



***Good practices with
respect to the development
and use of nuclear power
plant procedures***



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The originating Section of this publication in the IAEA was:

Nuclear Power Engineering Section
International Atomic Energy Agency
Wagramer Strasse 5
P.O. Box 100
A-1400 Vienna, Austria

GOOD PRACTICES WITH RESPECT TO THE DEVELOPMENT
AND USE OF NUCLEAR POWER PLANT PROCEDURES

IAEA, VIENNA, 1998

IAEA-TECDOC-1058

ISSN 1011-4289

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Printed by the IAEA in Austria

December 1998

FOREWORD

This technical publication on the development and use of plant procedures is part of an ongoing project on nuclear power plant instrumentation and control. The overall objective of this project is to provide systematic guidance and a forum for information exchange on current and emerging instrumentation and control technologies including:

- protection and automation systems,
- control rooms,
- operator support systems,
- training simulators, and
- human factors.

NPP procedures provide the interface between the equipment and the personnel who operate and maintain that equipment. They also serve as one of the principal mechanisms that NPP managers have to communicate standards and expectations for the operation and maintenance of the plant.

Some NPPs are now considering upgrades or improvements in their plant procedure systems to address identified weaknesses in the system for operation and maintenance of the plant. Others are facing new more competitive energy markets, requiring more efficient and effective ways to operate and maintain their plants. Such utilities are considering ways to reduce the burden of developing and maintaining their plant procedures system, while at the same time improving their effectiveness. This publication is intended to address the entire spectrum of issues facing Member States in developing and using NPP procedures.

The IAEA wishes to thank all participants and their Member States for their valuable contributions. The IAEA is particularly grateful to the Government of the United States of America and the Omaha Public Power District for hosting a consultants meeting on this topic from 23 to 27 June 1997 at its Fort Calhoun Station. The IAEA officer responsible for this publication is T. Mazour of the Division of Nuclear Power.

EDITORIAL NOTE

In preparing this publication for press, staff of the IAEA have made up the pages from the original manuscript(s). The views expressed do not necessarily reflect those of the IAEA, the governments of the nominating Member States or the nominating organizations.

Throughout the text names of Member States are retained as they were when the text was compiled.

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1. INTRODUCTION

1.1. PURPOSE OF THIS PUBLICATION

This publication is intended to provide information, particularly for NPP managers, concerning good practices with respect to the development and use of nuclear power plant procedures. This publication is based on lessons learned from NPPs and utilities. One of the fundamental safety principles involves management's responsibility to establish a safety culture that governs the actions and interactions of all individuals and organizations engaged in activities related to nuclear power. The development of sound procedures and use of these procedures in the expected manner are practices that reflect positively on a safety conscious work environment and the safety culture of an NPP. This publication is intended to be applicable to NPPs in Member States that are now in operation, as well as for those that are now under construction or that are being commissioned. The good practices described in this publication are consistent with the IAEA Safety Series recommendations with respect to the development and use of NPP procedures.

1.2. DEFINITION OF PLANT PROCEDURES

The term "plant procedures" is used in this publication in a broad sense, addressing essentially all the procedures that are used in the operation of a nuclear power plant, including the following four categories:

- administrative procedures,
- operating procedures (normal, alarm response, abnormal and emergency procedures),
- maintenance and technical support procedures, and
- testing and surveillance procedures.

Administrative procedures describe how administrative aspects of NPP activities are carried out, such as review and approval of documents, training and qualification of NPP personnel, and maintenance and retention of plant records. These procedures are often provided both at the plant and individual department levels, with plant procedures addressing administrative requirements that apply throughout the plant, and department administrative procedures for activities that only apply to a particular organizational unit. **Operating procedures** are self-defined. **Maintenance and technical support procedures** relate to activities such as the conduct of preventive and corrective maintenance, radiation protection, and chemistry control. **Testing and surveillance procedures** relate to activities such as: functional tests of safety systems, post-maintenance test procedures, and post modification procedures. The principal plant documentation excluded from this definition of plant procedures is design documents including vendor manuals (unless they are used as procedures).

1.3. HOW TO USE THIS PUBLICATION

This publication is intended for use as a reference manual, particularly for NPP/utility managers who are tasked with developing or restructuring their procedure organizations. It is expected that it will also be useful for personnel responsible for the development of plant procedures. NPP/utility managers should focus particularly on sections describing organizational and strategic considerations, including configuration management, and review

the examples provided in the annexes as their interests and needs dictate. The entire publication is intended to be useful to procedure development specialists as it provides good practices and guidance for all elements of the procedure program.

At the end of this report a list of additional publications related to this topic is provided. Also, at the end of most sections of this report a cross-reference is provided to the documents that are particularly relevant to the topic presented in that section.

1.4. TERMINOLOGY

The following are terms that are used in this publication that either are not necessarily known to the target audience for this publication, or that are used in a particular context in this publication:

- **Configuration management.** The process to ensure the plant is modified, maintained, operated and tested in accordance with the design basis and licensing requirements.
- **Procedure writer's guide.** A document that provide guidelines for the development and revision of plant procedures.
- **Procedure user's guide.** A document that provides guidelines for the use of plant procedures.
- **Temporary procedure.** A procedure developed for usage during a limited period of time or number of uses (normally one-time). Temporary procedures can be developed for many purposes; such as, temporary installations for troubleshooting, correction of an error in a procedure, or to support a one-time evolution.
- **Verification.** The process of determining if a procedure is administratively and technically correct.
- **Validation.** The process of evaluating a procedure to ensure it is useable and it will function as intended.

2. PROCEDURE SYSTEM DEVELOPMENT METHODOLOGY

The development of an effective procedure system for an NPP involves several considerations and several steps. This section is designed to discuss this process.

The major steps involved in establishing an effective procedure's program are:

- establishing an organizational unit dedicated to procedure development and revision
- organizing and structuring of procedures
- defining qualifications of procedure writers
- designing procedures
- developing procedures
- identifying interfaces with other documents.

References [1–6] provide additional information concerning the topics presented in this section.

2.1. ESTABLISHING AN ORGANIZATIONAL UNIT DEDICATED TO PROCEDURE DEVELOPMENT AND REVISION

Utilities/NPPs have found that for an effective plant procedures system it is important to give careful consideration to the responsibilities and authorities within the NPP organization performing this effort. The following are some lessons learned with respect to plant organization and structure for procedure development and maintenance. Some plants decided to have a dedicated procedures development group. Some plants require procedure development by other work groups, such as operations staff or operational experience feedback, as a part time responsibility. Many NPPs have found it beneficial to establish a dedicated procedures group reporting to one NPP department manager. Through use of a plant procedures group, it is possible to establish more efficient and effective methods for development, distribution and revision of plant procedures, resulting in lower costs and more uniform quality of procedures. These gains may be possible because the staff of such a procedures group maintains a familiarity, through their day-to-day activities, with requirements and methods for procedure development, whereas the alternative of using part-time procedure writers may require additional training or re-familiarization. The use of a comprehensive writer's guide will be beneficial to both of these options. The benefits of uniform quality and cost effectiveness can be achieved through either method but may require more coordination with the part time writers.

The establishment of a procedure group does not mean that this group should have all responsibilities for procedure development/revision, and that technical departments should none. Rather, shown below is an example of the division of responsibilities among organizational units for procedure development.

<i>Responsibilities of Procedures Writer's Group</i>	<i>Responsibilities of Technical Departments</i>
<ul style="list-style-type: none">• manage the initial drafting and subsequent amendment of the station suite of procedures• co-ordination of activities related to procedure development and maintenance• oversight of the quality of procedures from the standpoints of format and structure• the development of standards for procedures may be the responsibility of the procedures group• identifying training needs of personnel on procedure development and standards, and provide training, as needed	<ul style="list-style-type: none">• the technical content of procedures• identification of the need for procedure upgrades or revisions• technical aspects of procedure verification and validation• the development of standards for procedures may be the responsibility of a technical department such as quality management• providing adequate resources for technical aspects of procedure development, verification and validation, and review and approval

Irrespective of whether or not a dedicated procedure writers' group is used, such responsibilities need to be defined in a procedure writers guide or other appropriate documents. The division of responsibilities between the procedures writer's group and the technical departments will vary dependent upon the qualification and experience of the group. The writer's group they may be given responsibilities for additional tasks such as periodic review of procedures, periodic reports on revision status, the development of user aids for the performance of procedures.

The establishment of a dedicated organizational unit with overall responsibility for maintenance and revision of plant procedures is sometimes seen as a need for an increase in the total numbers of NPP/utility personnel. This is the case because the resources needed for procedure development/revision in many NPP organizations are not clearly identified. Often such responsibilities are the part time, ancillary responsibilities of many persons. If one looks at the numbers of new/revised procedures that are issued, and an estimate of resources needed per procedure change, the magnitude of such resources can be more clearly identified. Where a NPP has 4000–6000 plant procedures, they may process 200–300 changes to these procedures per month. Plants which group procedures in an alternative structure may have a different number of total procedures but the proportions which are amended may be similar. Assuming that 6 to 8 hours are required to research and prepare a typical procedure change, and that an additional 4 hours are needed for review and approval of such changes, a range of 2000–3600 person-hours per month is identified for developing and revising plant procedures (12 to 21 full time persons). Thus, if the establishment of a dedicated procedure group can result in improvements in efficiency in the range of 25% (while achieving the benefits of familiarity and uniform quality), then significant reductions in resources needed for this function can be realized.

References [7, 8] provide additional information concerning the topics presented in this section.

2.2. OVERALL ORGANIZATION AND STRUCTURE OF PROCEDURES

It is useful to establish a hierarchy for plant procedures in order to facilitate their development, use, and maintenance. Utility and NPP policies are at the top of the hierarchy. Procedures developed from these policies typically have increased level of detail. Figure 1 shows an example of a procedural hierarchy. Such a hierarchy, with appropriate links through mechanisms such as key words, provides an efficient way to locate needed information, particularly for computer-based systems.

Temporary procedures may exist for brief periods within any of the functional areas shown in the hierarchy above. Temporary procedures are treated as a separate category by some organizations and as part of the originating procedure by other organizations.

For a variety of reasons, including quality assurance, regulatory compliance, and process management; it is important to establish a structure that will provide both a history of plant procedure revisions, as well as the current status of ongoing revisions.

It is useful to take an integrated approach that considers plant procedures as part of an information management (IM) system that also includes all plant documents (e.g. design information, vendor manuals, as well as plant procedures). This is the case for conventional document centers, and particularly for plants which increasingly rely on computer-based systems for development, use and maintenance of plant procedures. For such computer-based systems, the greatest productivity improvements are realized when related functions are integrated into the IM system and redundant activities are minimized.

References [9–15] provide additional information concerning the topics presented in this section.

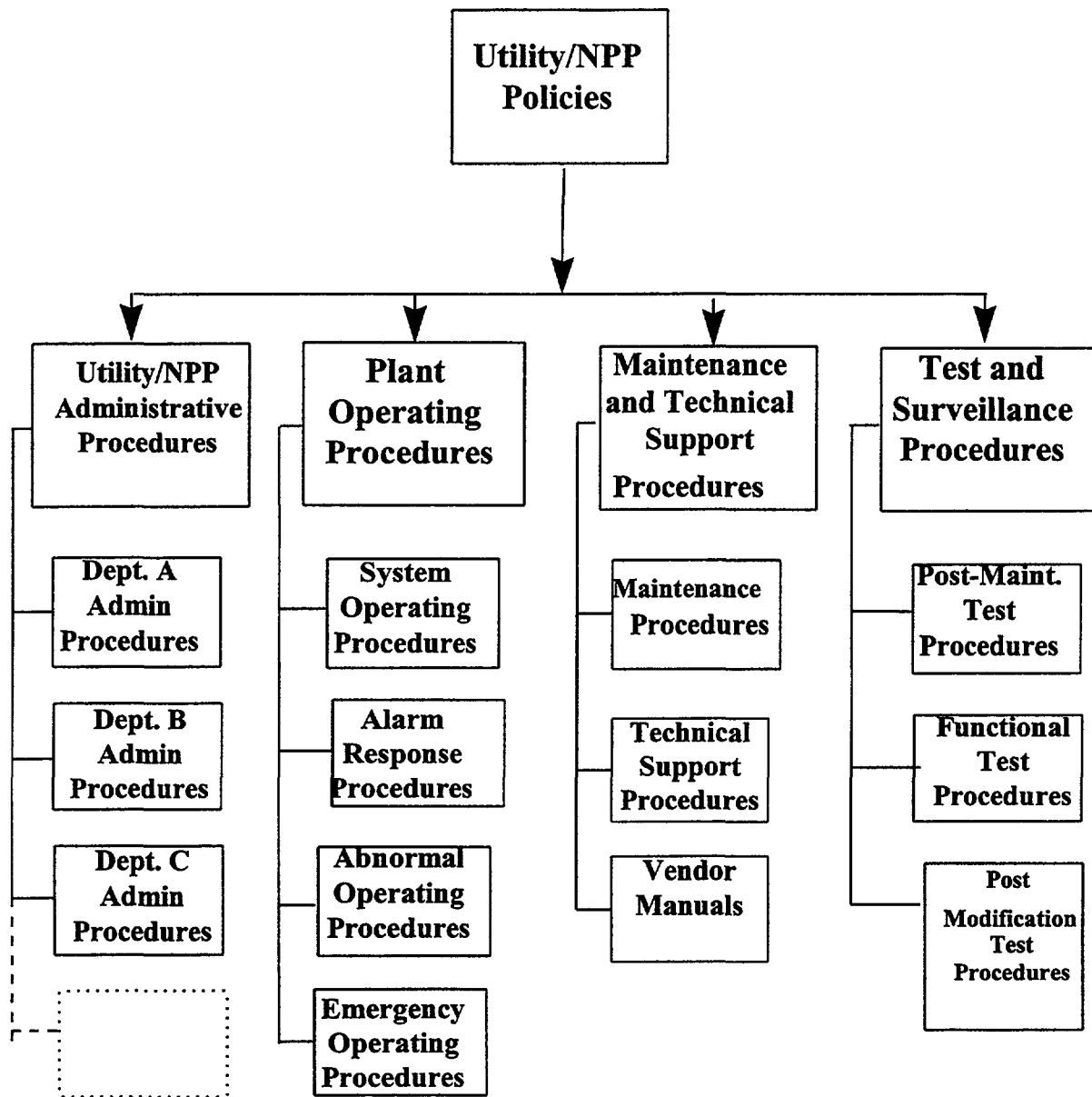


FIG. 1. Typical functional hierarchy of plant procedures.

2.3. QUALIFICATIONS OF PROCEDURE WRITERS

There are no industry standard qualification requirements for procedure writers since the qualifications will be related to the particular tasks and applications. However, an important aspect in maintaining the quality of plant procedures is to ensure the appropriate qualifications of procedure writers. Examples of methods for qualification of procedure writers include classroom training, on the job training, and self-study using procedure writer's guides. These training and qualification methods focus on human factors, formatting, and administrative issues. Technical qualifications of procedure writers should be based on their job qualifications (e.g. a qualified control room operator should be considered technically qualified to write procedures with respect to activities performed by control room operators). In addition to the technical expertise associated with the subject matter of the procedures, it is necessary for the writers to have the appropriate skills. These skills will include word processing and other

computer applications, as well as management and control of documents and files. The achievement of consistent standards of documentation require a combination of the use of templates, styles and word processing techniques, many of which will be defined in the procedure writer's guide.

With respect to technical expertise, it is important that procedure writers, particularly those within a procedure writer's group maintain contact and involvement with their technical colleagues, in order to remain familiar with developments of the plant and operational strategies. The attendance on some technical training courses may also be beneficial in maintaining up to date knowledge. Some NPPs have successfully dealt with this issue by rotating personnel to procedures groups for 1 to 2 years, and then back to the technical department. This has the long-term advantage of strengthening the links between the procedure writer's group and technical departments, but has the disadvantage of lower productivity of individuals when they are initially assigned as procedure writers.

2.4. DESIGN OF PROCEDURES

Experience has shown that considerable improvement in human and plant performance can be realized through careful attention to the design of NPP procedures. Obviously, the technical information provided in the procedures must be correct and have a sound basis. However, of equal importance is the way in which the information is organized and presented to the procedure user. Both considerations are addressed through procedure design.

There is a benefit in standardizing technical, administrative and other procedures across similar applications, within the NPP, within the utility and among plants of a similar design, where standards exist or can be agreed upon. This can result in an efficient process of development, revision and use of procedures, and will benefit from wider use of operational experience feedback. Some organizations already promote the standardization of processes within their members. References [7, 11, 12, 16, 17] provide additional information concerning the topics presented in this section.

2.4.1. Philosophy on the use and extent of plant procedures

It is important that there is an appropriate balance and integration between the three principal factors that support the conduct of activities by NPP personnel: supervision, training and qualification, and plant procedures. None of these factors alone can ensure adequate performance. Developing any one of the three without consideration or knowledge of the other two is likely to result in inefficient and/or ineffective performance. This relationship is shown in Figure 2.

The most comprehensive illustration of these components is the infrequently used procedures for high-risk evolutions. In these cases comprehensive validation, pre-job training and briefing, direct supervision, and direct management involvement are sometimes needed to assure proper task performance.

Plant procedures are the principal method to communicate management expectations concerning performance of plant activities. It is clear that it is neither appropriate, nor possible to have a procedure for every activity at an NPP. The following are some appropriate questions to consider in determining whether a procedure is needed:

- Do training and selection criteria provide assurances that the activity can be adequately performed?
- Is the activity closely supervised?
- Is there a good match between task complexity and skills of the worker?
- Does in-house or industry operating experience indicate a need for a procedure?
- What are the consequences of improper performance?
- Do vendor manuals or other documentation provide adequate information on performing the task?
- Is there a need to document task performance?
- Is there a need to satisfy a regulatory, utility or local requirement?

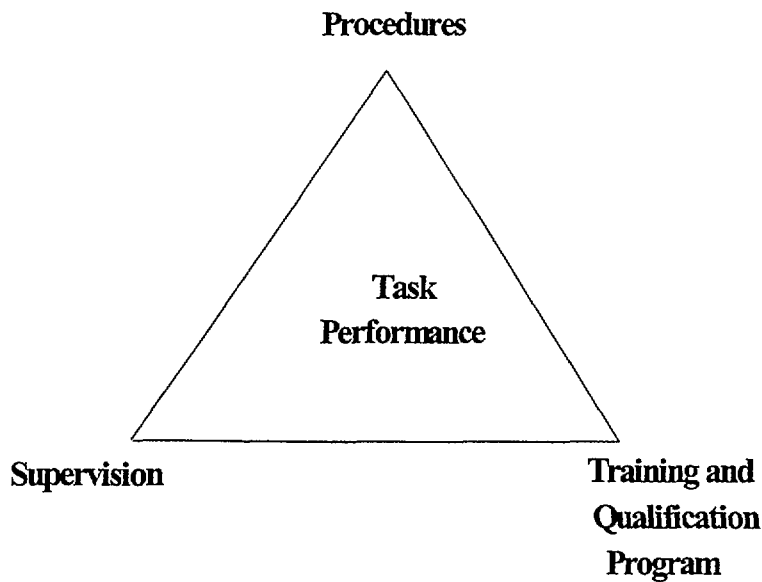


FIG. 2 Integration of supervision, training and procedures for task performance.

The following are examples of activities/tasks for which a procedure is generally not required because there is reliance upon skills of the trade or on-the-job training:

Example	Reason
<ul style="list-style-type: none"> • Checking tools/equipment prior to use • Operating a valve manifold with only a few valves • Initiating a work request • checking equipment during normal shift routine • Rebuilding a non safety class valve 	<ul style="list-style-type: none"> • The activity is simple and is performed frequently • The task is not complex for operators who have completed the training and qualification program • The task can generally be done from memory • The task can be done from memory using log sheets and other information • Successful accomplishment of the task is within the knowledge and skills of qualified personnel

References [3, 12, 18–23] provide additional information concerning the topics presented in this section.

2.4.2. Level of procedure detail and use

It is also important to recognize that the same level of detail and use is not appropriate for all plant procedures. The procedures should generally be kept as simple as possible, consistent with the training and experience expected of the user. For example, a detailed checklist type procedure may be appropriate for conducting a functional test of the plant protection system, while only general guidelines and criteria should be necessary for the conduct of pre-job briefings. It is necessary for plant management to establish a clear policy as to which activities will require detailed procedures and verbatim compliance, and for which activities lesser controls will be required. Table I shows an example where three categories of procedure use have been established; continuous use, reference use, and information use. This table also shows: types of tasks that are suitable for each category, procedure location during task performance, how the procedure is used, and what documentation of task completion is required.

Such a clear distinction between procedure categories and how each category is to be used has been found to facilitate procedure adherence because once the procedure category is established, there is very little interpretation required concerning expectations about how it is to be used.

Detailed, checklist type procedures are needed for many plant activities in order to ensure that they are performed in a consistent and controlled manner. However, it is important for the individuals using such procedures to recognize that a detailed checklist procedure has the effect of causing the persons to focus primarily on the individual steps, rather than on maintaining an overview of the task. Such checklists also tend to reduce the critical thinking during task performance. NPP personnel need to be aware of the focus that a detailed checklist can cause; that is, the potential for blind compliance. By being aware of these limitations, and using a self-checking technique such as the “STAR” system (stop, think, act, review), plant operations using detailed checklists can be performed very effectively. Section 3.1 provides further discussion with respect to establishing management expectations concerning the use of procedures.

Where it is necessary to include technical information with a procedure it should be specific to the tasks and separated from the procedural steps, usually by including it in the introductory material.

An additional consideration in the philosophy of plant procedures is the target audience for which they are written. A common practice is to address plant procedures to the least experienced person who is qualified to perform the task independently (without direct supervision). While this consideration may seem rather obvious it is useful from both the perspective of the procedure writer and the user to have this point clearly identified. It also serves as a reminder of the importance of the link between plant procedures and the training provided for a particular task.

References [10–12, 24, 25] provide additional information concerning the topics presented in this section.

TABLE I. PROCEDURE USAGE CATEGORIES

PROCEDURE CHARACTERISTICS	PROCEDURE USAGE CATEGORY		
	CONTINUOUS	REFERENCE	INFORMATION
Types of activities for which such procedures are to be used	Procedures that: <ul style="list-style-type: none"> - Control activities with a direct impact on Nuclear Safety or plant reliability or Technical Specification compliance - Control activities that are complex or difficult - Document activities (steps) as they are performed - Infrequently performed activities (less frequent than quarterly) - Activities performed at multiple locations simultaneously requiring co-ordination 	Other procedures that: <ul style="list-style-type: none"> - The work consists of small segments easily performed from memory - No immediate consequences of improper actions - Not complex or infrequently performed 	All administrative procedures and some technical procedures
Procedure location requirement	At the location of the job activity	Available to the user, but not necessarily in hand	Available as needed
How the procedure is to be used	<ul style="list-style-type: none"> - Steps performed as written and in specific sequence - Steps read before performance - Independent procedure readers may be used - Independent verification may be required for each step 	<ul style="list-style-type: none"> - Referred to prior to evolution start - Referred to as often as necessary to ensure procedure adherence 	-Referred to as needed
Documentation (sign-off) method	<ul style="list-style-type: none"> - Steps documented as performed - More than one step may be read and performed in sequence prior to sign-off (Note: that not all continuous use procedures have the requirement for sign off e.g. EOPs)	<ul style="list-style-type: none"> - As each hold point is completed - Other steps or sections at completion of the task 	Documentation of overall task completion

2.4.3. Reading level of procedures

The use and usefulness of procedures is significantly impacted by their reading level as compared to the reading level of the users. An example is that engineers typically write many NPP procedures. They often write at the level of a graduate of a technical university, such as other engineers. However, many of the NPP personnel who use these procedures may only have a secondary school level education. For example, the following sentence may be appropriate for a scientific journal but would not be suitable for a plant procedure:

“An emergency situation in human organization context is an extremal situation with relatively well distinguished domains of agent’s activity, and which requires rational explanations of agent’s interventions.”

The following illustrates language usage more appropriate for use in procedures:

“In an emergency the operator shall use the appropriate procedure or follow the guidance of the Operational Limits and Conditions.”

Additionally, for some of these personnel the procedures may be written in other than their native language. In recognition of this situation, some NPPs have intentionally controlled the reading level of their procedures to ensure that they can be clearly understood by their users. Reading level is heavily influenced by sentence length and multiple syllable words. Realizing this, some popular word processing programs include reading level analysis features. Because many technical words people need to know are unique to NPPs, these reading level analysis features can be adjusted to account for these words. Once that is done, it is relatively easy to determine reading level. Some NPPs have, as part of their procedure development process a step to perform a reading level analysis.

References [10–12, 25] provide additional information concerning the topics presented in this section.

2.4.4. Emergency operating procedures

Following the Three Mile Island accident in 1979, emergency operating procedures (EOPs) have been viewed as the next line of defense, after plant design, in preventing or mitigating core damage as a result of unplanned transients. The current industry trend for these procedures incorporates a symptom-based approach (also known as a state-based approach) where operator actions result from the monitoring of plant symptoms rather than from specific identified events (i.e. the operator responds to the symptom of loss of primary inventory as opposed to the specific event of a loss of coolant accident). The procedures may be formatted as flowcharts or dual-column, but all the symptom-based procedures prioritize operator actions based on the potential threat to the three barriers (fuel cladding, primary coolant system boundary, and containment) and allows the operator to respond to these threats prior to event diagnosis. The procedures also offer alternative actions should the primary action fail. The event-based approach relies on the operators expertise to diagnose the event and chose the procedure designed to mitigate that specific event, and in most cases, places a tremendous amount of stress on the operator to make the correct diagnosis.

Symptom-based procedures require the NPP to complete a significant amount of site-specific thermal hydraulic analysis of bounding scenarios. This analysis ensures a generic set of

operator actions for loss of each critical safety function are sufficient to mitigate the most severe challenge to that critical safety function. While NPPs of similar vendor type, or owners group, can share EOPs, any differences in plant design require the EOPs and thermal hydraulic analysis to be plant specific.

In recent years, it has been determined that the potential for a significant threat to the three barriers occurs, not only from full power operation, but also during shutdown conditions. EOPs, therefore, have been expanded to cover these conditions when the reactor coolant system may be depressurized and the vessel head removed. Due to the specific requirements of certain plant configurations that may exist during shutdown, together with the reduced level of automatic protection, many of these procedures are specific to these plant conditions and initiating events and thus are very event specific.

Most recently, it has been recognized that the operator needs additional guidance for those conditions beyond the design basis accidents where core damage exists or is imminent; hence the evolution of severe accident management guidelines (SAMGs). Due to the wide variety of conditions that may exist, these guidelines have been written in a symptom-based format and offer greater latitude in determining the appropriate success path.

Annex F describes the symptom-based, event-based, and integrated (combination of the two) approaches to emergency operating procedures. Procedures for abnormal conditions and design basis accidents may either be event-based or symptom based. Symptom based emergency procedures for managing beyond design basis accidents that take into account all the available capability of the plant are recommended.

References [22, 26–37] provide additional information concerning the topics presented in this section.

2.5. DEVELOPING PROCEDURES

2.5.1. Procedure writer's guide

Procedure writer's guides are documents that provide guidelines for the development and revision of plant procedures. A procedure writer's guide is an efficient and effective tool to ensure that the procedures are clear, concise, consistent, readable and easy to use. This goal is more achievable if the procedures are kept as simple as possible and use uncomplicated and standardized language. The contents of a typical procedure writer's guide includes:

- establishing the technical basis for procedures (including information and data gathering)
- the types of procedures to be addressed (scope)
- the category of procedure (e.g. continuous use)
- content and format guidelines, including:
 - appropriate level of detail
 - consistency
 - text and page layouts
 - graphic design (e.g. use of symbols)
 - writing style and language

- format such as linear narrative or flow charts
- procedure organization
- use of warnings, precautions and limitations
- use of color.
- writing action steps
- computerization (additional information on this topic is provided in Section 5.1)
- procedure verification and validation
- review and approval process
- example procedures
- glossary of terms
- acronyms and abbreviations
- action verb lists (where only defined words are used in standard instructions)
- constrained language list (where only a limited vocabulary is approved)
- symbols
- equipment identification
- tolerances.

Annex A provides the table of contents for an example procedure writer's guide, along with information on how to obtain the complete document.

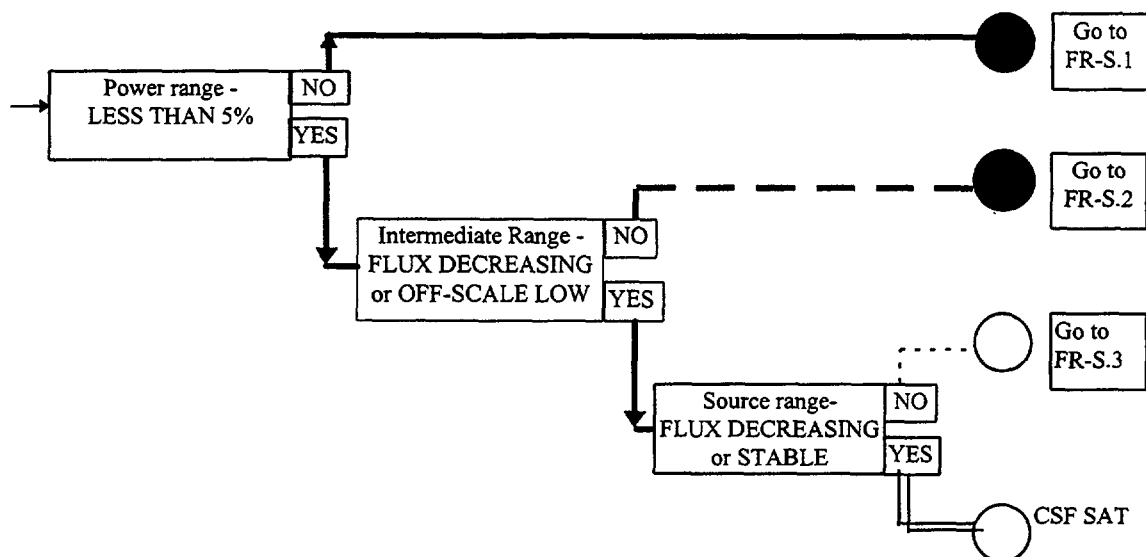
References [10, 11, 25, 38–48] provide additional information concerning the topics presented in this section.

2.5.2. Human factors

The procedures form the principal interface between NPP personnel and the plant. It is therefore essential that good human factor practices are incorporated consistently throughout the procedures, and through the process of developing and maintaining the procedures. One method of achieving this is to include the best practices in the writer's guide. Human factors will also affect other aspects of the process, in particular the verification and validation. Much attention has been paid to human factor aspects of power plant operations since the beginning of the 1980s, and many of the good practices recommended here are derived from earlier programs.

References [32, 49–56] provide additional information concerning the topics presented in this section.

One aspect which is necessary to establish at the outset is the use of color in plant procedures. Many facilities rely on black and white printing and photocopying for reproduction of the procedures and have therefore avoided the use of color. As color printing and copying become more economical and standard the use of color will become more commonplace, as it already is for computer monitors and safety parameter display systems (SPDSs). It should be treated with care and reference made to specific human factors advice to avoid inappropriate use. When color is used, the criteria should be clearly established and applied consistently. Shown in Figure 3 is an example of a color flowchart for an SPDS display that has been designed so as to be understood if printed in black and white.



Symbols and Abbreviations:

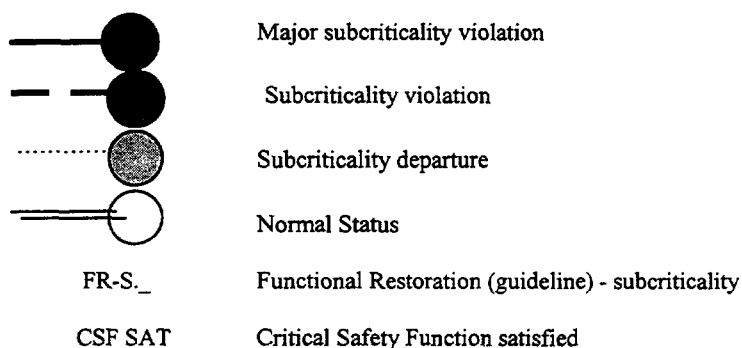


FIG. 3. Subcriticality status tree.

2.5.3. Considerations in a multi-national/multi-language situation

There are occasions when different cultures and languages may exist between the plant designers, the construction contractor and the end users (typically NPP personnel). This is particularly true for plants in developing countries which are often provided by foreign suppliers. When these situations exist it is important that they are considered from the outset of the development of the procedures. The end users should be involved in this process from the beginning. Particular considerations in this area include:

- Particularly for multi-language communities, which language is to be used for the plant procedures. In some cases, plant procedures have been provided in two languages. When this occurs there needs to be a method to establish priority between the two different versions of the procedures if differences exist.
- Different cultural norms may favor one format over another (e.g. use of graphics vs. text, flowcharts vs. linear approach).

- Verification and validation of procedures should be done in the language(s) which will be used for the procedures.
- Where procedures are prepared from source material in another language, consideration should be given to the language skills and training needs of both the originator and the client organization, as both will have a role in verification of the procedures.
- Where procedures are used by staff for whom the procedure language is not their first language, appropriate language training should be available to the subject staff and their supervisors.

2.5.4. Operator (or user) aids

The provision of operator aids, such as dedicated display systems, annotations to the controls or instruments at the task location, or computerized support, should be recognized in the development of the procedure. The level of detail or additional material provided in the procedure will be influenced by the content of these aids. However the use of such aids requires their inclusion in the configuration management process used for plant procedures in order to ensure that they remain appropriate and effective when the procedure or plant is changed.

A particular example of an operator aid is the integration of the operating procedures with the control function possible with computerized work stations in advanced control room design. In these cases alternative procedures may be required when the computerized interface is unavailable. Such procedures should be mutually consistent as far as the differing design features allow. A similar situation arises with the use of an auxiliary shutdown panel, or emergency control room, to cover the loss of function of the main control facilities. Annex G presents an example of this situation.

References [3, 19, 49] provide additional information concerning the topics presented in this section.

2.6. IDENTIFYING INTERFACES WITH OTHER PUBLICATIONS

There are a number of interfaces that procedures have with other documentation. Three such interfaces that are important are:

- Supporting documentation necessary to complete the task using a plant procedure (e.g. vendor technical manuals)
- Bases information (including design and licensing documents)
- Training material

Individual organizations may include specific documents in different categories. For example, the document containing the operational limits and conditions (known in many utilities as the technical specifications) may be considered to be part of the design information if published as part of the safety case, or as part of the operating manuals. Guidance on the development of an operational limits and conditions document is contained in IAEA Safety Series No. 50-SG-

O3 [57]. Additionally, further discussion on operational limits and conditions is contained in IAEA Safety Series No. 50-C-O, Code on the Safety of Nuclear Power Plants: Operation [37].

2.6.1. Supporting documentation

Supporting documentation, such as vendor technical manuals, should be considered as part of the plant procedures system. It must be ensured that the supporting documentation is available and appropriate. If the supporting documentation is revised it is necessary to determine the need for related changes in plant procedures. Some vendor manuals may not be included in the NPP configuration control system, but a mechanism should be established to identify the impact of changes in vendor manuals on plant procedures. Changes to the design may impact the information in the vendor's manuals, and this also needs to be recognized, particularly if it is not possible to update the vendor's manuals.

It should be recognized that supporting documents that are not included in the overall plant procedures system may not be available within any computerized network and thus may not be available for on-line reference or search.

2.6.2. Bases information

It is important for assumptions in the procedures to be identified, in order that changes in these assumptions be reviewed to determine whether such changes result in a need to revise associated procedures. However, including these assumptions (bases) in the procedures often results in procedures that are more difficult to use. One method of maintaining information on the bases for procedures without reducing their ease of use is to record the bases for procedure tasks in supporting documents. Such supporting documents should not contain material that is necessary to complete procedure tasks. Such bases documents can provide useful training material, a link to the reference documents, and may record the commitments to operate in a particular manner. If bases documents are produced it is necessary to maintain consistency with the related procedure through including these bases documents in the procedures configuration management system.

It is beneficial to separate design information from the procedure steps as far as practical. This helps to maintain the clarity and focus of procedures and to minimize the number of procedures which need to be revised when design information is updated. To satisfy quality assurance requirements, a list of the references that relate to each procedure is necessary. It is beneficial to include bases information related to plant procedures as part of the computerized plant procedures network so this information is available for on-line reference or search. Operating experience feedback and regulatory commitments are examples of such information.

2.6.3. Training material

For many NPPs, the information provided in plant procedures, and supporting safety analysis and design documents is used to develop training materials. It is important that interfaces are identified between these documents and training materials, so that training programs are based on current and correct information. One way to reduce the resources needed to maintain such training materials is to use, wherever feasible, the associated procedures and related documents, rather than creating separate training materials with the same information. In addition to reducing the resources needed to maintain training materials, this approach has the

additional advantage of training NPP personnel to use the procedures and other documents that they will be using on the job. Such an approach does not eliminate the need for training materials related to the basis for use of plant procedures, because there remains a need to develop lesson plans on how to teach such information. Rather, the volume of separate training materials is reduced to the minimum needed.

2.7. VERIFICATION AND VALIDATION

For any procedure to be useable it is important to include verification and validation in the development process. In this context, verification and validation are defined as:

- **Verification** — The processes of determining if a procedure is administratively and technically correct.
- **Validation** — The process of evaluating procedures to ensure that they are useable and that they will function as intended.

Many NPPs have adopted a graded approach to verification and validations meaning that the approach and resources devoted to these efforts are commensurate with the importance of the activity. The importance is generally determined based on the consequences of inadequate performance of the activity. The methods and resources needed for verification and validation will vary for different types of procedures. For an administrative procedure, such as record keeping, verification and validation can be completed through a tabletop review. For emergency operating procedures, verification might include checking technical information in procedures against the applicable design documents, while validation might include the use of mock-ups of the plant, a full-scope control room simulator as well as direct use of the plant. For infrequently performed procedures that can be scheduled, some NPPs have used an approach of validation just prior to use.

The process of verification and validation should be as simple as possible. The level of verification and validation necessary for each category of procedure will differ, but should be clearly defined in the management of the process. For validation of many procedures it will be sufficient to perform the process at the first use of a new procedure, or the first use following major revision. Techniques generally used for validation are listed below from most rigorous (and resource intensive) to least rigorous:

- on-the-job validation
- simulated performance
- walk-through
- table-top discussion
- comparison (of the procedure with like procedures).

Special attention must be paid to ensuring procedures are validated in the form they will be used in the field. Procedures intended for use on a computer screen should be validated while using a computer and procedures intended to be used as paper copies should be validated using the paper version. Computer based procedures, particularly those using hypertext, require special considerations for their verification and validation because of the multiple ways in which they can be used. The verification of computer based procedures should be applied to all phases of the preparation process. The process should be designed such that

weak links and potential deficiencies are avoided. The verification of such procedures require special techniques that are not currently standardized.

Some NPPs include the first actual use of the procedure as the final step in validation. In this case it should be clear to the user if a procedure has been previously validated or not, so that additional care may be applied when performing this task.

When simulation modeling is used to validate procedures, either in advance of being able to access the plant or for off-normal or emergency procedures that cannot be encountered on the plant, the quality of the results will be limited by the extent and validity of the simulator model. At the early stages of a simulator project the analytical information may be incomplete or untested.

Annex D provides an example of a procedure verification checklist. Annex E provides an example of a procedure validation checklist.

References [27, 28, 31, 58, 59] provide additional information concerning the topics presented in this section.

2.8. REVIEW AND APPROVAL

- It is necessary that only approved procedures are used. Therefore, an administrative process is needed to ensure that the appropriate level of review and approval is provided prior to use of plant procedures. An administrative process to ensure adequate review and approval should have the following characteristics:
- The process should be as simple and as fast as possible.
- Unnecessary reviews and approvals should be avoided; each reviewer should be aware of the aspects of the review for which he is responsible.
- The requirements for verification and validation should be identified.
- Training requirements prior to releasing the procedure for use should be identified.
- The need for a periodic review should be determined.
- The choice between temporary or permanent procedure change should be determined.

Section 4.3 provides details concerning the procedure revision process.

References [7, 9, 14, 24] provide additional information concerning the topics presented in this section.

3. USE OF PROCEDURES

Procedures are used to ensure safe and reliable operation. For this to be achieved it is necessary that tasks are performed in a manner which is consistent with the assumptions of the safety analysis. This not only requires that procedures are written, but also that they are available, and are used in the expected manner, with the appropriate questioning. Procedure

user's guides have become an accepted aid to enhance the consistent and appropriate use of procedures.

3.1. PROCEDURE USER'S GUIDE

A procedure user's guide clearly defines the rules for using plant procedures. Some NPP procedure user's guides are in one document where generic rules are first discussed followed by chapters describing specific rules related to each category of procedures. Other NPPs have separate user's guides for each type of procedure. In either case a procedure user's guide generally includes the following:

- Defines management expectations concerning when and how procedures are to be used. Included in this topic is the procedure usage categorization presented in Table I (continuous, reference, information).
- Establishes system for retrieval of the current, approved procedure for performance of task.
- Specifies an approval/authorization process before performance of the procedure.
- Clearly define rules of performance (i.e. transitions between procedures, sign offs, communications).
- Identifies how operator aids are to be used during the performance of procedures.
- Defines allowable deviations from procedures and specifies options when procedures can not be performed as written.
- Defines a method for documentation of completion or partial completion of the procedure (step wise, task wise, etc.).
- Provides a method for final storage for records to conform to station and regulatory requirements.

A procedure user's guide can assist in achieving consistent performance of procedures thereby reducing human error and achieving management expectations..

Annex B provides an example of a procedure users guide. References [12, 16, 18, 20, 21] provide additional information concerning the topics presented in this section.

3.2. DOCUMENT ADMINISTRATION AND AVAILABILITY OF PROCEDURES

Procedures must be available to the users at any time. Whenever procedures are needed for immediate use they must be readily available and retrievable by the users (i.e. a controlled copy of the operating procedures in the control room). These controlled copies must be maintained in the work place and periodically checked to ensure the required procedures are available. The procedure set must be organized to allow easy retrieval and the necessary copies must be available to enable users to execute the procedures, including access to electronic databases.

Some NPPs maintain procedures in an electronic form with the capability to print copies as required by the users. Whether making a copy of a procedure or printing an electronic copy

the procedure control system must ensure the user obtains the approved version of the procedure.

It is of utmost importance that the user access only the copies of documents that are approved for use and that are the current revision. Furthermore, this should be readily apparent to the user. There are many ways to achieve this. One example would be to stamp each page of the procedure with a colored stamp that was initialed by an authorized person. (The reason for the colored stamp is to allow the user to quickly differentiate between a controlled copy and a black and white photocopy.) Experience has shown that use of a local area network (LAN) where users have read only access to the controlled files is another effective way to recognize an approved document. Annex C provides an example of a system to identify the approved version of a procedure.

References [12, 19] provide additional information concerning the topics presented in this section.

4. MAINTENANCE AND REVISION OF PROCEDURES

For NPPs that have been operating for some time, maintenance and revision of plant procedures is their most resource intensive aspect. The following are some aspects of plant procedures that relate to their maintenance and revision.

4.1. CONFIGURATION MANAGEMENT

Configuration management is the process that ensures the plant is modified, maintained, operated and tested in accordance with the design basis and licensing requirements.

Configuration management methods are used to ensure plant procedures and supporting technical documents are consistent with the systems, equipment, and components installed and operated in the plant. Configuration management methods are also used to update plant procedures and supporting technical documents when physical changes are made to actual plant systems, equipment, and components.

It is essential that the procedures and supporting technical documents reflect current conditions and requirements. When physical changes are made to actual plant systems, equipment, and components concurrent changes should be made to operating procedures and supporting technical documents. Similarly, a system is needed to ensure changes to externally generated documents (e.g. vendor manuals, calculations) are properly incorporated into the procedures. Changes to maintenance procedures and other supporting technical documents can be deferred for a period of time after initial operation of the modifications. Configuration management, as it pertains to documentation control, is even more difficult in multi-unit stations where design changes to systems may be at various stages on each unit and no one procedure will be applicable to all units at a particular point in time. Some NPPs have addressed this need through requiring that each unit's procedures be uniquely identifiable (e.g. be printed on colored paper exclusive to that unit).

References [7, 60–63] provide additional information concerning the topics presented in this section.

4.2. FEEDBACK MECHANISM

A mechanism should be in place to allow anyone in the NPP to identify errors in procedures and to submit suggestions for revisions and provide reasons for changes. This is especially true if difficulty was encountered when implementing the procedure. The process should be easily implemented in order to encourage constructive feedback. It should also ensure feedback is given to the person submitting comments as to what follows up actions are being taken due to their submissions. Plant and industry operating experience are sources of information which should be used to improve procedures. These include:

- lessons learned through operation and maintenance activities
- modifications/upgrades of plant systems and equipment
- feedback from training activities
- information developed through training development activities
- external information and recommendations.

References [9, 16] provide additional information concerning the topics presented in this section.

4.3. REVISION PROCESS

The revision process itself should be simple and timely so as to limit the use and existence of temporary instructions. An efficient system allows for easy “partial revisions” of individual sections that would not destroy page numbering of the document downstream of the change but still include a mechanism for identifying the latest revision to a section. Efficiency can be realized in such a system as it may be quicker to pass revisions of a section through the approval process than it would to pass an entirely revised procedure through the same process. Some NPPs use a revision numbering system where “change of intent” of a procedure is indicated by a full number change (e.g. Revision 5 to Revision 6), while “non-intent” changes are indicated by going from Revision 5a to 5b. More rigorous review is required for change of intent revisions. Non-Intent changes typically are correction of typographical errors, component labeling errors, etc. NPPs have found it important to include in their revision processes the following features:

- A way to track the status of procedure revisions that are in progress.
- A method to identify the training requirements for a revision and a method to identify when required training is complete.
- A method to monitor “turnaround” time from the submittal of a request for revision until the revised procedure is issued for use.
- Monitoring of the backlog of procedure revisions.
- A means to determine which procedure revision was in effect at a particular time.

With the advent of computers, maintenance of documents has become much more manageable and has allowed easier access to document by the workforce. However use of computer based files comes with its own set of concerns that must be addressed. As more and more plants’ word processing requirements are met electronically, it becomes increasingly important to have electronic controls in place to prevent “unauthorized” changes to the master document. As

documents are placed on local area networks (LANs) to give greater access to the workforce there is a danger that unauthorized or unapproved changes could be made. Users should have a read only capability to documentation to ensure changes cannot be made. The procedure change author or reviewer would be allowed to make comments and changes to the a copy of the master file. Only an authorized individual or documentation control group would be allowed to make changes to master files and have the capability of replacing the existing master copy on the network with the latest revision. There must also be a method to ensure any controlled paper copies of the latest revision get updated simultaneously with the electronic copy.

Reference [22] provides additional information concerning the topics presented in this section.

4.4. REVIEWS OF PLANT PROCEDURES

Many NPPs conduct periodic reviews of procedures at a fixed interval. A number of NPPs have eliminated such periodic reviews, relying instead on real-time reviews prior to use along with continuous feedback to identify ways to improve the system. Frequently used procedures should not require periodic review if the users report deficiencies and the procedures are amended in a timely manner. The criteria for whether periodic review is required should therefore include the safety significance and the frequency of use. Many NPPs have found that significant effort is required for a periodic review of plant procedures without a significant benefit. These plants have instead adopted a review prior to use approach with a more comprehensive review given to infrequently used procedures prior to their use (e.g. procedures for high consequence, infrequent tasks such as refueling .should be reviewed each time prior to use).

The need and type of periodic review would, to a certain extent, depend upon the quality of process in place for maintenance and revision. An effective review process would ensure procedures are current and of high technical quality. This would alleviate the need for rigorous periodic reviews. However, it is prudent to do a periodic review of a lesser magnitude as part of an audit to gain assurances the system is performing well. This could be limited to a sampling of the procedures. The extent of problems found would influence the sampling size. Another reason for periodic review would be to address those documents infrequently used. A good periodic review cycle would require that a sampling of procedures be reviewed over some minimum period (say every two years).

References [9, 22] provide additional information concerning the topics presented in this section.

4.5. TEMPORARY PROCEDURES

A temporary procedure process is needed to provide immediate instructions in two circumstances:

- until documentation changes can be implemented through the normal procedure approval process, or
- when there is a temporary and approved change in equipment or system status.

Efforts should always be made to limit the time frame and numbers of such temporary procedures (some NPPs use the total number of temporary procedures in place as a performance indicator). Guidance should be provided as to the required approvals for temporary procedures. Also, a mechanism is needed to ensure the user is aware of any temporary procedures.

References [16, 18, 22, 64] provide additional information concerning the topics presented in this section.

5. PROGRAMMATIC CONSIDERATIONS FOR PROCEDURE PROGRAMS

Implementation of a procedures program has several considerations that should be addressed to ensure the overall success. Computerization of procedures, impacts on training, development of procedures for new plants, use of common procedures among plants, and workforce restructuring, all affect the success of a program. The following section discusses these factors and their relationship to a procedures program.

5.1. ORGANIZING AND STRUCTURING PROCEDURES TO FACILITATE THEIR COMPUTERIZATION

The scope of this report does not include how to develop computer-based plant procedures systems, as this topic was addressed recently in IAEA-TECDOC-808, Computerization of Operation and Maintenance for Nuclear Power Plants, July 1995. However, what is included here are issues that should be considered in the organization and structure of such procedures systems to facilitate their computerization. These include:

User/reviewer issues:

- appropriate access controls (e.g. read only for users; read and comment for reviewers)
- formats that are suitable for display on all computer systems in use
- computer monitors capable of displaying the appropriate amount of information
- links between alarms/indications and appropriate responses (e.g. hypertext links)

Developer/maintainer issues:

- Master document will usually be an electronic file (although approved controlled copies will be on paper).
- Common standards are needed for all plant procedures (e.g. word processor software, human factors considerations such as procedure formats). This does not mean that procedures all have to have exactly the same look and level of detail, but rather that the same functions are performed in a consistent manner (for example, EOPs will likely have a different structure than maintenance or test procedures).
- Use of common standards will facilitate searches for revisions, cross-references, etc. and minimize the effort required for updates. It is important to recognize that such capabilities will be dependent upon adherence to such standards.
- Capability provided to facilitate searches for revisions, cross-reference, etc. and minimum effort required for updates. This will require the use of standardized terminology.

- Use of plant database for component IDs, titles, set-points, etc.
- Capability of software to incorporate figures and graphics.

Annexes G and H provide example applications of computerization of procedures. References [35, 56, 65, 66] provide additional information concerning the topics presented in this section.

5.2. LOSS OF EXPERIENCED WORKFORCE AND TRANSFER OF KNOWLEDGE

NPPs have often found that after 10 to 20 years of operation there is a point at which a significant fraction of the plant work force is lost due to retirement, reorganizations, etc. When these individuals depart, the knowledge that they have about how and why things are done is often lost. This can result in an overall loss of organization knowledge and memory unless methods are established to identify and retain this information. Upgrades or expansions of plant procedures are effective ways to do this as part of a more global configuration management program. In addition, related bases documents are important in order to identify, for future use, the reasons why things are done as they are and to amplify relationships to other documents/commitments. Management expectations such as safety culture and good operating practices and skills need to be clearly included to avoid being lost (e.g. the need to use two independent indications to confirm plant response).

Reference [67] provides additional information concerning the topics presented in this section.

5.3. THE EFFECT OF INCREASING COMPETITION AND OPEN ENERGY MARKETS ON THE PHILOSOPHY OF PLANT PROCEDURES.

Many NPPs are now facing the prospect of operation in open energy markets where they must compete, based on lowest price, to sell the electricity they produce. This is resulting in additional emphasis on improving efficiency and performance. Many nuclear plant operators are instituting changes to simplify plant operation and support functions while maintaining high levels of safe and reliable operation.

Procedures are an integral part of tasks and processes for the operation and support of nuclear plants. The optimization of these tasks and processes needs to be done in a systematic way that evaluates the need for a task or process, integrates and simplifies them and develops appropriate procedures. This optimization process should result in improved safety and operational performance as well as a reduction in the number or volume of procedures. Attachments 1 and 2 of Annex B provide an examples of methods used to make objective determinations as to what procedures and level of detail of these procedures are appropriate.

Deficiencies in the plant procedure system may contribute to errors or inconsistent performance that prevent achievement of improved safety, reliability and availability. In these cases systematic efforts to improve the procedures will be justified on both an economic and safety bases. The same type of criteria as described above should be considered in determining where improved procedures would be most effective, and also the types of improvements that should be considered.

5.4. PROCEDURE DEVELOPMENT ISSUES UNIQUE TO NEW PLANTS

For new plants, it is important for the plant procedure system to be an integral part of the initial plant design. In other words, that the information needed to operate and maintain the plant is considered during the design process for the plant, and that integrated decisions on plant hardware and layout are made based on both technical and human factors considerations. This approach is quite cost-effective for the following reasons:

- contemporary information management (IM) systems provide the potential for significant productivity gains (but, as evidenced by backfits of some existing NPPs, such gains are much more expensive and difficult to realize if IM needs are not considered during the design phase);
- necessary resources and knowledge are more available at the time of the plant design;
- nomenclature and documentation needs can be better integrated from both design and operational perspectives at this time;
- continuity of documentation can be maintained from pre-operational through startup to operational phases:
 - results/data from earlier phases can be directly used to develop procedures for the operational phase
 - pre-operational/start-up test results are needed for validation of operating procedures);
- costs incurred during plant design, construction, and testing can be considered as capital costs, rather than operation and maintenance (O&M) costs.

There are considerable advantages to be gained through maintaining continuity of procedure writers from pre-operation through start-up (commissioning) and operation. The number of procedure writers will be greater in the pre-operational phase and will inevitably include temporary contract staff. There will be benefits to the transfer of knowledge if a core team of permanent or long term procedure writers continue with the group into the operational phase. The knowledge that such procedure writers develop as a result of their involvement in these phases of the plants development can therefore be maintained. Also, engineers are not always good procedure writers because they tend to write for other engineers, rather than for an audience that has less knowledge about the plant design than they do. The reduction in size of the procedure writers group will be progressive during start-up and the early years of operation when the majority of procedure validations will occur.

Some plants have found that after several years of operation, a significant fraction of the procedures written have not yet been used. This is an indicator that some unnecessary procedures have been written. If procedures are written during the commissioning phase, or early in the operational phase that are not expected to be used until later in the plant life cycle (e.g. in-service inspection, major component overhauls), it is quite possible that these procedures will require significant modification prior to their use based on experience gained, administrative procedure changes, etc. Thus, it may be desirable to delay development of such procedures until closer to the time they will be used.

As indicated earlier, there are potentially significant advantages to be realized from establishing a common nomenclature and designation for components and equipment among the architect engineer, construction contractor, and utility. Through this approach efficiencies can be gained in development of equipment lists, drawings, design documents and plant procedures. However, establishing such common nomenclature requires considerable effort, as each of these organizations have established systems which they are generally reluctant to change. An alternative, which doesn't realize all the benefits, is a comprehensive cross-referencing of nomenclature/designations for plant equipment and systems.

5.5. THE RELATIONSHIP BETWEEN TRAINING AND USE OF PROCEDURES

There should be an integrated, coordinated effort between NPP personnel training and qualification programs and the plant procedures system. A decision as to the level of detail and structure of a particular procedure for a particular task should be based, at least, partially upon knowledge of the training objectives related to this task. Similarly, the training objectives for a particular task should be developed based on an understanding of the level of detail of the associated procedure. For example, if the training objective for a particular maintenance task, such as: "lap a valve seat to vendor specified tolerances, without reference to the associated procedure", then the procedure should be in the reference or information category. Further there is not a need to provide detailed steps in the procedure, because this task has been determined to be one where skill of the trade is expected (i.e. personnel who have completed the training and qualification program for this task are expected to be able to perform the task without continual reference to the procedure.

A comprehensive training program where all aspects of the procedures (actions, bases, consequences, etc.) are discussed can result in a reduction in the amount of information required to be maintained in the procedures thus reducing level of effort needed to develop and maintain procedures. This is not meant to imply that there should be no overlap between the knowledge provided through training and what knowledge/information is provided in plant procedures. Rather, the training and procedures provided for a particular task should be analyzed in a coordinated manner. This relationship between training and qualification programs and plant procedures can be analyzed to find the most cost-effective combination for the utility/NPP. This analysis should include the consideration that there is some minimum background knowledge and skills that are needed to respond appropriately in the case that the task does not proceed as described in the procedure, and also that through training the task may be performed more efficiently (e.g. fewer resources required) or more effectively (e.g. more reliably, lower radiation exposures). Again, the interrelated aspects of these factors underline the importance of an integrated approach toward training of NPP personnel, and procedure development and use. The following are some specific issues in this regard:

Determining whether training is needed related to a procedure. Training should be required on all of those procedures where a failure to satisfactorily perform the task may result in significant negative consequences to the plant or NPP personnel.

Determining who needs the training identified for a particular procedure. Training should be provided to all staff considered qualified to perform the activity. This should include initial training and periodic refresher training. However, for those tasks that are performed infrequently, and which can be scheduled, the approach described below for just-in-time training may be a more appropriate alternative.

Determining how often training is provided. Training should be provided at a sufficient frequency to ensure that personnel can perform the task adequately. There will be a significant fraction of tasks which personnel are expected to maintain their proficiency through working on the job, and thus for which no further training is needed. Other tasks with demanding performance standards, and which are not performed routinely on the job, should have refresher training. Tasks performed in response to emergency or abnormal conditions are obvious candidates for this category. Other infrequently performed tasks that can be scheduled in advance, such as tasks associated with outage maintenance or in-service inspection, may be candidates for just in time training, pre-job briefing, or special task qualification, where only a few persons are qualified to perform these tasks.

Link = training to rules of usage. A training program should familiarize all procedure users with the established policy for use of those procedures. This training should address all of the rules of usage and management expectations.

Training should be conducted using approved procedures for the following reasons:

- To ensure personnel are trained in the performance of the task in the most accurate up-to-date manner.
- To prevent negative training on demonstrating inappropriate methods.
- To provide training to demonstrate a consistent format for the performance of the task by all members of the workforce.
- To provide a method for feedback to the procedure development process that can avoid potential adverse consequences during the performance of the task.

Training should be provided on safety significant revisions to plant design and administrative requirements. A structured (and typically documented) decision should be made as to whether training on such changes are needed prior to releasing a revised procedure for use. This decision should also include how the training is to be integrated with the procedure change. Training should be given to all procedure users on those topics where revisions have been made that may have significant impact on the plant should the task be performed incorrectly.

Training on plant procedures should:

- Explain the need/objective of training on the procedure.
- Describe the basic action steps of the procedure.
- Describe/explain the basis for action steps.
- Thoroughly explain the consequences/significance of failure to perform task correctly.
- Describe operating skills and good operating practices that should be applied during the performance of the procedure.

Procedure training should make use of training aids/settings needed to achieve training objectives. Among the training settings generally available for NPP personnel training are:

- Class room,
- Simulator/mockup,
- In plant, or
- On the job training.

The rigor of procedures training should be defined by frequency of performance of task and significance of failure:

- Frequently performed tasks with high level of consequence should have a higher level of training on a more frequent basis.
- Frequently performed tasks with low level of consequence should have a minimum amount of training and rely on performance feedback to determine frequency and scope of training.
- Infrequently performed tasks with high level of consequence should have a high level of training most effectively administered in the following manner:
 - just in time training, and/or
 - pre-job briefing.
- Use of experienced staff that have performed task in the past.
- Infrequently performed task with low level of consequence should have a low level of training most effectively administered by a method such as a pre-job briefing by an experienced staff member.

Reference [68] provides additional information concerning the topics presented in this section.

5.6. CO-OPERATION BETWEEN PLANTS

The use of common procedures or procedures prepared from common guidelines between stations or from owners groups offers several advantages:

- Facilitates movement of personnel between plants
- Reduces the cost of procedure development
- Facilitates the transfer of operating experience between plants.

Caution must be taken when implementing a common procedure to ensure the common procedure is consistent with the plant's physical configuration and design basis. Similarly when developing plant specific procedures from a common guideline the procedure must be developed in accordance with the procedure writer's guide and the plant's configuration.

6. EVALUATING THE EFFECTIVENESS OF PROCEDURES PROGRAMS

The purpose of evaluation is to determine the effectiveness of procedures programs and to identify whether and where revisions or improvements are needed. An evaluation of the procedures program should be used to optimize both the products (i.e. the quality of plant procedures) and the process (development and maintenance) for plant procedures. Evaluation includes both self-assessment and independent review. For many NPPs, evaluation of the effectiveness of procedures programs is not a stand alone activity, but is rather part of an overall evaluation of plant performance. Such an approach has the advantage of evaluating, in an integrated way, all of the factors that contribute to plant performance. This is particularly important for plant procedures because, as has been indicated earlier, the performance of NPP personnel is influenced by a combination of the quality of plant procedures, training, qualification, and supervision.

The following are examples of inputs for evaluating the products of procedures programs:

- operating experience feedback
- periodic reviews of plant procedures
- feedback from procedure validation and verification
- feedback from training activities
- self-assessment reviews
- audits and other external reviews
- plant performance indicators.

These evaluations must consider all aspects of task performance including procedures, training and qualification, and supervision. It is important to ensure that such evaluations identify the root causes of any weaknesses identified, rather than only the symptoms. For example, treating the symptom of perceived inadequate training when the cause is a poor procedure will result in continued problems until the root cause is identified and corrected. Similarly identification of good procedural practices provides the opportunity to promulgate these practices to other procedures and improve the overall safety, reliability and availability of the plant.

The maintenance of plant procedures is an important part of the procedures program. The following are examples of information that may be used to evaluate the process for maintenance of plant procedures:

- the backlog of changes requested
- the response time for a change to be implemented
- the number of temporary changes
- the length of time that temporary changes are in effect
- the quality of the review process
- the attitude of procedure user's toward making change requests.

In summary, a necessary component of a plant procedures program is the evaluation of the both the effectiveness of the process for procedure development and maintenance, and the quality of the procedures.

References [22, 69] provide additional information concerning the topics presented in this section.

Annex A

SAMPLE OF A PROCEDURE WRITER'S GUIDE TABLE OF CONTENTS

NOTE: USDOE STD-1029-92, *Writers Guide for Technical Procedures*, US Department of Energy, 1992 can be obtained at the following internet address:
<http://www.osti.gov/html/techstds/standard/standard.html>

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- Procedures and the Safety Envelope
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Annex B
EXAMPLE PROCEDURE USER'S GUIDE

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1.0. Purpose

- 1.1. This publication identifies good practices to consider when developing a procedure users guide. It encompasses the following types of procedures: management policies, administrative, technical/ operating, maintenance and surveillance. Good practices for emergency, abnormal and alarm response procedures are covered in a separate guide.
- 1.2. This publication presents human factors principles that are applicable to procedures. Applying these principles to the preparation and maintenance of any type of procedure will provide a more readable and understandable document.
- 1.3. Implementation of the guidance in this publication ensures consistency in procedure format, wording and style, thereby reducing potential human error and provides for a greater degree of success in achieving management expectations.

2.0. References

- 2.1. ANSI N18.7-1976, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants.
- 2.2. EPRI NSAC-105, Guidelines for Design and Procedure Changes in Nuclear Power Plants.
- 2.3. INPO 82-017, Emergency Operating Procedure Writing Guideline.
- 2.4. INPO 83-004, Emergency Operating Procedure Verification Guideline.
- 2.5. INPO 84-020, Good Practice OP-210, Review of Operations Department Procedures.
- 2.6. INPO 85-003, Alarm Response Procedures Development and Review Guideline.
- 2.7. INPO 85-026, Writing Guideline for Maintenance, Test and Calibration Procedures.
- 2.8. INPO IHPW-019, Industry Perspectives and Lessons Learned on Procedure Writing.
- 2.9. INPO Good Practice OA-106, Technical Procedure Use and Adherence.
- 2.10. NUREG-0899, Guidelines for the Preparation of Emergency Operating Procedure.
- 2.11. NUREG/CR-1369, Procedure Evaluation Checklist for Maintenance, Test and Calibration Procedures.
- 2.12. NUREG/CR-3817, Development, Use and Control of Maintenance Procedures in Nuclear Power Plants: Problems and Recommendations.

3.0. Definitions

3.1. Administrative Procedures

- 3.1.1. Administrative Procedures assign responsibilities and provide requirements for

activities that are mandated by regulatory entities and do not involve any manipulation, operation, modification, maintenance, testing, or calibration of plant equipment.

3.1.2. Administrative procedures are typically used to solve problems, assemble documentation, process information, and present results of administrative functions.

3.1.3. Administrative procedures may control activities affecting quality or nuclear safety.

3.2. Technical procedures

3.2.1. Procedures that provide details for performing specific tasks involving a man/machine interface.

3.2.2. Technical procedures are used for maintenance, equipment operations, component lineups, surveillance, tests, instrument calibrations, and inspections important to the safe operation of a nuclear power plant.

3.3. User's Guide

3.3.1. A users guide is a document that defines the rules of usage for each specific type of procedure. This may be in the form of one document where generic rules are discussed with chapters describing specific rules related to each category of procedure such as EOPs, normal operating procedure, administrative procedures, maintenance procedures.

3.4. Level of Use Classification

3.4.1. The designated minimum required reference to the procedure during performance of the task.

3.4.2. The following represent the level of use classifications to be applied to procedures:

a. Continuous Use:

Usage requires having the procedure present and read directly by the user or designated reader regardless of how frequently the procedure is performed.

b. Reference Use

Usage requires having the procedure available for reference if needed, but not necessarily in-hand.

Frequently performed technical procedures (tests or evolutions

performed quarterly or more frequently) should be reviewed prior to use.

c. Information Use

The evolution may be performed from memory. The procedure is available for use as needed and for training purposes. (The procedure does not need to be available at the work location). All Administrative procedures fit this use classification.

3.5. Terminology

3.5.1. With respect to all procedures, the following word definitions apply:

- a. May, denotes permission, not a requirement or recommendation. Step provides a possible action to be accomplished if appropriate.
- b. Must, denotes a requirement or a mandatory activity. Step is performed as written.
- c. Shall, denotes a requirement or mandatory activity. Step is performed as written.
- d. Should, denotes a recommendation, not a requirement. Step is performed as written normally, however conditions may be such that alternative actions may need to be evaluated. Supervisor approval is needed to not perform a 'should' action.
- e. Will, denotes a requirement or a mandatory activity. Step is performed as written.

3.6. Procedure Change (On the Spot Change)

3.6.1. A modification to an existing document which results in a page for page change out of selected pages. Changes may be hand written or typed and can either be temporary or permanent modifications to the document.

3.7. Procedure Revision

3.7.1. A document modification which results in a complete redistribution of the entire document. Revisions shall be typed and are permanent modifications to the document.

3.8. Operator Aids

3.8.1. Posted information or signs including sketches, notes, graphs, instructions, drawings, and other documents used to assist operators in performance of their duties. This includes, but is not limited to, items such as posted equipment pre-start instructions, posted instrument setpoints or signs telling operators how to perform actions.

4.0. Responsibilities

This section identifies the individuals and their responsibilities related to procedure use. Specific titles will vary among nuclear power plants, however the responsibilities are generally the same.

4.1. Managers:

- 4.1.1. Convey the content and expectations of this procedure to all personnel they supervise.
- 4.1.2. Ensure all personnel maintain the plant in a safe condition while conducting procedurized activities.
- 4.1.3. Evaluate procedure problems and ensure appropriate corrective measures are taken.
- 4.1.4. Determine the appropriate level of use classification for procedures within their organization.

4.2. Supervisors:

- 4.2.1. Monitor worker activities to verify personnel are aware of managements expectations.
- 4.2.2. Monitor worker activities to reinforce consistent implementation of procedure use and adherence requirements
- 4.2.3. Ensure personnel are adequately trained on procedures necessary to perform their assigned tasks.
- 4.2.4. Conduct appropriate pre-job and periodic briefings to ensure that the process and sequence of activities are understood.
- 4.2.5. Ensure procedures are technically correct and appropriate for work in their functional areas.
- 4.2.6. Evaluate procedure problems and ensure appropriate corrective measures are taken.

4.3. All Personnel

- 4.3.1. Understand and follow the procedure use and adherence requirements provided in this publication.
- 4.3.2. Review and understand applicable procedures prior to performing activities governed by these documents.
- 4.3.3. Perform procedurally controlled activities with a questioning attitude to determine if the procedure is adequate for the activity.

- 4.3.4. Provide feedback to supervisors on procedure problems and assist as necessary in resolving them.
- 4.3.5. Evaluate procedure problems and ensure appropriate corrective measures are taken prior to and during performance of these documents.
- 4.3.6. Evaluate procedures to determine if there is a better or more efficient way of performing the activities controlled by these documents and take action to implement these changes.

5.0. Procedure

5.1. Procedure Adherence

- 5.1.1. Procedures shall always be adhered to during the course of activities, whether the procedure is in hand or the activity is being performed from memory. Performance of an activity from memory, without referring to the procedure, does not relieve the individual from the responsibility for performing the activity in accordance with the procedure.
- 5.1.2. The designed purposes and direction provided in procedures shall be followed during the course of activities, regardless of the level of use. If flexibility is given within the procedure which allows the individual to alter the Steps or segments on an activity, then the procedure is being adhered to as long as the user stays within the flexibility specified.
- 5.1.3. Plant equipment shall be operated according to approved, current revision procedures. (Note: this step should be expanded to detail the methods for verifying the current revision of a procedure.)
- 5.1.4. Personnel shall use a self-checking technique (e.g. "STAR") when operating equipment, implementing procedures, placing or removing clearance tags or other activities that could affect personnel or equipment safety.

S = Stop
T =Think
A =Act
R =Review

- 5.1.5. When a situation arises in which the procedure to be used does not work or unexpected circumstances occur, the following actions shall be taken:
 - a. Place the system or component in a safe condition.
 - b. Contact supervision to inform them of the situation and status of the component/system.
 - c. Evaluate the situation to determine the cause of the unexpected response.
 - d. Modify the existing procedure or develop new procedures as necessary for the existing situation.

5.1.6. Procedure changes are required to be initiated before continuing with a procedure that does not work. The following are examples of situations in which a procedure change is warranted.

- a. Procedure steps cannot be performed as written or in the sequence specified (if the sequence is required).
- b. Procedure will be used for circumstances other than its stated purpose.
- c. Procedure step(s) would result in an incorrect action or inappropriate response.

5.1.7. Verbal (written or oral) communication of steps: Procedural steps communicated verbally should be acknowledged as properly understood. Verbatim repeat backs normally should not be necessary, but as a minimum, paraphrases should be used.

5.1.8. Corrections on procedures shall be lined through with a single line so as to not obscure the original entry, initialed, and dated by the person making the correction.

5.2. Procedure Use

NOTE: Attachment 1, Procedures Level of Use Determination, is an aid for determining the appropriate level of use classification. Attachment 2, Procedure Requirement Evaluation Flow Chart, is an aid for determining when a procedure is required to be developed for an activity.

5.2.1. Each manager responsible for a procedure shall determine the appropriate level of use classification based on the following considerations.

- a. Consequence of improper performance.
- b. Complexity of the procedure.
- c. Frequency of procedure performance.
- d. Need to document procedure performance.

5.2.2. "Continuous Use" procedures have one or more of the following characteristics:

- a. The consequences of improper action could have a direct impact on nuclear safety, Technical Specification compliance, and/or reliability.
- b. The procedure documents activities as the steps are performed.
- c. The activity is difficult and/or complex.
- e. The activity is performed infrequently. (Tests or evolutions performed less frequently than quarterly.)

5.2.3. All "Continuous Use" procedures shall have the following note on the cover sheet.

CONTINUOUS USE

Continuous Use of Procedure Required. ; Read Each Step Before Performing

5.2.4. "Continuous Use" procedures shall be used as follows:

- a. Procedures, or applicable portions thereof, shall be available at the location of the work activity.
- b. Each step of the procedure shall be performed exactly as written and in the sequence specified in the procedure unless specifically allowed otherwise.
- c. Each step of the procedure shall be read before performance, however more than one step may be read and then performed in sequence before sign off.
- d. Independent procedure readers may be utilized in the "Continuous Use" mode. For example, a procedure reader may be used to read each step out loud to the worker(s), who shall repeat back and then perform the action required by the procedure step.

5.2.5. "Reference Use" of procedures is for work activities not classified as requiring "Continuous Use". The typical characteristics of a "Reference Use" procedure include:

- a. Work consists of small segments that can be easily performed from memory.
- b. No immediate consequences of improper actions.
- c. The work is not complex or infrequently performed.

5.2.6. "Reference Use" procedures will not incorporate a procedure usage level note on the cover sheet.

5.2.7. "Reference Use" procedures shall be used as follows:

- a. "Reference Use" procedures shall be available to the user.
- b. "Reference Use" procedures shall be referred to as often as necessary to ensure procedure adherence requirements are satisfied.
- c. The user may obtain and utilize copies of any "Reference Use" procedure needed to perform a task.

5.2.8. "Information Use" procedures are used as follows:

- a. The procedure is referred to as needed.
- b. Documentation and sign-offs are performed as each step on a form or data sheet is completed.
- c. A level of use classification note will not be used on most "Information Use" procedures.

- 5.2.9. Technical Procedures Classified as "Information Use" will have the following note on the cover sheet.

INFORMATION USE 1

Refer to as Needed. Documentation and Sign-Off Required as

Each Step of a Form or Data sheet is Completed.

5.3. Procedure Deviations

- 5.3.1. Deviations from procedures which depart from a license condition or a technical specification have additional requirements as stated below.

- a. A deviation from approved procedures that departs from a license condition or a technical specification is permitted if the deviation is for an emergency when the action is immediately needed to protect the public health and safety and no action consistent with license conditions and technical specifications that can provide adequate or equivalent protection is immediately apparent.

- 5.3.2. The approvals required and the order of notification depend on the urgency of the protective action required. The guidelines listed below are to be followed:

- a. If enough time exists, the superintendent - shift operations shall consult with another member of the plant management staff before approval of the deviation and before implementation.
- b. The deviation shall be approved by the superintendent - shift operations prior to performing the protective action.
- c. The appropriate regulatory authority must be notified, if the protective action would violate a technical specification or license condition. The regulatory authority must be notified before performing the protective action if time permits; otherwise, the notification must be made as soon as possible.
- d. The approved deviation shall be entered in the shift operations log and reported to the manager of operations. The departure and circumstances surrounding the departure shall be submitted to the plant nuclear safety committee by the manager of operations.

5.4. General Usage Guidance

- 5.4.1. Approved procedures shall be followed as written and users shall not deviate from or omit steps except where specifically allowed by procedures.
- 5.4.2. Performance of an activity without referring to the procedure does not relieve individuals from their responsibility to perform activities correctly and in accordance with the latest revision of approved procedures.

5.4.3. If a procedure section/step cannot be performed exactly as written due to missing detail that is within the normal skill of the performer, then performance of the procedure section/step may continue. For example:

- a. A procedure requiring a specific valve be opened to vent a line may assume that removing the pipe cap to accomplish the venting is within the operator skill, or
- b. A procedure requiring a transmitter to be removed may assume that disconnecting leads, tubing, and conduit are within the skill of the craftsman.

5.4.4. If an evolution is suspended for an extended period of time, verification of the initial conditions should be performed again. Re-verification is made at the discretion of the supervisor/designee based on plant conditions that may have changed. As a minimum, a review of the evolution up to the point of suspension should occur.

5.4.5. Operator aids may be used to supplement approved procedures when the information provided is viewed as a convenience and not a requirement for proper implementation of the procedure, but they may not be used in lieu of approved procedures. Use of operator aids shall comply with the following guidelines:

- a. Use of operator aids should be minimized and properly controlled to ensure that postings are correct and current.
- b. They should not be posted in a manner that will obscure controls, indication, or indicating lights.
- c. They should be suitably protected from the environment and firmly attached in close proximity to where they would be expected to be used. They should not be written directly onto equipment.
- d. Operator aids should not be used to bypass normal facility procedure review and approval process. Operator aids that alter procedures should not be approved; instead, appropriate procedures should be changed to incorporate the necessary information.

5.5. Partial Performance of Procedures and Procedure Sections

5.5.1. The act of partially performing any procedure or procedure section should be carefully considered.

- a. Partial performance of procedures may be performed without revision of the procedure when:
 - i. Not all the components listed in a procedure are to be tested or operated; AND

- ii. It can be clearly determined which steps apply to the tested or operated components; AND
 - iii. The remaining steps can be performed without compromise in the designed purpose or direction of the procedure.
- b. When partial performance of a procedure is used during troubleshooting, it should be done in accordance with an approved troubleshooting procedure.
- c. In no case are steps or Sections to be partially performed because of faulted procedure step logic, incorrect guidance, or incorrect step description.
- d. If the procedure is incorrect, a procedure change is required.
- e. If the step(s)/section(s) not performed require a sign-off, then the step(s)/section(s) are marked N/A.
- f. When a procedure or procedure section is not performed in its entirety, then only the prerequisites and initial conditions that apply must be performed.
- g. steps or sections which provide a conditional statement may be performed or not performed based on whether the conditional statement is met.

5.5.2. Steps or sections may be marked N/A or partially performed provided all the following criteria are satisfied:

- a. The step or section is not essential to achieving the designed purpose or direction for which the procedure is being used.
- b. Omission of the step or section does not violate the precautions and limitations or Technical Specifications.
- c. Supervisor/designee concurrence is required to omit step(s) or section(s) during the performance of a procedure. This concurrence and reason is required prior to performing the affected step(s)/section(s). Notes should be used in the "comments" of data sheets, in the procedure or work package, to explain why steps/sections are marked N/A.
- d. The omitted step(s)/section(s) are marked N/A and initialed by the supervisor/designee if procedure sign-off is required.

5.5.3. A governing procedure, work request, troubleshooting plan, or similar document, may be used to state the steps to be performed, or may state the nature of the task in such a manner that it is clearly evident which steps of the procedure are required to accomplish the task.

- 5.5.4. If steps are not performed in the procedure, then corresponding steps and sign-offs on the data sheets/forms should be marked N/A. This may be done without additional review and approval.

5.6. Procedure Sign-Offs

- 5.6.1. Procedure steps that have sign-offs shall be signed off as completed except as follows:

- a. If more than one individual is performing the activity, one person shall coordinate the activity. The coordinator may proceed to the next step based on acknowledgment from a performer that a step has been completed. Step completion shall be documented by:
 - i. The coordinator signing each step based on notification by the performer that the step has been completed, or
 - ii. The performer verifying the required action was completed and signing the applicable step(s) at the completion of the activity.

- 5.6.2. The need for independent verification is identified in procedure steps and sections by an additional initial and date sign-off line.

- 5.6.3. Independent verification of specific procedure or instructions steps is required when:

- a. It is important to ensure compliance because of the consequence of an error or omission in performance.
- b. Equipment/components could be rendered inoperable and remain untested if not checked.

- 5.6.4. Independent verification may be accomplished by either or both of the following:

- a. Two appropriately qualified individuals shall independently verify the step has been accomplished. Both verifications are to be implemented by the procedure and documented by the initials or signature of the two individuals performing the verification.
- b. In certain instances, it may be possible to accomplish one verification from observing plant instrument indications, annunciators, valve position indications, etc. This is acceptable as long as the indication is a positive one and is directly observed and documented.

5.7. Multiple Participants

- 5.7.1. Personnel involved in the activity should review the procedure before starting the activity to ensure that the steps and sequence are understood.

- 5.7.2. When more than one individual is performing steps in a "continuous use" procedure, the following shall apply:

- a. One individual shall co-ordinate the activity and maintain the master verified working copy of the procedure.
- b. If other participants are not in the immediate vicinity of the co-ordinator, they may use a verified working copy of the document for guidance during procedure performance.

5.8. Revisions to In-Progress

- 5.8.1. When a new revision to an in-progress procedure is issued, the responsible Supervisor shall have the new revision reviewed against the in-progress procedure to determine the affect on procedure performance.
- 5.8.2. If only a small portion of the old revision is incomplete and the remaining portions have not been modified by the new revision, the old revision may be completed without modification.
- 5.8.3. If a major portion of a continuous use procedure has not been completed or the remaining portions are affected by the new revision, the responsible Supervisor shall have the completed data transferred from the old revision to the new revision.
 - a. The date a step was originally performed shall be transferred to the new revision and initialed by the person making the transfer at all completed steps.
 - b. The person making the data transfer shall annotate in the ~~§Remarks~~ section of the new procedure all steps covered by the data transfer and any outstanding discrepancies from the old revision.
 - c. The responsible supervisor shall review the new revision following data transfer and initial and date the remarks section of the new procedure.
 - d. The old revision of the procedure shall be annotated as ~~§superseded~~ by the new revision, signed and dated by the responsible Supervisor.
- 5.8.4. The old revision shall be forwarded to document control for records retention.

5.9. Changes to In-Progress

- 5.9.1. A file copy of approved on the spot change (OTSC) should be placed in the controlled procedure manual/file with the affected procedure.
- 5.9.2. When an approved OTSC to an in-progress procedure is issued, the responsible Supervisor shall have the change reviewed against the in-progress procedure to determine the affect on procedure performance.
- 5.9.3. If the change prevents completion of the in-progress procedure, performance of the in-progress procedure shall be terminated.
- 5.9.4. If the change does not prevent completion of the in-progress procedure, the

responsible supervisor shall have the change incorporated into the in-progress procedure.

- a. A copy of all new approved OTSCs will be made and attached to the in-progress procedure.
- b. Details of the change should be pen and inked into the body of the document or the affected pages may be replaced with revised pages.

5.10. Retention of Completed Procedures

5.10.1. Completed procedures that are QA records shall be transmitted to Document Control and retained in accordance with station policy.

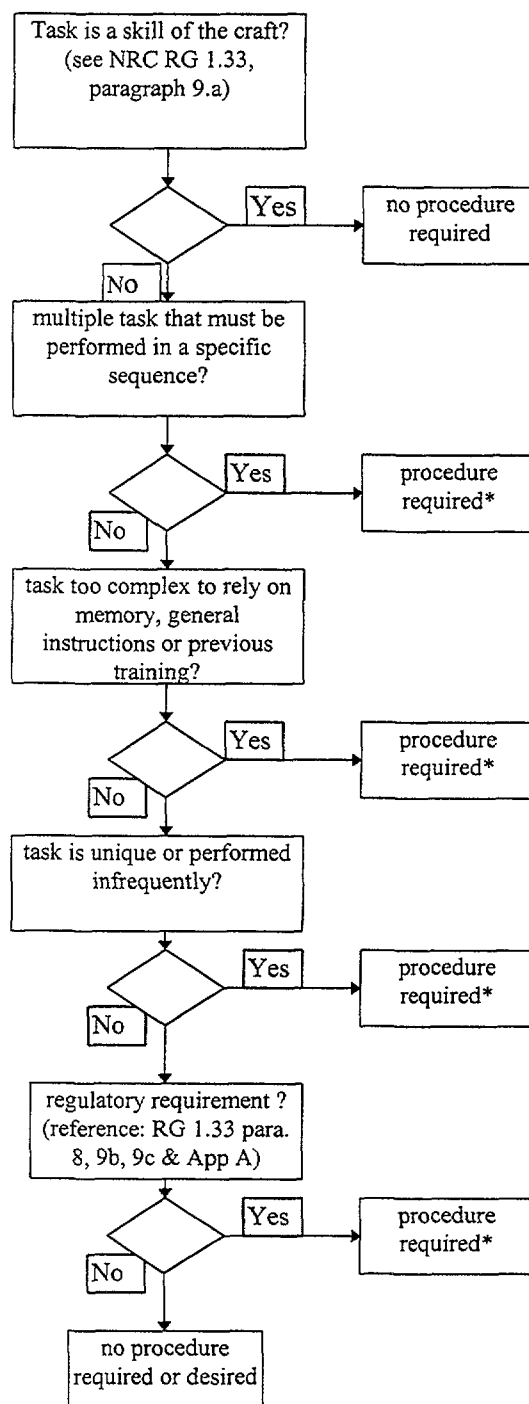
5.10.2. Completed procedures that are not QA records shall be transmitted to document control and dispositioned in accordance with station policy.

5.10.3. Completed component checklists should be retained in the control room until superseded by a more recent checklist.

Attachment 1 - Procedure Level of Use Determination

	CONTINUOUS	REFERENCE	INFORMATION
Application	Technical Procedures that: - Control activities with a direct impact on Nuclear Safety or plant reliability or Technical Specification compliance - Control activities that are complex or difficult - Documents activities (steps) as they are performed - Infrequently performed activity (less frequent than quarterly)	Other Technical procedures that: -The work consists of small segments easily performed from memory -No immediate consequences of improper actions -Not complex or infrequently performed	All administrative procedures and some technical procedures
Classification Use	Continuous Use or C	Reference Use or R	Information Use or I
Procedure Location Requirement	At the location of the job activity	Available to the user, but not necessarily in hand	Available as needed
Usage	-Steps performed as written and in specific sequence - Steps read before performance -Independent procedure readers may be used	-Referred to prior to evolution start -Referred to as often as necessary to ensure procedure adherence requirements met	-Referred to as needed
Documentation & Sign-off	-Steps documented as performed -More than one step may be read and performed in sequence prior to sign-off	-As each hold point is completed -Other steps or sections at completion of the task	As each step on a form or data sheet is completed

Attachment 2 -Procedure Requirement Evaluation Flow Chart



*When a procedure is not available, a vendor manual may be used for developing documented work instructions

Annex C
METHOD TO REGISTER THE HISTORY AND THE
CURRENT REVISION STATE OF PROCEDURES

No.1 shows the historical development of the procedure. The date in the header shows the topical date of the chapter of the procedure as to say the date of the last amendment of any page of the chapter.

No. 2 shows a chronicle line up of all amendment applications of this chapter of the procedure and the reason for the certain amendments. Further detail of the amendment is at the amendment documentation of the plant procedure group available.

No. 3 shows an example of a step-by-step program page section 5 of this chapter of the Emergency Manual. This section of the chapter is dedicated to the shift fitter who has to execute this certain stand alone task. It comprises every information needed by the fitter and is as „lending copy“ exclusively ready for his use. As to be seen this page of this section has been last amended on 5 Jan. 1997. This date is stated as topical date in the header of this page. So each page of the chapter has its individual revision date.

The topical date of the entire chapter is stated in the header of section 1 of the chapter (List of Revisions) as Topical Date.

In the every day handling it is time consuming to run this List of Revisions!

With respect to this fact and for some other reasons it is recommendable to use a computer-aided system to register the state and the history of the amendments of the procedure. In this case it is sufficient to state solely the date of the last amendment of each page at the List of Revisions to get an overview about the topical and valid review state. The history of amendments can then be repeated by the computer.

①

NPP Somewhere	Auxiliary Cooling Water System VE20 feeding into the RPV	Part : 3
		Chapter : 2.14
		Section : 1
		Page : 1
		topical Date : 22 May 1997

1 List of Revisions

Overview Revisions

		Page Revision						
		Revision 0	Revision 1	Revision 2	Revision 3	Revision 4	Revision 5	Revision 6
Section	Page	Date	Date	Date	Date	Date	Date	Date
2	1	21 Oct 90	27 Nov 92	05 Jan 94	08 Apr 97			
	2	21 Oct 90	08 Apr 97					
3	1	21 Oct 90	08 Apr 97					
	2	21 Oct 90	09 Dec 93	08 Apr 97				
4	1	21 Oct 90	16 Feb 95					
5	1	21 Oct 90	05 Jan 94					
6	1	21 Oct 90	12 Nov 91					
	2	21 Oct 90	17 Mar 96	22 May 97				
7	1	21 Oct 90	27 Nov 92					
	2	21 Oct 90						
8	1	21 Oct 90						
	2	21 Oct 90	05 Jan 94	17 Mar 96				
9	1	21 Oct 90	22 May 97					
10	1	21 Oct 90						
11	1	21 Oct 90	12 Nov 91	27 Nov 92	05 Jan 94	17 Mar 96		
	2	21 Oct 90						
12	1	21 Oct 90						
13	1	21 Oct 90	09 Dec 93					

②

<p>NPP</p> <p>Somewhere</p>	<p>Auxiliary Cooling Water System VE20 feeding into the RPV</p>	<p>Part : 3</p> <p><u>Chapter</u> : 2.14</p> <p>Section : 1</p> <p>Page : 2</p> <p>topical Date : 22 May 1997</p>
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cont.1 List of Revisions

List of Amendments

Date of revision	No. amendment application/Reason for amendment
21 Oct 1990	NT002/90/First issue
12 Nov 1991	NT007/91/Implementation of a simulation
27 Nov1992	NT009/92/Add of a hydrodynamic shaft seal temperature
09 Dec 1993	NT014/93/Amendment of the injection path
05 Jan 1994	NT002/94/Optimization of the task sequence
16 Feb 1995	NT007/95/Amendment of scheme of the logical sequence of the tasks
17 Mar 1996	NT011/96/Correction of a valve name
08 Apr 1997	NT017/97/Editorial improvements
22 May 1997	NT022/97/Correction of the given interlock time

③

NPP Somewhere	Auxiliary Cooling Water System VE20 feeding into the RPV	Part : 3
		Chapter : 2.14
		Section : 5
		Page : 1
		topical Date : 05 Jan 1994

5 VE/TH-Systems, set manual valves

working site: RGB B0223, B0228

needing staff: 1 shift fitter

coordinator main control room: name: phone No.

exec.

necessary equipment:

1) key-bunch	...
(restricted area HGS-T)	
2) 2 TMI-keys B2	...
3) radiation meter	...

storage site:

1) main control room 2E and 3E (TMI-key board)
2) main control room 2E if need be TEST 2
3) control area access or emergency board main control room

step-by-step program:

contact coordinator main control room approval given ...

(1) - access intermediate cooler 20 TF20 to release
(room-No. B0228) and to close 20 VE20 S104 ...

(2) - drain behind removal section
(room-No. B0223) to close 20 TH20 S407 ...

- emergency injection from VE to TH to release
(room-No. B0223) and to open 20 VE20 S103 ...

contact coordinator main control room report executing of the task ...

Annex D
EXAMPLE PROCEDURE VERIFICATION CHECKLIST

1. The checklist provided in this annex is an example of a comprehensive verification process. This process is not intended to be used for all procedures (or procedure modifications) but only those procedures that are most important from plant safety, personnel safety, or availability perspectives. Only procedure modifications that involved major changes in system or equipment characteristics would be subjected to this comprehensive process.
2. The term “verification” of procedures refers to the processes used to ensure (1) that procedures are technically correct, (2) that there is a correspondence between the procedures and the control room/plant hardware, and (3) that the language and nomenclature used in the procedures are consistent with the terms familiar to users
3. Any questions answered "NO" are required to be explained on a comment sheet.

	Yes	No	N/A
1. Does the procedure number correctly identify the primary user group?			
2. Does the procedure title accurately describe the activity, the subject equipment/system, and when appropriate, the frequency of use?			
3. Is the safety category identified and correct?			
4. Are procedure steps performed by other than the primary user group properly identified?			
5. Does the purpose accurately summarize the procedure objective(s)?			
6. Is the procedure format consistent with that specified for the procedure type by the Writer's Guide?			
7. Is the procedure type (Surveillance Test, Calibration, Preventive Maintenance, Operating Instruction, etc.) consistent with the stated objective(s) of the procedure?			
8. Are definitions provided for terms and acronyms which are not general usage by the primary and support users of the procedure?			
9. If the procedure is administrative in nature, are definitions or descriptions provided for all terms, acronyms and abbreviations?			
10. Do the references include all documents pertinent to establishment of the technical requirements and accomplishing the procedure objective(s), including those which provide the basis for acceptance when appropriate?			
11. Are the precautions and limitations sufficient to prevent unexpected plant/equipment reactions or violation of Technical Specifications?			
12. Are the precautions and limitations sufficient to prevent equipment damage or personnel injury?			
13. Based upon a physical review of plant drawings, will plant responses agree with those indicated in the procedure?			
14. Are all the necessary prerequisites/initial conditions included in the procedure, including any tagging and/or lineup instructions as required?			
15. Does the procedure identify the special handling or hazards and disposal instructions, associated with any controlled chemicals required by the procedure?			
16. Have all the necessary equipment/personnel protective measures been listed?			
17. When appropriate, are the qualification requirements necessary to perform the procedure or task stated, including any auxiliary personnel needed to support the primary user group?			
18. Is the list of Tools/Test Equipment/Materials/Parts/Protective Equipment sufficient to perform the task?			
19. Does the procedure identify any special tools/equipment needed to perform the task?			
20. Do the installed instruments meet or exceed the requirements of the procedures with regard to accuracy?			
21. If tools are listed, are they of sufficient range and type for the task?			
22. Are the range, accuracy and, when appropriate, the resolution, specified for stated calibrated Test Equipment? (Specifying the			

manufacturer/model number, or equivalent, of available equipment which has the appropriate requirements can be used to satisfy this.)			
23. Have provisions been made for calibration verification of Test Equipment and torque wrenches?			
24. Are the steps necessary to prepare the system/equipment for testing/calibration/maintenance/operation included or referenced?			
25. If the procedure task impairs a fire barrier, does the procedure require the necessary forms and notifications?			
26. Does the procedure provide a mechanism for obtaining permission from the Shift Supervisor (if plant operation is affected, including activities, which may generate a Limiting Condition for Operation) or other appropriate personnel before beginning the procedure or task			
27. Are the abbreviations, acronyms and engineering units used in the procedure consistent throughout the procedure and with those presented on attached data tables, graphs and illustrations?			
28. Are all data tables, graphs and illustrations properly labeled, and do references to them use the proper label?			
29. Is sufficient guidance provided (e.g. in a NOTE) when steps can be done concurrently or out of order?			
30. Are WARNINGS , CAUTIONS and NOTES located in the proper place (preceding the steps to which they apply) throughout the procedure, and readily understood?			
31. Are the steps written in short sentences with concise language?			
32. Are all steps or tasks stated as actions to be performed?			
33. Do steps contain not more than three actions per step? (One action per step is ideal, but step may contain up to three if they are closely related and in a logical sequence.			
34. Are the procedure steps listed in the most efficient sequence, consistent with current methodology and proper engineering practices?			
35. Is the level of detail compatible with the use of the procedure by the least experienced, qualified user (typically, the "lead person" or technician)?			
36. Is the level of verbal complexity, sentence length and grammatical structure appropriate for the least experienced, qualified user?			
37. Are unnecessary memory recall requirements avoided?			
38. Have limits and acceptable values been expressed as a range rather than relying on mental calculations or conversions whenever possible?			
39. Have aids such as conversion factors, tables, and graphs been provided where data processing/conversion is required?			
40. Is the procedure a self-contained document, minimizing referencing and branching to other procedures wherever possible?			
41. Where referencing or branching is necessary, are instructions complete and accurate so as to prevent omitting vital information and assure continuity of the procedure with no potential for endless looping?			
42. Have all ranges, quantities and values been identified with units that are applied consistently?			
43. Are QC Holdpoints/Witness Points identified in keeping with the			

Writer's Guide criteria and current commitments?			
44. Have checklists or data tables been provided for lengthy prerequisites, tests, calculations, or lineups when appropriate?			
45. Are the Independent Verification requirements consistent with the Writer's Guide criteria and current commitments?			
46. Are the steps necessary to restore the system/equipment to normal or to prepare for post-maintenance testing, when required, included or referenced?			
47. For Maintenance procedures (e.g. Repair/Rework, etc.), do the post-maintenance testing instructions, when required, adequately exercise the system/equipment, providing reasonable assurance of operability when returned to service?			
48. Where applicable (e.g. safety-related), do the post-maintenance testing instructions utilize surveillance tests to demonstrate operability when available and appropriate?			
49. Does the procedure provide the necessary instructions or reminders for completing any forms or closing any permits opened for performance of the procedure?			
50. Have techniques such as capitalization, underlining and font styles (bold , <i>italics</i> , script and letter size) been used effectively for emphasis, while recognizing that overuse reduces effectiveness?			
51. Have illustrations been used in place of long descriptions where possible?			
52. Are illustrations clearly labeled, easy to read and appropriate for the procedure task?			
53. Where possible, and appropriate, have illustrations been placed where they can be directly referred to in association with the accompanying text?			
54. Do quantities and dimensions correspond to referenced sources, documents and equipment configuration?			
55. Have all formulas and/or equations been transferred from existing procedure or references without modification?			
56. Are the acceptance criteria complete, credible, and consistent with referenced sources and current commitments?			
57. Is supplemental background information separated from the body of the procedure?			
58. Are the necessary signature requirements included (e.g. lifted leads/jumpers) and is it clear when they are required to be signed?			

Annex E
PROCEDURE VALIDATION CHECKLIST

1. The checklist provided in this annex is an example of a comprehensive procedure validation process. This process is not intended to be used for all procedures (or procedure modifications) but only those procedures that are most important from plant safety, personnel safety, or availability perspectives. Only procedure modifications that involved major changes in system or equipment characteristics would be subjected to this comprehensive process.
2. The term “validation” of procedure refers to the methods for assuring that procedures are usable by plant personnel.
3. Any questions answered "NO" are required to be explained on a comment sheet.
4. Supervisor or validator recommends the following type of validation: walk through, talk through, simulator, or other type (to be specified)

	Yes	No	N/A
1. Does the procedure number correctly identify the primary user group?			
2. Are procedure steps performed by other than the primary user group properly identified?			
3. When appropriate, are the qualification requirements necessary to perform the procedure or task stated, including any auxiliary personnel needed to support the primary user group?			
4. Is the list of Tools (including special tools)/Test Equipment/Materials/Parts/Protective Equipment sufficient to perform the task?			
5. Are the range, accuracy and, when appropriate, the resolution specified for stated calibrated Test Equipment? (Specifying the manufacturer/model number, or equivalent, of available equipment which has the appropriate requirements can be used to satisfy this.)			
6. Does the list of Materials/Parts include the manufacturer's part number when appropriate and available?			
7. Are the precautions and limitations which must be observed in the performance of the procedure listed?			
8. Does the procedure identify the special handling or hazards, and disposal instructions, associated with any controlled chemicals required by the procedure?			
9. Have all the necessary equipment/personnel protective measures been listed?			
10. Are all the necessary prerequisites/initial conditions included in the procedure?			
11. If the procedure task impairs a fire barrier (e.g. removal of a panel mounted meter from a halon protected panel, blocked open doors due to cords or cables strung through them), does the procedure require the necessary forms and notifications?			
12. Does the procedure identify all the necessary permits, such as Radiation Work Permit, Flame Cutting and Welding, Work Area Request, Tank Entry Permit, Chemical Permit which may be required?			
13. Are the steps necessary to prepare the system/equipment for testing/calibration/maintenance/operation included or referenced?			
14. Are the procedure steps listed in the most efficient sequence, consistent with current methodology and proper engineering practices?			
15. Are WARNINGS, CAUTIONS and NOTES located in the proper place (preceding the steps to which they apply) throughout the procedure and readily understood?			
16. Is sufficient information available to perform each step completely?			
17. Are equipment numbers and nomenclature (i.e. equipment labeling, annunciator window engravings) consistent with that on the equipment?			

	Yes	No	N/A
18. Are references to terminal, wire/cable and/or cabinet numbers consistent with the system/equipment "as built" condition?			
19. For procedures dealing with instrumentation, are the installed instrument displayed divisions and range, including units of measure, consistent with values specified by the procedure?			
20. Does the procedure contain the necessary instructions or notes to accommodate any physical plant obstructions or separations?			

Annex F

EMERGENCY OPERATING PROCEDURES EXPERIENCE

1. EMERGENCY OPERATING PROCEDURE GENERAL REQUIREMENTS

It is expected that emergency operating procedures meet the following minimum expectations:

- Expected emergency conditions shall be identified and procedures for dealing them prepared for use when required.
- Since emergencies may not follow anticipated patterns, the procedures should provide for sufficient flexibility of actions to accommodate variations, including multiple and sequential failures.
- The objective of emergency procedures is to return the plant to a condition covered by normal procedures or to provide for a safe extended and stable shutdown condition.

Table I demonstrates how NPPs from various countries design their operating procedure network to satisfy these IAEA guidelines.

1.1. Event-based approach

For event based procedures, the decisions and measures to cope with events are made with respect to the state of the plant related to predefined events, which are considered in the design of the plant. The operator must identify the specific design-based accident before the recovery/mitigating operator actions are begun.

Advantages:

- Procedures are easier of develop and maintain.
- If events follow the expected/analyzed scenario, the recovery/mitigating operator actions are more straight forward, easier to perform, more efficient, less time consuming, and are optimized for the specific analyzed condition.
- In case of a prompt and proper operator diagnosis, the event-based approach allows for the direct access to the predefined operator action, and by performance of these prompt actions, may prevent a more serious propagation of the emergency situation.
- In certain plant configurations, such as plant shutdown, where there exist a potential for a wider range of acceptable plant parameters, event-based procedures offer the operator a more direct approach to achieving an optimal recovery.

Limitations:

- Operators may be subject to unexpected events and thus be in situations for which they have had no specific training or procedures. Event-based operator recovery/mitigating actions are limited to predetermined/predefined accident scenarios. With this approach there is no method to deviate for the unexpected, which is typical of an accident scenario.

- Only a finite number of events have been analyzed and accounted for per the Final Safety Analysis Report (FSAR), and unanalyzed beyond design basis accidents are beyond the scope of the procedures.
- Most event-based procedures are “one way” oriented that deal with only a limited combination of events and which assume that all actions will be successful with no method to account for deviations or failures.
- Optimal recovery/mitigation is only possible after proper identification of the type of event.
- The need to promptly identify the event places stress on the operator. The event-based approach does not always provide the operator with a structured approach for performing this diagnostic step and places a tremendous amount of importance on the operator’s knowledge, experience level, and physical condition during a transient.
- There are no links or transition points between different procedures; therefore, there is no method for the operator to deal with multiple events (i.e. steam line break/LOCA, loss of feedwater/ATWS, etc.)

1.2. Symptom-based approach

The decisions for measures to cope with events are made with respect to the symptoms and the state of systems of the plant (e.g. values of safety parameters, critical safety functions). There is no need to identify the specific ongoing type of event before recovery/mitigating operator actions are begun.

Advantages:

- Symptom-based procedures resolve many of the limitations of the event-based approach by formally defining and prioritizing the major critical safety functions, the symptom-based approach follows the natural human (operator) tendency to want to keep the operating systems’ safety parameters within an accepted safe operational band. This allows for the operator to maintain optimal operating characteristics without being concerned about the ongoing accident scenario.
- More comprehensive thermo-hydraulic analysis needed for implementation of symptom based procedures results in better definition of operating characteristics of the plant.
- The method for monitoring of plant parameters used during the symptom-based approach is complementary to the needs of the plant staff during severe accident conditions.

Limitations:

- Symptom-based procedures are more labor intensive to develop and maintain, require more technical analysis, and require a different operator training approach; thereby, they become more expensive to implement.
- Additional modifications, instrumentation, operator aids (reactor vessel level indication, subcooling monitoring instrumentation, safety parameter display systems, etc.) may be necessary to implement this type of procedure.
- There is greater dependence on operator actions, and a need to develop alternate operator actions to facilitate recovery should the primary methods fail. This requires additional

dedicated thermodynamic analysis. This analysis necessitates more sophisticated codes and computer models that can be more expensive to obtain.

- Containment bypass LOCAs must be specifically diagnosed in order for the operator to respond with correct recovery/mitigating actions.

1.3. Integrated approach

The integrated approach allows for a parallel use of both event-based and symptom-based procedures. The diagnostic decisions to determine the type of event are made with respect to symptoms, as in the symptom-based approach. Once the event is characterized/identified, the integrated approach utilizes specific event based procedures for recovery/mitigating operator actions. A member of the control room crew continues to use a symptom-based procedure to monitor for changes in overall plant status while the control board operator utilizes an event-based procedure to recover/mitigate from the ongoing diagnosed event.

Advantages:

- The integrated approach takes advantage of the benefits of both the event & symptom based approach.

Limitations:

- It is necessary to have two procedures in use simultaneously.

TABLE I. STRUCTURE OF OPERATING PROCEDURES IN SEVERAL MEMBER STATES.

IAEA				Practice					
Plant Status		Strategy	Procedure	IAEA**	USA	France	Finland (Loviisa)	Germany (Gundremmingen)	WWER***
Normal		Prevent Unsafe Condition	Written and Authorized Instructions	NORMAL Event-based	NORMAL Event-based	NORMAL Event-based	NORMAL Event based	NORMAL Event-based	NORMAL Event-based
Anticipated Occurrences		Verify Normal System Functions To Limit Transients	Incident System Instructions	ABNORMAL Event-based	ABNORMAL Event-based	EOP Symptom-based	EOP Integrated	ABNORMAL Event-based	ABNORMAL Event-based
DBA (Safety Functions Challenged)		Verify Function of Engineered Safety Features	EOPs To Go To Cold Shutdown*	EOP Symptom-based	EOP Symptom-based or Integrated			EOP Symptom-based	EOP Symptom-based
Beyond DBA (Design Basis Barriers Challenge)	Prevention of Degraded Core Conditions	Restore Critical Safety Functions	Function Restoration	AMP Symptom-based					
	Mitigation of Molten Core Conditions	Mitigation of Consequences of Core Melt	Mitigation Actions	AMG Symptom based	SAMG Symptom based	SAMG Symptom-based			

*Event or Symptom-based, **Technical Reports Series No 368, ***Some WWERs have implemented symptom-based EOPS, and others have ongoing programmes

Estimate of Facility Manpower Resources Needed for Symptom-Based EOP Development and Implementation

Objective

Estimate the total man-hours that will be needed by each NPP to develop and implement the site specific symptom-based EOPs.

Scope

Based on input from international nuclear industry experts, this worksheet attempts to estimate the manpower resources that will be required for an NPP to develop and implement a network of site specific symptom-based EOPs.

Summary

The following is a summary of manpower resource calculations per the attached worksheet for the WWER NPPs:

TASK MAN-HOURS

1. First Draft EOP Development	12000
2. Technical Bases Document	2880
3. Verification	2400
4. Validation	2200
5. Second Draft EOP Development	100
6. Approvals	960
7. Training	19 200
8. Implementation	<u>200</u>
TOTAL man hours	38 980

Description

It is recommended that each NPP establish an EOP development infrastructure. This includes teams made-up of representatives with various expertise and dedicated to developing and implementing symptom-based EOPs. Experience has shown that through a series of workshops and on-sight mentoring from industry experts these teams can prepare and implement a set of symptom-based EOPs with a reasonable amount of effort and resources.

This document is an attempt to estimate the amount of effort that is necessary to develop and fully implement a complete set of EOPs for a typical single unit (or identical multi-unit site)

NPP. The EOP development/implementation activity can be broken down into several basic elements or tasks:

1. first draft eop development
2. technical bases documents including supporting analysis.
3. verification
4. validation
5. second draft eop development
6. approvals
7. training
8. implementation

Each of these tasks demands a unique organizational structure and allotment of manpower. The attached worksheet is one suggested method by which the EOPs can be developed and implemented. This worksheet will give an approximation as to the level of difficulty that will be required for development and implementation of fifty EOPs (most formats include less than 50 EOPs — some as few as 5 flowcharts and some nearly 50).

Keep in mind that the following variables may have a dramatic positive or negative affect on the final man-hour estimate derived from this worksheet:

- Availability of existing EOPs from similarly designed NPPs to use as a “macro”.
- Amount of existing technical basis information to support new mitigating and recovery strategies.
- Amount of mentoring provided from industry experts.
- Amount of existing and approved design information the regulatory body will allow the NPP to use from other similar NPPs.
- Amount of technical basis detail demanded by regulatory requirements.
- Number of operating crews to be trained.

With regard to the before mentioned variables, the following assumptions were made when completing the attached table:

- A set of EOPs including procedures, writers guide, users guide, and technical basis documents from a US facility are available to use as a guide for developing the site specific EOPs. These EOPs are not for the same specific reactor type, and may be used only to gain the knowledge of the correct format and usage of the EOPs. Availability and acceptance by the regulator of existing validated EOPs from a similar reactor type could dramatically reduce the man-hour requirement of this step.
- It is assumed a minimum of technical basis information is available from event-based licensing analysis. Availability and regulator acceptance of existing analysis data from similar reactor types would dramatically reduce the effort required for this step.

- On-site mentoring is assumed to be one week out of every six. By increasing the frequency and quantity of this mentoring, facility expertise can be dramatically improved in a much shorter time period.
- These figures assume the regulator allows no information from other NPPs to be directly applicable to the newly drafted instructions.
- These figures assume that a detailed technical basis document is required by the regulator.
- This example facility has six operating crews.

EOP Development and Implementation Worksheet			
Task	Description	Assumptions	man-hours
1	Draft first set of EOPs	<p>Form a six (6) member EOP development team:</p> <ul style="list-style-type: none"> - Group Leader - Operations Representative - Engineer - Three (3) Procedure Writers <p>Allow an average of 1 week of development time for each of the 50 EOPs.</p>	12000
2	Draft technical Basis Documents	<p>Form a six member EOP Technical Analysis Team:</p> <ul style="list-style-type: none"> - Six engineers from the design institute <p>Allow twelve weeks for the completion of the approximately 25 technical analysis calculations.</p>	2880
3	Verification	<p>Form a six member independent EOP verification team:</p> <ul style="list-style-type: none"> - Group Leader - Procedure Writer - two Ops representatives - two engineers <p>Allow eight (8) hours for the team to verify each of the 50 EOPs.</p>	2400
4	Validation	<p>Form an eleven (11) member independent EOP validation team:</p> <ul style="list-style-type: none"> - Group Leader - one (1) engineer - six (6) man ops crew - one (1) procedure writer - one (1) training instructor - one (1) simulator operator <p>Allow four hours of validation time for each of the 50 EOPs.</p> <p>Note: Multiple crews would be preferred. This would give the NPP a better cross section of operating staff and allow training to become a part of the validation process.</p>	2200

5	Draft Revision 2 of EOPs	Allow two hours to incorporate corrections in each of the 50 EOPs.	100
6	Obtain approvals	<p>Form a six member team to present the EOPs to the Regulators:</p> <ul style="list-style-type: none"> - Group Leader - Engineer - two procedure Writers - two operations staff <p>Allow 160 hours for approvals.</p>	960
7	Training	<p>Form six operating crews:</p> <ul style="list-style-type: none"> - two senior reactor operators - three operators - one shift supervisor <p>Provide a two member Simulator Training Staff.</p> <p>Allow four hours of classroom training and four hours of simulator training for each of the 50 EOPs.</p>	19200
8	Implementation	<p>Form a five (5) member administrative team for procedure duplication and document control.</p> <p>Allow one week for procedure implementation.</p>	200

Annex G

THE DEVELOPMENT OF OPERATING EMERGENCY PROCEDURES FOR THE FRENCH N4 SERIES PLANTS

After a brief introduction to the new French N4 series, this annex describes the main control room characteristics and the operating procedures for the N4 nuclear plants. This illustrates a situation when emergency procedures are required to be presented on computer displays and also as paper documents, to ensure the plant can be shutdown safely following faults on the computer displays.

1. INTRODUCTION

N4 is the latest French standardized PWR nuclear power plant of 1450 MWe. The two first units were commissioned in late 1996 on the site of CHOOZ (near the Belgium border). Two other units are going to be commissioned in early 1998 and early 1999 on the site of CIVAUX (center of France). The most innovative feature of the N4 series is a fully computerized I&C system. EDF, which was the designer of the N4 I&C, has drawn all the lessons from TMI, and has developed a system centered on ergonomics, operator aid and reliability of information. The computers give the operator diagnosis in real time of actual situations in the power plant and relay the most appropriate procedures to be applied.

2. THE N4 COMPUTERIZED CONTROL ROOM

This control room is made up of four computerized operator workstations, plus conventional devices : auxiliary panel and mimic panel.

2.1. THE COMPUTERIZED WORKSTATIONS

Normal situation, incident or accident requires 1 or 2 operator workstations. N4 operation system provides 4 of them in the control room.

Two operator workstations are dedicated to the two main operators for plant operation, the two others are used as complementary desks for supervision or in case of failure of the two previous ones.

Each operator computerized workstation is identical and comprises:

- 3 control screens and a keyboard for control dialogue,
- 4 alarms screens and a keyboard for alarm dialogue,
- 1 track-ball,
- 3 touch sensitive screens for commands, monitoring and display management,
- 1 alphanumeric keyboard and its display,
- 1 identification device (badge and key).

More details on safety classification are available in Reference [1].

2.2. THE SAFETY AUXILIARY PANEL

The "auxiliary panel" is a conventional facility provided to the operators as a back-up of the usual computerized control system. It is set in front of the operators workstations at the bottom of the mimic panel (the picture attached gives an overview of the N4 control room).

The auxiliary panel is only required in case of an accidental or pre-programmed unavailability of the computerized control system.

It provides sufficient facilities to continue full power operation for a few hours, which is sufficient to perform general diagnosis and check computers. After this period, it is decided to return to the computerized system or not. If not, the auxiliary panel enables the NPP's to reach a cold safe state in totally quiet conditions.

Further on, the operating means and available information on the auxiliary panel have to allow, without any duration limitation, the emergency procedures application.

2.3. THE MIMIC PANEL

The mimic panel is a display redundancy device. It shows the status or parameters already displayed by the computerized workstation or the auxiliary panel.

It has been designed to meet the following needs:

- to give to the operators an overview of the whole unit's operation,
- to provide to the different members of the operating team a common reference frame and constitute a common basis for analysis and reasoning,
- to facilitate shifting unit control to the conventional control system.

More details on the N4 main control room are available in Reference [2].

3. PROCEDURES OPERATED IN THE N4 CONTROL ROOM

3.1. NORMAL OPERATING PROCEDURES

The procedures for normal operation are computer based procedures . They are composed of :

- the global ones which indicate the main actions to perform (e.g. startup functions or main control loop monitoring) in order to change the global state of the plant,
- the system ones which are used to startup or stop the systems.

More details on the normal operating procedures are available in Reference [3].

3.2. SPECIFIC PROCESSING FOR EMERGENCY PROCEDURES

The emergency operating procedures follow a state based approach.

With the state based approach, it is possible to manage several events in the same time. No specific preliminary accident diagnosis is necessary, the only diagnosis needed is first to be sure you are in emergency conditions and second to determine the seriousness of the situation.

The French state-based emergency procedures cover 4 levels of gravity (each upper level includes the under level):

- **first one called ECP1:** incident situation (from reactor trip, including power supplies losses),
- **second one called ECP2:** accident (small LOCA),
- **third one called ECP 3:** accident (primary or secondary side) including activity in the secondary side,
- **fourth one called ECP 4:** severe accident (big LOCA or severe conditions within the containment),
- When the residual heat removal system is connected, these emergency procedures are called **ECPR1** instead of ECP1, and **ECPR2** instead of ECP2, ECP3, ECP4.

Depending on the situation, emergency procedures can be used either on the computerized workstations or on the auxiliary panel.

Then, the conception of emergency operating procedures needed in the N4 control room consists of developing two types of procedures :

- the **computer based procedures** used on the computerized workstations
- the **paper based procedures** used on the auxiliary panel, in case of unavailability of the computerized control system.

More details on the technical contents and on the specific functioning of computer based emergency procedures are available in Reference [3] .

REFERENCES

- [1] PEYROUTON, PIRUS, "Progress on N4 I&C architecture", Oak Ridge topical meeting, 19-21 April 1993.
- [2] P. CORNON, IAEA guidebook on nuclear power plant I&C - Proposal for chapter 5.2 "A French example", 11 July 1995.
- [3] D. PIRUS - Y. CHAMBON, "The computerized procedures for the French N4 series" - 1997 , IEEE Sixth Conference on Human Factors and Power Plants -Orlando, Florida, USA, 8-12 June1997.

Annex H

EXAMPLE OPERATING DOCUMENTATION DATABASE

**ORIGINAL SPECIFICATION DEVELOPED BY
G. KAPOCS, PAKS NUCLEAR POWER PLANT***

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1. INTRODUCTION
2. THE STRUCTURE OF THE OPERATING DOCUMENTATION SYSTEM
3. USER EXPERIENCE CONCERNING THE ADVANTAGES AND LIMITATIONS OF DEVELOPMENT TOOL
4. HARDWARE REQUIREMENTS OF THE USER SYSTEM
5. A POSSIBLE SCHEDULE OF IMPLEMENTATION AND THE POSSIBILITIES OF GRADUAL INTRODUCTION
6. PRESENTATION OF THE OPERATION OF THE COMPUTERIZED DOCUMENTATION SYSTEM AND THE FORMAL DISPLAY OF THE DOCUMENTS
 - 6.1. FLOW CHART OF THE USAGE OF DOCUMENTATION (ROOT DIRECTORY)
 - 6.2. DISPLAYING TEXT WINDOW IN THE FLOWCHART OF THE USAGE OF DOCUMENTATION
 - 6.3. DIRECTORY OF OPERATING INSTRUCTIONS OF NORMAL OPERATION
 - 6.4. CRITICAL SAFETY FUNCTION STATUS TREE 1. "BFSK"
 - 6.5. CRITICAL SAFETY FUNCTION STATUS TREE 2. "BFZH"

ATTACHMENTS

ATTACHMENT 1: CROSS REFERENCE BETWEEN HUNGARIAN AND ENGLISH WORDS:

ATTACHMENT 2: TABLE OF CONTENTS of the original specification

* This shortened version of the original specification was prepared by I. Lenkei.

1. INTRODUCTION

The idea of a computer aided operating documentation system was born in 1988. Based on the original Russian documentation, proposals to display them on the computer later on were made in 1981 and 1982.

In 1992 a plan was made for the development of an operating documentation database called UDOKAD. In April 1996. The development of a specification for the operating documentation system was started in a spare time by some experts. The present status of this system is in unofficial use at the plant. The technical specification document is in a trial usage period by the operators ,and the combining process of symptom oriented procedures is under consideration. The future of this computerised system will be decided by the technical board in the coming year.

The attachment to this annex provides a cross reference list between Hungarian and English words which are used in this annex. This annex is based on the detailed specification, which can be found at the Paks NPP in Hungary with Mr. Gyorgy Kapocs.

2. THE STRUCTURE OF THE OPERATING DOCUMENTATION SYSTEM

The proposed structure of the operating documentation system is shown in Figure 1.

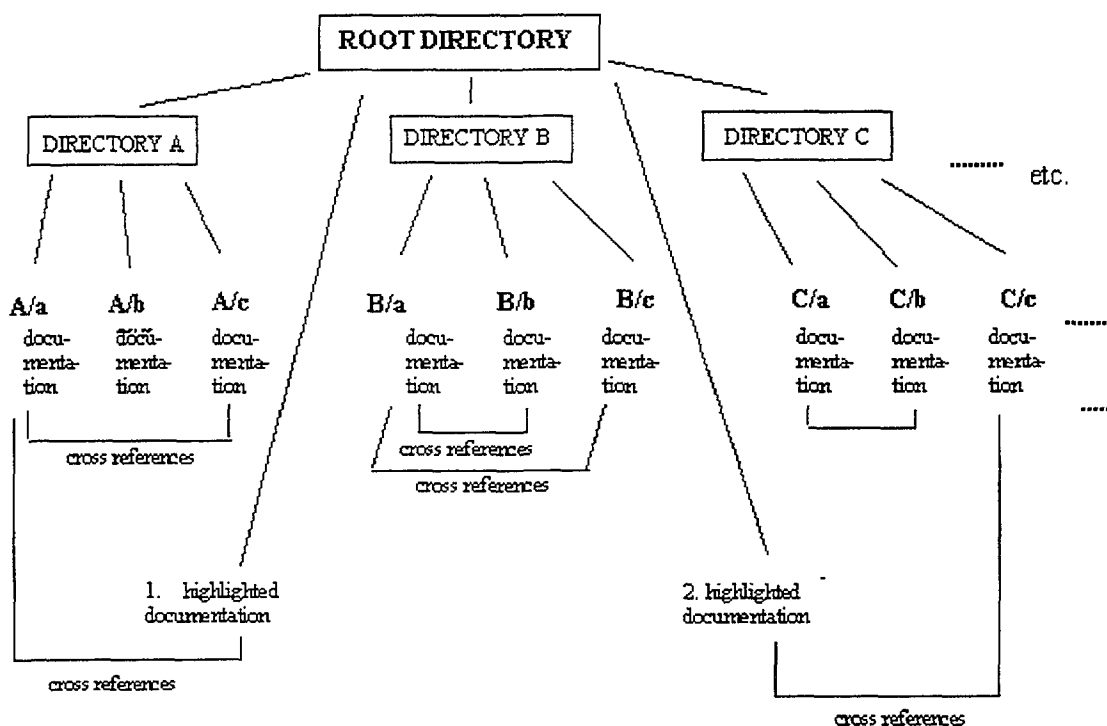


Figure 1

Going directly from the root directory to the subdirectories or into some highlighted documents is possible with the help of the method "application" well-known from the Windows programmes (triggering icon or macro on hypergraphics). It was suggested to include the documents of the same type and aim in one directory. (e.g. operating instructions

or emergency prevention instructions) If there are too many documents in a directory and they can be confused it is proposed to create subdirectories such as OI of the primary side systems, OI of the secondary side systems, etc. It is practicable to provide direct access for some highlighted documents (e.g. Technical Specifications; hereinafter called MÜSZ), Emergency Planning (hereinafter called BEIT)).

All the documents are of hypertext type for the user and constitute an independent complete file with the extension HLP. Besides the cross references in the document the Development tool method provides possibility for references between documents without losing the independence of the given document.

The compatibility should be provided mainly between documents existing in the same directory (it is especially important in case of normal operating instructions and the step-by-step emergency prevention instructions), but the cross references between the documents of directories and the highlighted documents are also important (especially in case of MÜSZ).



During structuring of the system the root directory of Figure 1 should be updated continuously because the quick review of the total cross references of documents will significantly facilitate carrying out of modifications consistently.


The name of files of documents should be set to the marking system accepted at present, such as:

PR04.HLP - OPERATING INSTRUCTIONS OF REACTOR
 SZ01.HLP - OPERATING INSTRUCTIONS OF TURBINE AND OIL SYSTEMS
 PR06.HLP - OPERATING INSTRUCTIONS OF MAKE-UP WATER AND BORIC ACID
 REGULATING SYSTEMS

The triggering icons of each document are corresponding to the icons symbolising the type of the given document, such as:

Normal primary side operating instructions  Normal secondary side operating instructions 

Normal electrical system operating instructions  Operating instructions of abnormal cases


Emergency prevention instructions 

The so-called INFO-BANK part (documents of background information) of the normal operating instructions can be accessed through an icon existing in the highlighted field on every page of the OI.

3. USER EXPERIENCE CONCERNING THE ADVANTAGES AND LIMITATIONS OF THE DEVELOPMENT TOOL

An information system of any size limited only by the memory of the computer can be created with the help of the designer's development tool. The information system means a system of HELP files based on one another. The system can be easily installed in any Windows type environment, the files can be run by the help of HLP.EXE file belonging to the basic facilities of Windows. Hypertext on-line documents can be created without any special computer knowledge with the help of the instruction manual. The facilities provided by the Help of Windows are enough for the users of operating documentation of NPP and they provide much more effective way for maintaining documents and fulfilment of the quality assurance requirements. The creation procedure of hypertext documents, the relationships of *.hpl, *.doc, *.rtf and *.hh files edited in Word-6 environment, the usage of the so-called help compiler (HCG.EXE; HC31.EXE; HC.EXE) and creating hypergraphics are described well in the instruction manual together with other practical guides.

The software provides a possibility to build multimedia connections into the *.hpl documents. In case of computers equipped with sound card and video card the *.hpl documents can replay sound and movie parts that could be an important feature in the development of the operating documents for training purposes.

The graphics of larger sizes can be fitted into the document by importing (importing will reduce the running speed to a certain extent).

A main window and five secondary windows can be defined in the documents, their sizes can be set while editing the documents.

The "search" function can access 400 chapters in a document.

The "preliminaries" can remember the last forty steps of searching in a document, which will facilitate the quick return after digressions.

A *.hpl document can contain about 32 thousand indexed references.

It can be seen from the above data knowing the individual documents limits will not be succeeded while creating a document, the development tool is suitable for the creation of the whole documentation system.

4. HARDWARE REQUIREMENTS OF THE USER SYSTEM

During the development of the operating documentation system the key operating working areas (e.g. control rooms, Plant Control Room) should be considered. The safety and the authenticity of information are very important on these working areas. Therefore an autonomous micro network should be created with single central PC equipped with CD ROM, micro network card with 3 to 4 places for users, SVGA monitor and mouse. The operating documentation will be given to the user from the developer on CD data medium. At the same time the whole documentation should be installed on a network CD ROM server with wider access possibilities. The network access should be provided from the control rooms, and from

different working places of technical support experts (especially of procedures writers) and from operating working places of shifts.

Besides the operating working areas of shifts, the Main control rooms PCs with network access should be implemented at the different working areas (e.g. Room for primary field operators). Of course the whole documentation should be made in a traditional written form (master copy) too and it should be existing according to the requirements of the users' working areas. It is important that the written and printed documents should be similar to the computerised hypertext versions as closely as possible, and the cross references and references should be unambiguous and exact in the written form, too.

5. A POSSIBLE SCHEDULE OF IMPLEMENTATION AND THE POSSIBILITIES OF GRADUAL INTRODUCTION

Several documents from the elements described in the detailed specification of the operating documentation system have been worked out neither in the traditional written form nor in a computerised form, therefore the hypertext processing is only part of the realisation of the whole system. There was a decision about the development of the symptom oriented emergency procedures (Westinghouse model) a contract with WESE(Brussels), therefore these documents will be prepared in a certain period of time (in 3 years). Preparation of the document „Alarm procedures” is about a work of one engineer-year, a great part of the necessary information is available in different documents (e.g. circuit diagrams). The new version of Technical Specification is ready after the work of one engineer-year.. The instructions of abnormal status are based on the chapters of existing plant procedures and will be completed by the chapters of the present secondary side and electrical emergency prevention instructions. If essential modifications are not necessary in these documents, the hypertext processing can be started. Selection of documents classified for the technical background information directory can be carried out now giving an order of significance, and the processing can be started. The present form of the normal operating instructions being the largest chapter will be only modified a little according to the proposed idea, thus their processing into hypertext format can be immediately started. Since the great parts of OIs are in Microsoft Word-6.0 format therefore a quick progress can be achieved on this field. First of all the OIs of the main equipment and systems (e.g. make-up water system, turbine, generator, etc.) should be prepared because of the hierarchy of cross references.

On the basis of the above mentioned considerations the following possible schedule is proposed for the realisation of the operating documentation system, using a dedicated group with limited number (3 or 4 experts):

Normal operating instructions:	-	completion in 2 years
Abnormal OI s :	-	completion in 1 year
Alarm procedures:	-	completion in 1 year
BEIT:	-	completion in 6 months
EOPs	-	completion in 3 years
Technical background information:	-	completion in 3 years

Testing of the available 40 to 50 documents prepared by the end of the following year can be started on the simulator, and in case of their suitability they can be introduced on the working places. In what follows the information system would be developed simultaneously with the

preparation of documents and in about three years the whole size described in the present specification would be developed. Preparing and specifying of each document will be possible being in possession of experiences gained during the gradual introduction.

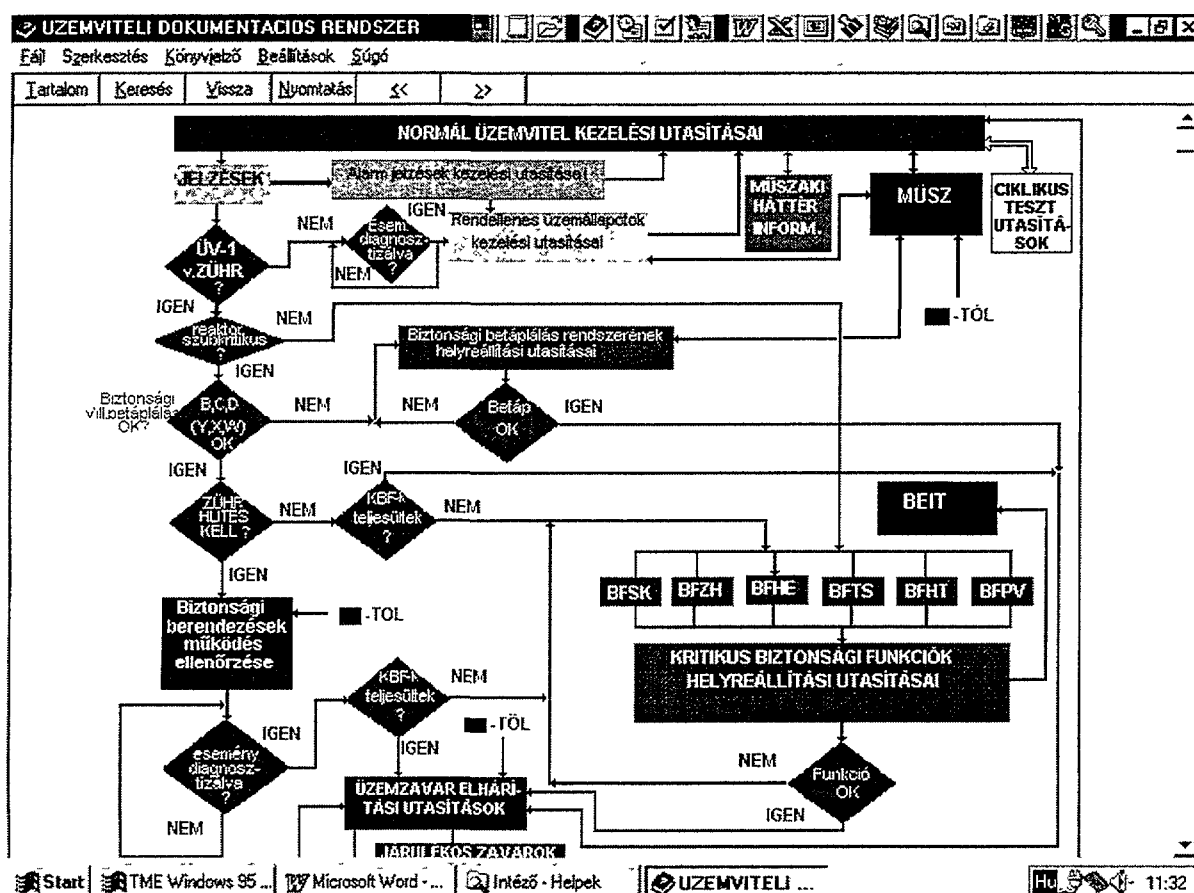


Figure 2

6. PRESENTATION OF THE OPERATION OF THE COMPUTERIZED DOCUMENTATION SYSTEM AND THE FORMAL DISPLAY OF THE DOCUMENTS

6.1. Flow chart of the usage of documentation (root directory)

The documentation most frequently used by the operating staff can be put into the flow chart of the usage of documentation presented in Figure 2. The flow chart was made on the basis of the Westinghouse-type documentation system. The figure is a hypergraphics that is located in the file SYSTEM.HLP. Directories of documents or documents themselves can be accessed by the help of macros by clicking on the coloured fields. Moreover by clicking on the symbols of logical junctions so-called pop-up text window will appear which explains the legend of the rhombus-type field.

The following directories or documents directly can be accessed by the main figure of SYSTEM.HLP:

- (1) DIRECTORY OF NORMAL OPERATING INSTRUCTIONS
- (2) OPERATING INSTRUCTIONS OF ABNORMAL CONDITIONS
- (3) TECHNICAL BACKGROUND INFORMATION DIRECTORY
- (4) DIRECTORY OF TESTING INSTRUCTIONS
- (5) DIRECTORY OF EMERGENCY PREVENTING INSTRUCTIONS
- (6) DIRECTORY OF RECOVERY INSTRUCTIONS OF CRITICAL SAFETY FUNCTIONS
- (7) DIRECTORY OF RECOVERY INSTRUCTIONS OF THE EMERGENCY POWER SUPPLY SYSTEMS
- (8) TECHNICAL SPECIFICATIONS
- (9) ALARM PROCEDURES
- (10) EMERGENCY PLANNING
- (11) CHECKING THE OPERATION OF SAFETY SYSTEMS
- (12) STATUS TREES OF CRITICAL SAFETY FUNCTIONS
- (13) ABNORMAL CONDITIONS DIAGNOSTICS
- (14) EMERGENCY DIAGNOSTICS

In the following the sample sheets of documents already made or partially ready will be presented by the help of „print screen” function. On the basis of them the whole documentation system can be built up. During the harmonising process the amount, organization and forms of the operating documents to be included can be changed, but it does not effect the practical nature and suitability of the whole system.

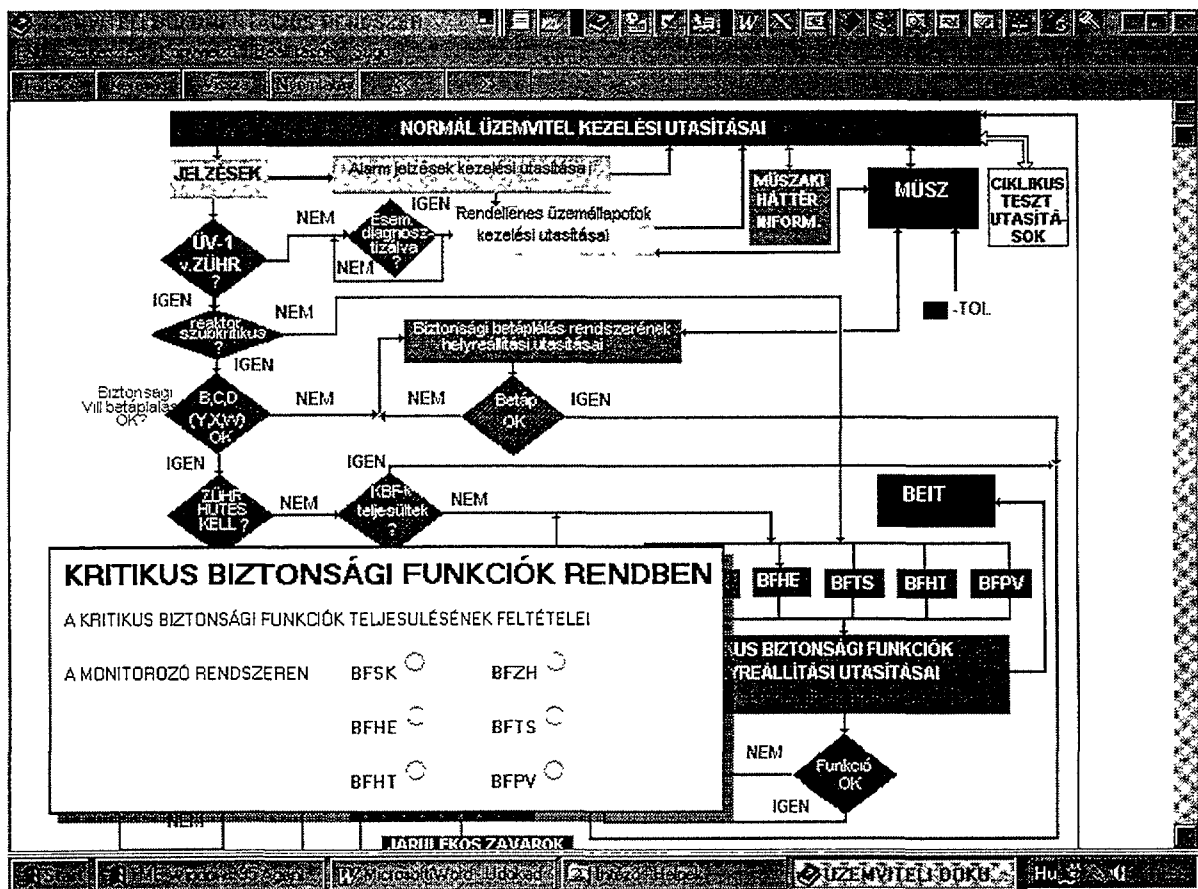


Figure 3

6.2. Displaying text window in the flowchart of the usage of documentation

Figure 3 shows an example for the use of pop-up. By clicking on the rhombus field of the logical junction “KBF-ek teljesültek?” (critical safety functions satisfied?) the pop-up window contains the suitability criteria of critical safety functions (hereinafter called KBF). The detailed description of KBF-s can be found later in this shortened document. The on-line monitoring system will be realised in the computer system. The description of logical examination of safety functions, the necessary input indications and the interpretation of symbols can be found in the item about critical safety function status trees. By clicking again on any other point of the screen the pop-up text window will disappear.

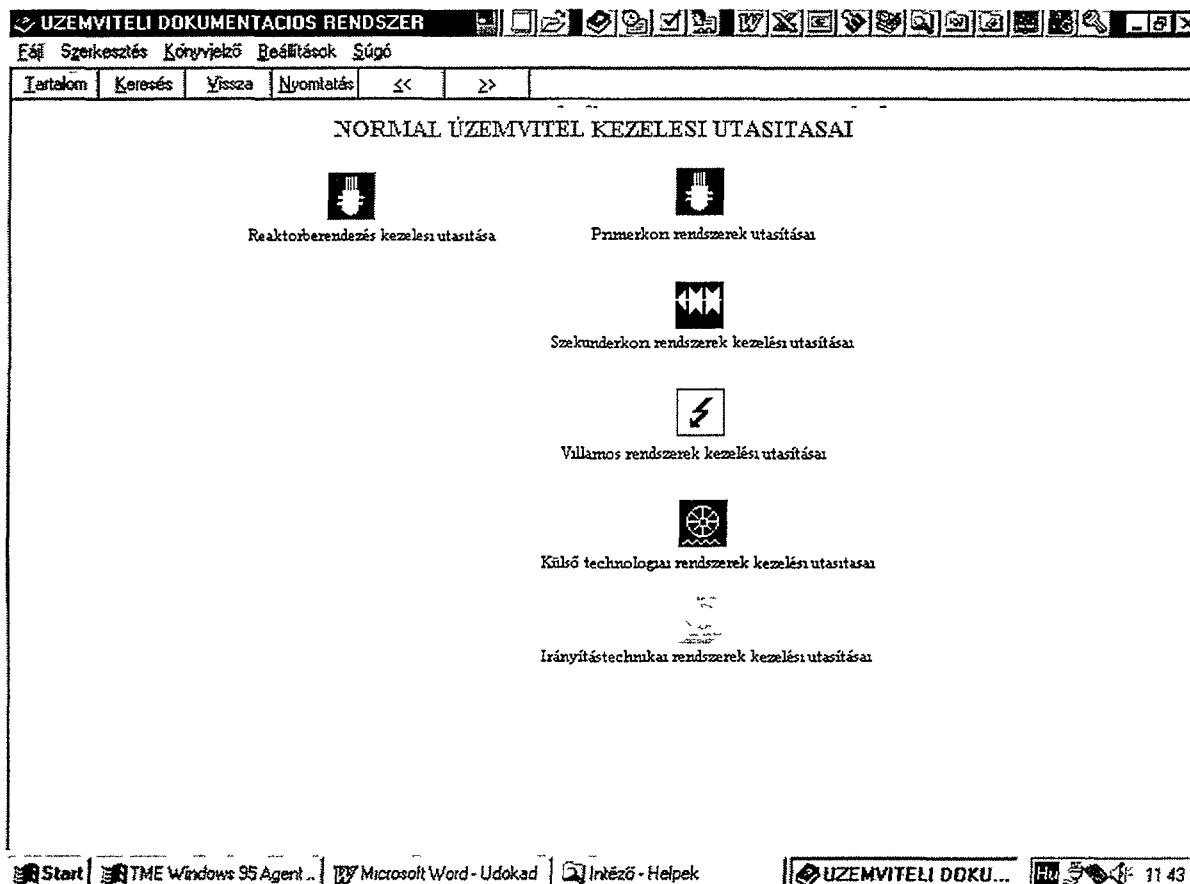


Figure 4

6.3. Directory of operating instructions of normal operation

By clicking on the field of “normal operating instructions” we can reach the directory shown in Figure 4. The documents in the directory are represented with icons drawn by icon editor typical to the type of the instruction (primary, secondary, electrical, external technology, chemical, etc.) and the title of the instruction, too. If the number and type of documents will increase significantly, the directory can be organised into hierarchy, e.g. primary, secondary, electrical, etc. subdirectories. The documents can be opened by clicking on the appropriate icon field. More than one document can be open at the same time, in this case the arrangement of the open documents is determined by the possibilities of Windows.

indicate status and different level violation of critical safety functions, and these "outputs" are simultaneously inputs into appropriate chapters of Critical Safety Function Restoration Guidelines. Figure 5 shows "BFSK" status tree algorithm will be adapted to Paks nuclear power plant. On the basis of this figure subcriticality has two heavy violation, if reactor power does not decrease adequately at Reactor Trip, or if intensive recooling has occurred before development of shut-down boric acid concentration. Clicking on red circle labeled "1.1" first page of instruction entitled "absence fulfillment of Reactor Trip" appears (BFSK-1.1).

Graphic indications used correspond to conventional symbols accepted in Westinghouse documentation. Clicking on violet field labeled BFSK of "Documentation usage flowchart" Figure 5 appears.

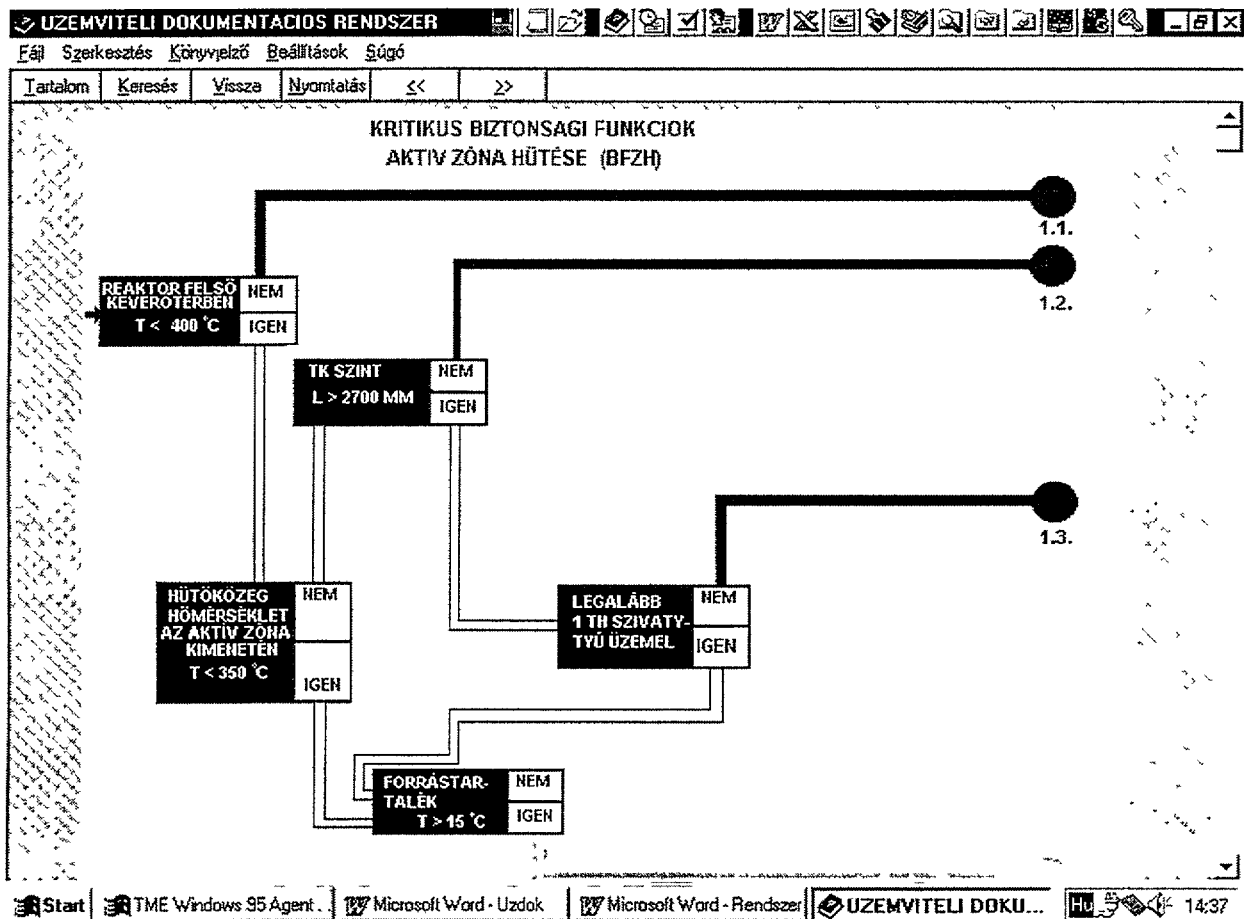
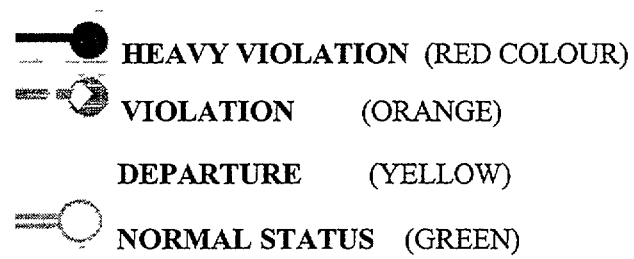


Figure 6

6.5. CRITICAL SAFETY FUNCTION STATUS TREE 2. "BFZH"

The critical safety function status tree Figure 6 shows how the core cooling status tree will be adapted to Paks nuclear power plant. Parameter values for individual logic branches can be changed on the basis of analyses. Here also outputs of status tree lead to chapters of Critical Safety Function Restoration Guidelines which are suitable for given conditions.

According to conceptual symbols,



The paragraphs are shown above give only a limited part of the whole system. The structure and the usage of the detailed system is the same.

ATTACHMENT
CROSS REFERENCE BETWEEN HUNGARIAN AND ENGLISH TERMS

Hungarian terms	Corresponding English terms
NORMAL UZEMVITEL KEZELESI UTASITASAI	NORMAL OPERATING INSTRUCTIONS
JELZESEK	ALARMS
ALARM JELZESEK KEZELESI UTASITASAI	ALARM RESPONSE GUIDELINES
MUSZAKI HATTER INFORM.	TECHNICAL BACKGROUND INFO
MUSZ	TECHNICAL SPECIFICATION
CIKLIKUS TESZT UTASITASOK	TEST PROCEDURES
UV-1, ZUHR?	REACTOR SCRAM , SI ACTUATION?
IGEN	YES
NEM	NO
BIZTONSAGI BETAPLALAS RENDSZERENЕК HELYREALLITASI UTASITASAI	SAFETY SUPPLY RESTORATION GUIDELINES
ESEMENY DIAGNOSZTIZALVA?	EVENT IS DIAGNOSED?
REAKTOR SZUBKRITIKUS?	SUBCRITICALITY SATISFIED?
BIZTONSAGI VILL.BETAPLALAS OK?	SAFETY SUPPLY OK?
ZUHR HUTES KELL?	SI NECESSARY?
KBF-K TELJESULTEK?	CRITICAL SAFETY FUNCTIONS SATISFIED?
BIZTONSAGI BERENDEZESEK MUKODES ELLENORZESE	SAFETY SYSTEM CHECKING
UZEMZAVAR ELHARITASI UTASITASOK	EMERGENCY OPERATIONAL PROCEDURES
KRITIKUS BIZTONSAGI FUNKCIOK HELYREALLITASI UTASITASAI	CRITICAL SAFETY FUNCTION RESTORATION GUIDELINES

Hungarian terms	Corresponding English terms
FUNKCIOK	FUNCTIONS
BEIT	EMERGENCY PLANNING
REAKTORBERENDEZES KEZELESI UTASITASA	MAIN OPERATIONAL PROCEDURE (START UP,COOLDOWN)
PRIMERKORI RENDSZEREK UTASITASAI	NORMAL PRIMARY SIDE OPERATING INSTRUCTIONS
SZEKUNDERKORI RENDSZEREK UTASITASAI	NORMAL SECONDARY SIDE OPERATING INSTRUCTIONS
VILLAMOS RENDSZEREK KEZELESI UTASITASAI	NORMAL ELECTRICAL SIDE OPERATING INSTRUCTIONS
KULSO TECHNOLOGIAI RENDSZEREK KEZELESI UTASITASAI	NORMAL EXTERNAL SIDE OPERATING PROCEDURES
IRANYITASTECHNIKAI RENDSZEREK KEZELESI UTASITASAI	I&C SIDE OPERATING PROCEDURES

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Consultants Meeting

Omaha, Nebraska, United States of America: 23–27 June 1997

Advisory Group Meeting

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Vienna, Austria: 15–19 June 1998

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