.

31. Do explanatory notes avoid the use of action statements? (Statements directing personnel to perform actions must not be imbedded in explanatory notes.) (B)

Explanation. See explanation for Item #27.

32. Are instrument readings, control values, and other limits used to guide operator actions expressed in quantitative terms when possible? (B)

Explanation. In this and other studies, reactor operators have expressed a need for more quantitative limits in procedures. It has also been found that operators vary among themselves with regard to their interpretation of qualitative modifiers, e.g., slow, fast, rapidly. Finally, high-stress conditions can distort an individual's perception of slow, fast, etc. Use of quantified limits will promote more uniformity of responses.

33. Are quantitative limits expressed as ranges rather than single values? (C)

Explanation. When equipment does not permit the setting of point values, or when a range of values is acceptable, the limits should be expressed in terms or ranges. However, they should be expressed in a form to avoid errors of addition, subtraction, or conversion. Example:

Preferable	Not Preferable
____ to ____	______ ± ______
(Best) ______ (_________ — _________) midpoint lower limit upper limit	______ ± ______ %(Worst)

34. Are limits compatible with those stated in the emergency operating procedure technical guidelines? (A)

Explanation. None.

35. Are the contingencies provided for in the procedure consistent with those specified in the emergency operating procedure technical guidelines? (A)

Explanation. Many procedures are written as though all conditions and limits will be met. They do not address the exceptions. For example, if equipment is operating outside the range specified by the procedure they fail to instruct the operator what action to take. In the study on which the checklist is based, it was found that the procedures preceded by a formal engineering analysis (as represented in the emergency operating procedure technical guidelines) covered 4.5 times as many contingencies as the emergency operating procedures that were not derived from engineering analyses. The implication of this finding is that an emergency operating procedure might be incomplete with respect to contingency information. If the inspector finds that no engineering analysis was performed, the completeness of much of the information in the procedure is doubtful. It is impractical for the inspector to perform an engineering analysis of the magnitude required to identify all contingencies that can be reasonably expected. However, the inspector can determine the compatibility between a procedure and its supporting emergency operating procedure technical guideline with respect to the number and content of contingencies. Also, it may be helpful to make a partial evaluation of the procedure with the aid of the control room operating staff using the walk-through process.

36. Are contingencies written in a consistent style and expressed so that the conditional statement precedes the action statement? (A)

Explanation. If the action instruction precedes the conditional statement, there is an increased probability that the operator will perform the action before reading the qualifying condition. For example, a contingency instruction should be written "If (condition) do (action)" rather than "Do (action) if (condition)." Also, the instructions should be written in a consistent style to aid comprehension.

37. Are contingency instructions easy to understand? For example, if three or more conditions are associated with an action, they should be listed separately from and ahead of the action statement. (A)

Explanation. Frequently, the instruction to perform an action depends upon the presence of several conditions or combinations of conditions. In these instances the majority of the procedures reviewed provided this information in lengthy, hard-to-understand sentences. Essential contingency information could be overlooked or misinterpreted in complex sentences, particularly during high-stress conditions conducive to the impairment of comprehension. A tabular or columnar format promotes ease of comprehension. Example:

This	Not This
If any of the following conditions exist: ________ ________ ________, do ________.	If ________ or ________ or ________ exist, do ____.

38. If calculations are required, is space provided in the procedure to perform the computations and to record the results? (C)

Explanation. This provision is intended to increase the accuracy of performing calculations and to facilitate subsequent verification of the results.

39. Do required calculations use formulas and values that are compatible with the emergency operating procedure technical guidelines? (A)

Explanation. None.

40. Do graphs, charts, tables, and figures meet all of the following criteria? (A)

a. They are compatible with the procedure.
b. They are legible and readable under expected conditions of use.
c. Values can be extracted or interpolated easily and with required accuracy, e.g., nonlinear scales are not used.
d. Units of scale and measurement are readily available and usable to the operator.
e. Titles are descriptive of contents and use.

Explanation. Misinterpretation of graphs, charts, and tables has resulted in performance errors. It is often traceable to poor readability of these materials—which, in turn, is attributable to 1) inadequate original construction, or 2) inadequate reproduction. The following guidelines are provided to evaluate readability.

Original construction. Letters and numbers should be typed rather than handwritten. Lines on graph paper should be reproducible on licensee reproduction equipment. On graphs, units of measurement used in plotted values should be compatible with divisions on graph paper. That is, if plotted values progress in units of five, e.g., 5, 10, 15, etc., it is better to separate the values by five lines than by four lines. To facilitate accuracy of locating values in charts and tables, look for such aids as 1) partitioning tables with lines, 2) arranging values in subgroups, e.g., inserting spaces between subgroups of five values, and 3) placing connecting lines between values or between nomenclature and values.

Reproduction. In some cases, copies are so many generations removed from the original or master copy that lines in graphs, charts, and tables have deteriorated or disappeared, making it difficult to track or interpolate values. Letters and numbers can undergo similar deterioration. Also, materials have sometimes been reduced in size so that readability is impaired. Letters and numbers should be at least 1/8 in. in height, unbroken, and unfilled. All lines in the reproductions should be as visible as they are in the orginal master copies. First, compare the reproductions to the original or master copies. Then, evaluate the readability of the reproductions under the conditions of illumination in which personnel use them.

41. If the procedure specifies an action that must be performed at a later time or repeated at periodic intervals, does it provide a means to assist the operator in performing the step(s) within the required time frame? For example, if an action must be repeated every 15 minutes, are there spaces for the operator to record the times at which the action must be performed? (A)

Explanation. Some emergency operating procedures require that an action such as checking a pressure or flowrate be performed at set intervals, e.g., every 15 minutes. In the past, failure to observe timing requirements has resulted in LERs describing overflows, excessive draining, etc. Provisions within the procedure for recording times at which time-critical actions must be performed will enable operators to comply with timing requirements more consistently and more accurately.

Perform Operator Walk-Through for Items #42 - #52.

42. Are the emergency operating procedures readily identifiable and easily accessible? (B)

Explanation. Although this item does not represent a procedure characteristic, this assessment can be readily made as part of the walk-through process.

43. Does the procedure identify all major symptoms or combinations of symptoms associated with the emergency? (Determine whether the operator can describe major symptoms or combinations not identified by the procedure.) (A)

Explanation. See explanation for Item #45.

44. Does the procedure specify automatic actions associated with the emergency adequately? (Determine whether the operator can describe automatic actions not specified by the procedure.) (A)

Explanation. See explanation for Item #45.

45. Does the procedure specify all critical actions required to respond to the emergency? (Observe whether the operator performs critical actions not specified by the procedure.) (A)

Explanation. Items #43, #44, and #45 deal with the completeness of an emergency operating procedure. As described earlier (see explanation for Item #35), the completeness of a procedure is a function of the quality of the engineering analyses on which the procedure is based. It is possible that the inspector will find that no engineering analyses were performed as part of the development of the procedure being evaluated. It is also possible that some of the analyses that were performed were inadequate. Study findings comparing the amount of contingency information in procedures not derived from engineering analyses against procedures derived from emergency operating procedure technical guidelines (see Item #35) underline this possibility. The inspector is not in a position to perform engineering analyses to determine the completeness of the information in a procedure. However, the procedure can be compared with the emergency operating procedure technical guidelines to determine the compatibility between them. A partial evaluation can be made with a relatively small investment of time with the assistance of members of the operating staff. Discussions with and observations of experienced operators performing a walk-through of the procedure should disclose procedural omissions.

46. If the procedure contains sequence-critical actions, is the sequence specified by the procedure correct? (Observe whether the operator performs sequence-critical actions in the sequence specified.) (A)

Explanation. The inspector will encounter some procedures in which sequences of actions are not critical and other procedures in which sequences are critical to successful accomplishment of an operation. In many cases, the licensee will not make this distinction obvious. As a first step, the licensee should be required to identify sequence-critical steps. The inspector can then determine the accuracy of the sequences as part of the walk-through evaluation process.

47. Does the procedure allow enough time to perform time-critical actions? (Observe whether the operator can perform time-critical actions in the time allowed, i.e., by equipment response, distances involved, etc.) (A)

Explanation. Some actions specified in emergency operating procedures are time-critical. Time-critical steps should be identified by the licensee along with the time allowed to perform a step or the time allowed to intervene between steps. The inspector should then determine whether or not the operator or crew of operators can perform these steps within the allowed time limits.

48. Does the procedure identify equipment adequately? (Determine whether the operator can readily identify all equipment and items referred to in the procedure.) (A)

Explanation. None.

49. Are references to equipment in the procedure identical to the labels displayed on the equipment? (B)

Explanation. None.

50. If the answer to Item #49 is Yes, are references to equipment labels typed in upper case letters in the procedure? (B)

Explanation. It is a technical writing practice to print references to equipment labels in capital letters. Use of this guideline enables operators to locate and identify procedural references to equipment quickly. It also informs operators that these are the labels they will find on the equipment itself.

51. Are the units of measurement used in the procedure the same as those displayed on instruments? (A)

Explanation. Use of the same units of measurement in procedures and on instruments will prevent errors introduced in converting units of measurement.

52. Does the procedure identify the location of each item of equipment adequately? (Observe whether the operator can locate switches, gauges, etc. in a timely manner.) (A)

Explanation. Findings from TMI-2 and other studies suggest that procedures sometimes fail to provide enough location information to the operators. This deficiency can be particularly serious in an emergency during which search time might be limited. Emergency operating procedures should be evaluated for this characteristic as part of the walk-through.

CHAPTER IV

APPLICATION OF THE CHECKLIST

The checklist can be applied to serve either or both of two distinctly different purposes. They are:

1. to identify deficiencies in a sample of procedures with the objective of correcting the deficiencies in that specific sample of procedures, and/or
2. to identify deficiencies in a sample of procedures with the objective of correcting the process that produced the deficient procedures.

In the first case, the inspector is basically performing the function of an editor, and, as a result, the impact of the inspection process will be confined to the procedures being evaluated. The rate at which existing procedures are modified and new procedures are prepared far outpaces the rate at which they can be evaluated by inspectors. Therefore, if only changes in identified deficiencies are sought, the objective of improving the effectiveness and safety efficiency of the inspection process will not be attained.

In the second case, the impact of the inspector on the quality of licensee procedures will be maximized. Here, the procedures are viewed primarily as indicators of the quality of the procedures development process. Although the inspector should also seek to have the specific procedures that are reviewed corrected, the main objective of the inspection is to determine the overall quality of the licensee's procedures development process. If the samples of procedures exhibit particular deficiencies in common with each other, a change in the process used by the licensee to prepare or revise procedures, or a change in the licensee's specification governing the format or content of the procedures is required. This kind of corrective action, coupled with periodic inspections, will effectively improve the quality of all of the emergency operating procedures, rather than just the procedures selected for review. If the checklist is used in this manner, the objective of improving the effectiveness and safety efficiency of the inspection process will be advanced.

Based on inspector experience in evaluating procedures with checklists, the following method of application is suggested.

- To identify deficiencies that are common to a set of procedures, sample a small number of procedures that is representative of the licensee's emergency operating procedures. Evaluate the procedures in detail with the checklist to determine whether they have deficiencies in common with each other. After they have been identified, it may be unnecessary to review subsequent procedures on these generic characteristics.

- To identify deficiencies specific to a particular procedure, perform a review for the following characteristics in the order listed below. Complete the review of a procedure on one characteristic before proceeding to the next characteristic.

  a. Proper procedure and page identification information
  b. Consistency of format and style
  c. Adequate entry conditions
  d. Check-off and verification provisions
  e. Clarity and specificity of instructions (e.g., sentence structure, action, equipment, limits)
  f. Adequacy of information (e.g., cautions, notes, instructions)
  g. Adequacy of contingency instructions and branching

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16. ABSTRACT *(200 words or less)*

This document describes a checklist to be used by U.S. Nuclear Regulatory Commission (NRC) Office of Inspection and Enforcement inspectors during their evaluation of emergency operating procedures. The objective of the checklist is to aid inspectors in identifying characteristics of the procedures that can lead to operator performance deviations. Explanations of the procedures evaluation criteria comprising the checklist are provided. Methods of performing the evaluations are described and suggestions for applying the checklist to increase the effectiveness of the inspection process are made. A companion document, Development of a Checklist for Evaluating Emergency Procedures Used in Nuclear Power Plants, NUREG/CR-1970, describes the methodology used to develop the checklist and presents the study findings on which the procedures evaluation criteria are based.

Revision 1 of the checklist, presented herein, is the result of a one-year field test by NRC inspectors in all five NRC regions. It incorporates improvements that were suggested by inspectors based on their experience with the checklist in performing evaluations of licensee procedures.

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CHECKLIST FOR EVALUATING EMERGENCY OPERATING PROCEDURES
USED IN NUCLEAR POWER PLANTS

MARCH 1983