EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Study of Outage Request Switching and Clearance Forms

Technical Report

Study of Outage Request Switching and Clearance Forms

1013109

Final Report, February 2006

EPRI Project Manager
G. Gela

ELECTRIC POWER RESEARCH INSTITUTE
3420 Hillview Avenue, Palo Alto, California 94304-1395 • PO Box 10412, Palo Alto, California 94303-0813 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES

ORGANIZATION(S) THAT PREPARED THIS DOCUMENT

Beare Ergonomics

Quality Training Systems

NOTE

For further information about EPRI, call the EPRI Customer Assistance Center at 800.313.3774 or e-mail askepri@epri.com.

CITATIONS

This report was prepared by

Beare Ergonomics
6243 Parallel Lane
Columbia, MD 21045

Principal Investigator
A. Beare

Quality Training Systems
PO Box 386
Columbia, MD 21045

Principal Investigator
S. Lutterodt

This report describes research sponsored by the Electric Power Research Institute (EPRI).

The report is a corporate document that should be cited in the literature in the following manner:

Study of Outage Request Switching and Clearance Forms. EPRI, Palo Alto, CA: 2006. 1013109.

REPORT SUMMARY

Many organizations can benefit from this research by improving the information content and the quality of their switching and clearance forms, hence avoiding errors and improving worker and system safety. Also, many utilities are consolidating or standardizing procedures and documents used by formerly independent utilities. This situation presents an opportunity for developing more effective documents, but hitherto there has been little basis other than custom or personal preference for choosing among possible formats or developing new forms. This study collected and analyzed switching and clearance forms from 29 utilities to identify ways to reduce switching errors.

Background

EPRI has accumulated a vast body of knowledge and experience regarding the factors that contribute to switching safety and reliability. For example, EPRI's job and task analysis for switching, published as report 1001789, "Generic Job and Task Analysis," identified the steps that many utilities include as part of their detailed switching procedures. Establishing well thought-out procedures and then paying proper attention to them can provide rewards in risk mitigation. This study of switching and clearance forms is a part of EPRI's ongoing effort to facilitate the sharing of information among participating utilities.

Objectives

To analyze documents used by utilities for switching instructions and clearances in order to identify opportunities for improvements that might help reduce switching errors and improve worker and system safety.

Approach

The project team analyzed sample outage requests, switching instructions, and other clearance-related documents submitted by utilities. Twenty-nine participating utilities supplied sample documents, including 36 sets of switching instructions and 37 Outage Requests or Cover Sheets and related documents derived from them. When appropriate, the team followed up by conducting telephone interviews to clarify or complete submitted information. Analysis consisted mainly of counting to determine the prevalence of various content and format features. To perform this analysis, the team reviewed each document against a checklist of possible or expected characteristics and noted the presence or absence of each feature on a record sheet.

Results

There is room for improvement in the switching instructions of many utilities. The three most commonly observed deficiencies in the submitted documents were:

- Lack of place-keeping aids—spaces for checking off the step or recording the time it was performed—on forms intended for field use
- Presentation of actions on multiple components in a single line of instructions—it is not a single step if multiple components are involved.
- Lack of spaces to write in the names of the dispatcher directing the work and the field person or persons executing it.

Examination of submitted switching forms and requests also revealed that:

- Many fields on the examples reviewed were not filled in. If there are fields that are never used, they should be removed from the document.
- Some documents had additional annotations or initials in the margins. The name of the switchman was the most common such annotation on switching forms that did not have a field for this purpose. Human Factors Engineering practitioners believe that such spontaneous additions, especially if made by multiple users, indicate that the information is considered useful and that there probably should be a field for it.

EPRI Perspective

Many utilities have gotten by with sub-optimal documents for years. However, problems with the instructions are likely to be a contributing factor in switching errors. While these format defects will seldom be the principal cause of an error, they present an ongoing, unnecessary, and avoidable opportunity for something to go wrong.

Keywords

Switching errors
Switching
Data acquisition
Documentation
Safety and reliability
Human factors engineering

ABSTRACT

This study of switching and clearance forms is a part of the Switching Safety & Reliability project's ongoing effort to facilitate the sharing of information among participating utilities. Many organizations can benefit from this research by improving the information content and the quality of their switching and clearance forms, hence avoiding errors and improving worker and system safety. Also, many utilities are in the position of consolidating or standardizing procedures and documents used by formerly independent utilities, which usually used different formats for switching and other outage related documents. This situation presents an opportunity for developing potentially more effective documents, but hitherto there has been little basis other than custom or personal preference for choosing among possible formats or developing new ones. This study collected and analyzed switching and outage requests and related documents from 29 utilities to identify required and common elements or practices, to examine the extent to which accepted principles of procedure writing are reflected in these documents, and to identify potential opportunities for improvements that might help reduce switching errors.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1
INTRODUCTION

Study Objectives and Background

This study of switching and clearance forms is a part of the Switching Safety & Reliability project's ongoing effort to facilitate the sharing of information among participating utilities. Many organizations are in the position of consolidating or standardizing procedures and documents used by formerly independent utilities, who usually used different formats for switching and other outage related documents. This situation presents an opportunity for developing potentially more effective documents, but hitherto there has been little basis other than custom or personal preference for choosing among possible formats – or developing an entirely new one.

The purpose of this study is to explore the variety of documents used for switching instructions and clearances, and – as a natural extension – outage requests. By doing so, we hope to identify:

- Required and common elements or practices
- The extent to which accepted principles of procedure writing are reflected in these documents
- Potential opportunities for improvements that might help reduce switching errors
- Unique elements that may be useful to other companies when consolidating or revising such documents

Approach

To accomplish the above objectives, researchers conducted a careful analysis of sample documents submitted by utilities followed up by telephone interviews where appropriate to clarify or complete the information.

Documents Examined

Researchers examined the following documents:

- Outage requests and related documents (e.g., switching instruction cover sheets)
- Switching instructions
- Other clearance-related documents where they existed; there were in practice very few of these

Participating Utilities

A letter requesting participation in the study was sent out to all members of the Switching Safety and Reliability project and to representatives from utilities at recent Switching Safety and Reliability conferences. Those wishing to participate were invited to submit copies of the switching instructions for a simple outage, the outage request for the work, and any other documents routinely associated with such work, such as a clearance record if this was a separate document from the switching instructions.

Twenty-nine (29) participating utilities supplied sample documents, including 36 sets of switching instructions and 37 Outage Requests or Cover Sheets and related documents derived from them. A list of utilities submitting forms for review is given in Appendix A.

There were three utilities that submitted multiple examples of forms:

- A western utility submitted forms from four operating regions – all were very similar but differed in minor details.
- Four utilities operating under the umbrella of a regional transmission company submitted switching and outage request forms and additional planning documents. The switching instructions used by two of them were conventional word-processed checklists with subtle differences, but a definite convergence of formats. One employed an elaborately formatted Excel spreadsheet in landscape orientation and the fourth presented instructions in a rather crowed table format.
- A southern utility submitted forms from two regional offices that were produced by the company's computerized scheduling system and were identical in all details of format. These were field forms, as the dispatchers apparently do their work directly from computer displays.

Two-thirds (24) of the instructions involved transmission equipment (rated 69kV or higher) and one-third (12) involved sub-transmission or distribution lines or equipment (rated less than 69kV). The two longest and most elaborate instructions received (both involving several locations and well over 100 steps) involved distribution work, as did the two shortest sets of instructions.

Analysis of Documents

The analysis of these documents focused on:

- Content: variations in scope of information required or presented
- Format: physical characteristics of documents and how information was organized and presented.

Analysis consisted mainly of counting to determine the prevalence of various content and format features, that is, noting the presence or absence of some characteristic in the particular document examined, and tabulating these observations to yield an estimate of how common that characteristic is in the sample of documents of this type.

To perform this analysis, each document was reviewed against a checklist of possible or expected characteristics, and the presence or absence of each noted on a record sheet.

The checklist of characteristics was "bootstrapped" over several iterations. We started with some *a-priori* expectations about what the content and format of the documents would or "should" be. In addition, a sample of the documents was examined and any additional features or content they exhibited was added to the a-priori list. The entire set of documents was then compared against this list. In doing so, we found several things that were not on the original list. The new material was incorporated into the list (third revision) and all documents again reviewed against the revised list. Most of the content of the lists used is shown in the tables in the following sections.

In some cases the persons submitting the documents were contacted for clarification of how they were used.

Limitations of this approach:

- The documents examined for this study probably do not constitute the complete set of documents associated with a switching job: they are not all there is to the documentation required for scheduling and performing switching. For example, copies of outage requests submitted were usually typed or word-processed: many of these may have been based on a fill-in-the-blanks original completed by hand. Load studies performed prior to scheduling switching are alluded to or summarized in the more elaborate outage requests or cover sheets, but no separate documents were submitted.
- All descriptions and inferences are based on the sample of materials examined, which were generally completed outage requests and switching instructions (very few participants submitted the procedures that spell out how to prepare the forms, and what does or does not get included). Although these samples illustrate many of the characteristics of the utility's documents, they most likely do not show the complete range of possible entries. For example, switching instructions may direct the operation of cutouts and auto/manual switches when appropriate. However, if these steps were not required for the particular switching job that was submitted as an example, we would not know that such steps were a routine part of the instructions.

Organization of this Report

The report consists of five sections and two appendices:

1. Introduction
   - Study Objectives and Background
   - Approach
2. Outage Requests and Derivative Documents
3. Switching Instructions

4. Other Documents Related to Planning or Execution of Switching
   - Clearance records
   - Planning documents
   - Pre-dispatch checklists
5. Concluding Remarks

Appendix A: List of Utilities Contributing Forms

Appendix B: Sample Forms

The examples (forms or portions of them) that are used in this report have been "sanitized" to remove identifying information such as individual and company names, control centers, and cities, and often the labels of check boxes (for example, notifications/coordination with an ISO or neighboring utilities). Minor details like street and station names have usually not been changed. However, readers will recognize their own forms, and it is possible that readers from adjoining utilities that have seen a particular company's forms will as well.

2
OUTAGE REQUESTS AND DERIVATIVE DOCUMENTS

In this section, we describe the forms used for requesting outages and documents derived from them, such as the cover sheets with outage information that are often attached to switching instructions.

The content (and, to a lesser extent, the format) of these forms is determined by how they are used to support the scheduling process, which itself varies a great deal in complexity from utility to utility.

The great variety in the way these "request" documents are used (are they a simple request or a complete record of the planning process, is it line work or substation work, are there ISO requirements to address or only our own, etc) require that this section be essentially descriptive rather than analytical. To "evaluate" these forms would require an understanding of the individual processes in which they were used that is far beyond the scope of this study.

From these descriptions and examples, the reader may identify some feature that he or she feels useful in someone else's forms. Outage requests supply basic information about the reason for the request and the work to be performed. This information may be summarized succinctly as similar to the journalist's "5 W's" – Who, What, Where, When and Why. However, even the simplest outage requests usually contains the 6th important "W": What else, i.e., additional useful information related to the requested outage.

Types of Outage Request

Outage requests appear to assume a variety of forms:

1. **Simple request for equipment. (5 Ws).** This type of outage request provides original input **to** the scheduling process. In its simplest form, its function is to identify switching needed to support work to be done. At least one utility indicated that the original request could be phoned in and the Outage Coordinator would take it from there through development of the switching instructions. Sample 1 in Appendix B is an example of a very simple outage request form of this type.

2. **Work planning document (5 Ws & what else).** This type of outage request, especially those that are in an electronic form, is elaborated as additional information becomes available. Some paper forms have more information than is usually supplied by the requestor, for example notifications of neighboring utilities or an ISO. These more elaborate documents have spaces for recording other information that is related to the proposed switching: load flow studies, or other types of engineering analyses, notifications, concurrent

clearances, etc. Samples 2 and 3 in Appendix B are examples of such forms. Some utilities also have additional documents used in planning.

Some electronic forms expand to acquire and display load studies, engineering analyses etc, as they become available, and these can be printed all on a single document. One of their principal values is in electronically facilitated collaboration. Individuals or departments that may be geographically separated can append required analyses or signoffs to the package. In addition, electronic documents can be electronically forwarded to crews in the field or an ISO- a process that is easier, quicker, and less subject to degradation than sending a fax. Lastly, electronic systems have the capability of distributing information to a variety of different documents as required for their use. Information can be entered once and reproduced in a variety of differing formats, or the format of documents produced may be altered to adapt to the information available. There may be a field on the planner's screen for entering parties to be notified: if none are entered, the printed document may simply omit that field.

3. **Cover sheet for the switching instructions.** Some variant of a cover sheet is very common, perhaps nearly universal. This may be developed from the original request and contain additional information from other planning documents. Although the cover sheet may be formatted differently than the outage request, it presents most of the same information as the request. Sample 4 in Appendix B is an example of a cover sheet. In other cases, the original or expanded request may contain fields (e.g., for recording issue and release of clearance in real time) that allow it to be used as a cover sheet without further modification. Sample 5 is an Outage Request form that has such fields. Although outage requests without such fields can and probably are used as coversheets, they would not be so identified for this study.
4. **Hybrid forms.** Two utilities submitted outage requests using another type of form, that we call hybrid forms. These constitute yet a fourth category of request document. They contain both the outage request information and the switches required to be operated. One form (#11) is formatted for the switching to be developed on the outage request form. This is usually done by someone other than the person requesting the outage (e.g., the Outage Coordinator). In the other (# 39), the requestor identifies all switches to be opened and tagged to perform the desired work, and the form contains spaces for real-time issue and release of the clearance. The listing of switches to be opened is sufficient for an experienced crew to switch directly from, without additional written instructions, so it is often used as the switching instruction sheet.

Content of Outage Requests

Even the simplest outage requests must answer the "5 W's" about the reason for the request and the work to be performed – Who, What, Where, When, and Why – and usually a sixth: What else. The "what else" is additional information needed to schedule and support the work of the switchmen and those performing the work for which the outage is requested. This information may be provided by the requestor or added by one or more other persons processing the Outage Request, such as an Outage Coordinator or engineers performing studies required to support the request.

There is, however, great variation in the nature of additional information requested/provided. As stated in the introduction, it is not clear from examination of a single sample whether the

variation observed is due to differences in what companies record on the outage request, or the requirements of the particular outage described by the sample document. For example, notifications may appear on a cover sheet only if required for a particular outage.

The information commonly contained on the outage requests examined is shown in the tables that follow (Tables 2-1, 2-3, and 2-4). (The hybrid forms contain the same kinds of information as the outage requests, but are discussed separately). The "Simple" column in the tables is for what appear to be the simplest or most basic outage requests examined; the "As Cover" column is for more elaborate forms used as cover sheets and the "Cover" column is for obvious cover sheets. Cover sheets were identified by the fact that they either 1) contain fields for entering information such as the time the clearance was actually issued and released, or, 2) are page-numbered continuously with the instruction pages. Within each column, the first number is the percent (rounded to the nearest integer) of the sample (number of forms of each kind is given at the head of the column) and the second is the number of documents on which the feature appeared.

The "meat" of the outage request, information that explains the reason for the requested clearance and allows the development of the appropriate switching is shown in Table 2-1. In the table, 'field' in parentheses indicates that there is a label or labeled field for the information. 'Field/ck box' indicates either a field or a labeled check box. Such boxes are sometimes used when there are different levels of clearance, types of tag, or a list of other departments or utilities (or an ISO) that may need to be notified or coordinated with.

Table 2-1
Basic Information on the Work to be Performed

Item #	Simple n = 20		As cover n = 8		Cover n = 7	
	%	#	%	#	%	#
Who						
Person in charge/clearance/permit holder	60	12	100	8	71	5
Contact information (phone/cell/pager/radio)	30	6	75	6	43	3
Contact for emergency release of clearance	10	2	—	0	—	0
Reference to field supervisor/other contact	5	1	13	1	29	2
What						
Equipment to be worked on	95	19	100	8	100	7
Voltage level or T/D (separate field)	35	7	13	1	—	0
(and/or) Equip't description included voltage	25	5	38	3	43	3
Where						
Location of work (separate field)	80	16	100	8	57	4
(and/or) Equip't description included location	35	7	38	3	57	4
When						
Requested date/time out & return or duration	100	20	88	7	100	7
Rain a consideration/alternate date (field)	15	3	25	2	—	0
Why						
Work to be done (reason for clearance)	100	20	100	8	86	6
What Else						
Remarks/notes/other info (text entry)	75	15	38	3	100	7
Clearance/order/tag type (field/ck boxes)	60	12	50	4	86	6
Isolation points (limits) identified (field for)	55	11	63	5	71	5
Emergency restoration time (field)	30	6	50	4	57	4
Restore nightly? -- or equivalent (field)	20	4	25	2	14	1
Customer outage (field)	20	4	13	1	—	0
Notifications required (text entry)	20	4	13	1	57	4
Other utility (field/ck box)	15	3	13	1	14	1
ISO (field/ck box)	15	3	13	1	29	2
Customer (field/ck box)	10	2	—	0	—	0
Own departments (P&C, etc) (field/ck box)	20	4	25	2	29	2
Grounds to be installed (field for)	20	4	25	2	14	1
Location of grounds (text entry)	10	2	25	2	—	0
Work scope changes (text entry)	—	0	—	0	14	1
ISO jurisdiction	15	3	13	1	29	2

Although we believe that all of the items listed in Table 2-1 represent at least potentially useful information, relatively few of them appear on the majority of forms. Inspection of Table 2-1 reveals the following common content, that is fields found on virtually every form. These are the information required to answer the "6 W's" mentioned earlier, Who, What, Where, When, Why & What else.

- ***Who?*** Person in charge/clearance/permit holder appeared on 60% of outage requests and 88% of cover sheets. There was always a person named on the outage request, either the requestor or the person to be in charge of the work, though not always separate fields for both.
- ***What?*** Equipment to be worked on appeared on 95% of simple requests and 100% of cover sheets
- ***Where?*** Location of work appeared on 80% of simple requests and 58% of cover sheets as a separate field. When not a separate field, location was a part of the equipment description, e.g., "Jones Street Breaker 32G."
- ***When?*** Requested date/time out and return or duration of the outage appeared on 100% of both.
- ***Why?*** Work to be done (reason for clearance) appeared on 100% of requests and 94% of cover sheets.

Note that the above "core" information appears on cover sheets as well as simple requests, and also frequently appears on switching instructions, especially those that did not appear to be accompanied by a cover of some sort.

- ***What else?*** A field for entry of remarks/notes/other information appeared on 75% of simple requests and 100% of cover sheets.

There were a number of fields that appeared in some, but often fewer than half, of the documents. Many of these may represent additional stages of planning for the outage. They include:

- Identification of isolation points as part of the request. This field appears on half of the simple requests. (One Outage Coordinator explained that, for his system at least, the requestor is expected to know the system well enough to do this – though it is always checked and subject to revision by the Outage Coordinator)
- Map/drawing references are given in about a third of requests (and possibly should be universal)
- Phone/fax/cell/pager/radio of persons named as requestor/clearance holder/person in charge of the work. At least one of these fields appears on most "simple" outage requests. One form had fields for all of these, plus an office location.
- Check boxes for external entities or departments/work groups to notify or coordinate with. (The presence of this information suggested that the document was a planning document rather than a simple request. Much of the added information was of such a nature that it was most likely be filled in by someone processing the request and planning the outage, rather than the person requesting the outage.)

Uncommon Content

In addition to the information shown in Table 2-1, there were 23 different fields that appeared in only a few (usually only one or two) forms. These are listed in Table 2-2 below, with the number of documents in which they appeared given in parentheses.

Table 2-2
Other Information Included on Outage Request Forms

Responsible switching center (5)	Vehicle number (2)
Company performing work (6)	Concurrent clearances (1)
Phasing required (5)	Switchboard Rotos affected (1)
P&C engineering review (3)	Rotation required (1)
Coordination with Other utility (3)	Load transfer required (1)
Recloser blocking (3)	System change needed (1)
Engineering review (2)	Radial feed (1)
Protective relays affected (2)	Special customer (1)
Contingencies created (2)	Special studies required (1)
Emergency work request (2)	Additional line on same structure (1)
Revision information (rev # or date) (2)	Power flow notes (1)
Contractor information (2)	

A few of the items in Table 2-2 (recloser blocking; concurrent clearances; additional line on same structure) have obvious safety significance; others (responsible switching center; company performing work) are most likely due simply to the size of the utility. Still others may have simply evolved as useful in support of the way the company operates.

A few request forms included unusual but possibly useful fields. For example, the grid for making a drawing of the proposed work shown in Figure 2-1 is included in one utility's form, which is also used as a cover sheet to the switching instructions. The entire form is shown as Sample 5 Appendix B.

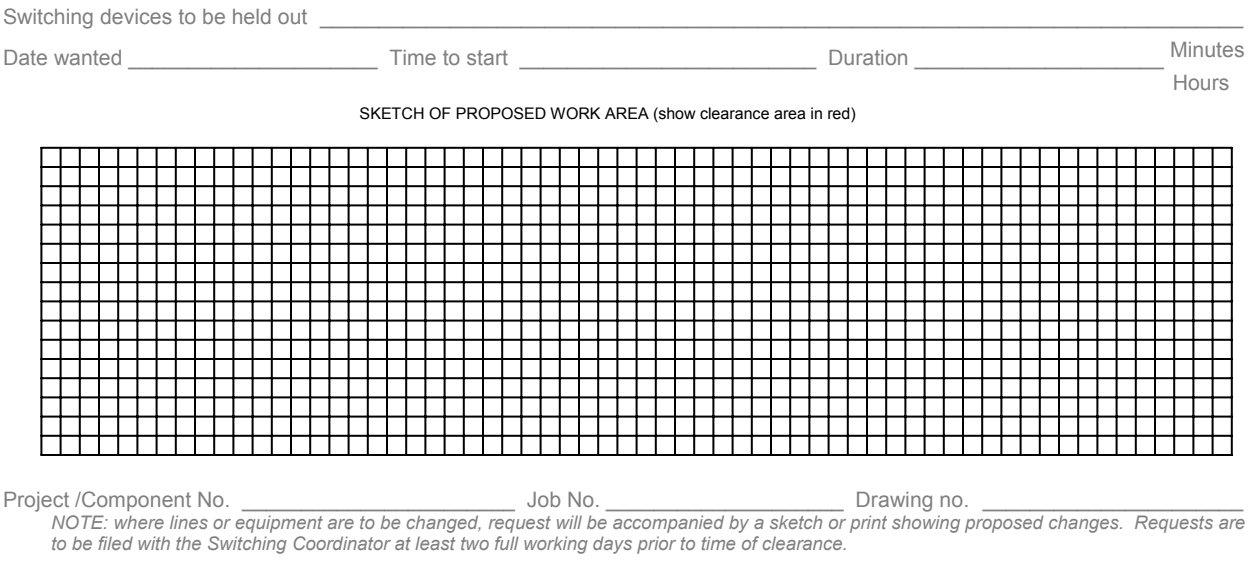


Figure 2-1
Grid for Sketching Equipment Involved in Proposed Outage

Administrative Information Included in Outage Requests

Most Outage Requests also contain information on the development of the document itself. This "administrative" information is summarized in Table 2-3.

Of the information in Table 2-3, only some kind of identifying number, the date of the request, and the name of the person submitting it appeared on the majority of request forms. A variety of numbering schemes were used to relate the outage request to the resulting switching. Some use the request number as the number of the switching instructions or clearance. Others had spaces for writing in the clearance or switching order numbers.

Two of the items above, "OK per field review" and "Checked by" suggest practices that we believe may be desirable. We also believe the practice of having a second party check over an outage request after it is prepared is far more common than is suggested by the small percentage of forms on which such checks are recorded suggests.

Table 2-3
Administrative Information Included in the Outage Request

Item #	Simple n = 20		As cover n = 8		Cover n = 7	
	%	#	%	#	%	#
Request # (unique identifier)	60	12	50	4	29	2
(and/or) Permit / clearance / work order #	40	8	50	4	43	3
(and/or) # appears on switching instructions	40	8	63	5	86	6
Date request prepared/submitted	65	13	75	6	86	6
Prepared/submitted by (name/initials)	100	20	63	5	100	7
Contact info (phone/cell/pager/radio)	50	10	38	3	29	2
Requestor supervisor	5	1	13	1	29	2
Submitted to/received by (field)	15	3	13	1	29	2
Approval/authorization status	65	13	88	7	71	5
Name/signature/organization approving	50	10	38	3	57	4
Account to which work charged (field)	20	4	25	2	—	0
OK per field review (field)	—	0	13	1	—	0
Checked by (name / initials)	10	2	13	1	57	4
Document revised (date or other field)	10	2	13	1	14	1
Switching written or assigned?	5	1	25	2	14	1

Format of Outage Request Forms

Format features of outage requests are summarized in Table 2-4. Note that in many cases we do not know if there is not a simple handwritten request form that is the basis for, or an input to, the word-processed or computerized forms submitted to us, which then contain additional planning/scheduling information.

Hybrid Forms

Two utilities had forms that combined the switching and clearance information on a single form. In one case (#11), the switching was apparently developed on the form after the request had been submitted. In the other (#39), the switches desired open were submitted with the form, which also provides spaces for issuance and release of clearance. The utility contact said that substation crews could and routinely do perform the switching from the form without preparing additional switching instructions. This form is shown in Figure 2-2.

Table 2-4
Format Features of Outage Request Forms

Item #	Simple n = 20		As cover n = 8		Cover n = 7	
	%	#	%	#	%	#
Spaces for data to be entered by hand OR	45	9	50	4	29	2
Word Processor/ template OR	60	12	63	5	86	6
Computer screen	20	4	25	2	—	0
Visible grouping of information (sections, demarcation)	50	10	75	6	86	6
More than one page	10	2	38	3	14	1
Pages numbered if more than one	5	1	13	1	14	1
Reference to map/drawing/sketch (field for)	35	7	38	3	29	2
Other planning documents referenced/attached	15	3	13	1	—	0
Signatures handwritten (fields for)	25	5	13	1	43	3
Request document is separate from switching instructions *or*	100	20	100	8	43	3
Part of (page #ed) packet with instructions	5	1	—	0	57	4
Real-time clearance issue / release (spaces for)	5	1	25	2	57	4
Other real-time switching info (names / times)	—	0	25	2	29	2
Postponement / reschedule (rain date)	15	3	25	2	29	2

LOGO

WORK ORDER NO.

ELECTRIC SYSTEM

REQUEST FOR AND RECORD OF EQUIPMENT OUTAGE

DATE: DAY: FROM: TO: ☐ NOT SUBJECT TO WEATHER

REQUESTED BY: JOHN DOE TEL, NO.: (732)764-3261 DEPT./DIV./GEN. STA. CENTRAL SUBSTATION

REQUESTS THE FOLLOWING: BRUNSWICK SWITCH 220-2 TRANSFORMER AND 220-2 GROUP A & B 26 KV OCB'S CLEARED & TAGGING FOR STATION WORK

LOCATION	DESIGNATION OF EQUIPMENT	TAGGING TYPE	TAGGING NO
BRUNSWICK SWITCH	220-2 230 KV LOAD BREAK DISC.,CONTROL HANDLE,CONTROL POWER	R	3
BRUNSWICK SWITCH	220-2 TRANSFORMER 2A & 28	Y	2
BRUNSWICK SWITCH	220-2 VOLTAGE REGULATOR	Y	1
BRUNSWICK SWITCH	220-2 TRANSFORMER 26 KV GROUP A BUS DISCONNECT	R	1
BRUNSWICK SWITCH	220-2 TRANSFORMER 26 KV GROUP A OCB AND CONTROL	Y	2
BRUNSWICK SWITCH	220-2 TRANSFORMER 26 KV GROUP A TRANSFORMER DISCONNECT	Y	1
BRUNSWICK SWITCH	220-2 TRANSFORMER 26 *KV GROUP B BUS* DISCONNECT	R	I
BRUNSWICK SWITCH	220-2 TRANSFORMER 26 KV GROUP B OCB AND CONTROL	Y	2
BRUNSWICK SWITCH	220-2 TRANSFORMER 26 KV GROUP B TRANSFORMER DISCONNECT	Y	1
BRUNSWICK SWITCH	220-2 26 KV TRANSFORMER NEUTRAL DISCONNECT	R	1

EQUIPT. TO BE: ☐ SWITCHED OUT BY MAINTENANCE ☐ SWITCHED BACK BY MAINTENANCE

☐ CLEARED & TAGGED ☐ GRD. & SHORTED ☐ CUT & READY ☐ TAPED ☐ PORT. GRD'S/GAPS

☐ REMOTE TRIP/P.W. OFF ☐ CARRIER OFF ☐ RECLOSING OFF ☐ INST. TRIP ON ☐ PHASING NECESSARY

FOR: DEPT./DIV./GEN. TEL./RADIO NO. AVAILABILITY OC

GROUP TAGGING: NAMES OF PERSONS IN CHARGEOF WORK TOTAL

LOCATION AND NATURE OF WORK

COMPUTER: TAGGED OUT HR. SO/SD TAGGED IN HR: SO/SD

PORT. GRD'S/GAPS INSTALLED HR: DATE:

EQUIPT. TAKENOUT OF SER.: HR: DATE: TOTAL TAGS INSTALLED

ASSIGNED TO: HR: DATE

RELEASED TO: HR- DATE: REM. TAGS GRD'S/GAPS SO/SD

RE-ASSIGNED TO; HR: DATE; TAGS GRD'S/GAPS SO/SD

RELEASED BY HR: DATE., TAGS GRD'S/GAPS SO/SD

RE-ASSIGNED TO: HR: DATE: TAGS GRD'S/GAPS SO/SD

RELEASED BY: HR: DATE- GRD'S/GAPS SO/SD

EQUIPMENT RESTORED TO SERVICE HR: DATE: REMOVED SO/SD

FAX TO _____ BY _____ DATE _____ TIME_____

TO _____ BY _____ DATE _____ TIME_____ WORK ORDER NO.

SHEET # _____ OF _____ CONTROL NO. _____ REFER TO ORDER NO. _____

Figure 2-2
Hybrid Form used for both Requesting and Performing Switching

Recommendations

Outage requests exhibit a great variety of formats and contents, in part due to the kinds of work that the forms are intended to address and in part due to differing kinds of information collected by the utilities submitting them.

Majority practice supports the following recommendations:

- Inclusion of the outage request – or most of the information on it in the form of a cover sheet – with the switching instructions, at least the dispatcher's copy. Most do this and the Switching Safety and Reliability Project staff has advocated it for quite a while. An alternative evident in several of the switching instructions examined is to print some of the information from the outage request – at least the purpose of the outage – on the top of the switching instructions themselves.
- The "what else" of the outage request, i.e., spaces for notes or remarks, appears very useful and is again a majority practice.
- Identification of isolation points as part of the request (majority practice). These may be identified by the requestor or the Outage Coordinator or other persons planning the switching.
- Format: some structure or organization of the content that makes it possible to find whatever you are looking for rapidly seems useful.

There are a number of common but not majority practices that appear to have some potential to aid in error avoidance or simply to be useful information that may be recorded in other documents when not on the Outage Request. Although we know of no "authority" recommending them, they seem worth considering on their obvious merits. They include:

- Map/drawing references provided in the request. This practice is relatively common, obviously useful, and possibly should be universal.
- Check boxes for entities to notify/coordinate with (though this is more for planning documents than for simple request documents).
- Using the request number as the clearance or switching procedure number, or both.
- Phone/fax/cell/pager/radio of persons named as requestor/clearance holder/person in charge of the work.
- Alternate dates to accommodate weather or conflicting outages.
- Identification of contingencies created by the outage.
- Unused data fields present but N/A'ed, rather than hidden, as seems possible on computer generated forms.
- A field to indicate that information on the request form (especially clearance points) has been checked by a second person. Two of the Outage Request forms examined had a "checked by" field on the outage request form. We believe that many do this, but it is not recorded on the form, as the checking of switching instructions usually is.

Items that appeared on only one or two forms also appear to us to be potentially useful for avoiding errors or speeding recovery from them. These include:

- Information on related clearances, especially those sharing clearance points in common. The safety significance of this condition is obvious.
- Indication whether the outage as written involves or creates a radial feed situation.
- Protective relays affected (may aid in recovery from an error).
- Person to contact for emergency release of clearance.

3
SWITCHING INSTRUCTIONS

The term "switching instructions" is used here to refer to the sequence of switching steps for affecting a particular outage. This document has different names in different utilities. Some common variants include switching procedure, switching log, switching program, etc.

Some of the switching instructions that were reviewed were produced electronically while others were hand-written:

- There were 32 switching instructions produced using word processing or other computer-based tools; of these one was not used because it was a test program rather than a switching procedure.
- Four utilities hand copied switching instructions onto a pre-printed 'switching order' form. These are blank formatted forms usually bound as a pad. One utility's pads had pre-numbered blanks, for the others, the switchperson is expected to enter an order number issued by the dispatcher.

The forms also differed in terms of the intended users. There were 27 forms that could have been used by both Control Center (CC) and field personnel, and 8 that were specifically intended for the use of field switchpersons. The latter (field) group includes the 4 on order blanks filled out by hand (instructions are dictated by the dispatcher to the field switchperson) and 4 intended for field use but printed out for the operators. Two of these were identical in that they were submitted by different regional offices of the same utility and, more importantly, produced by the same computerized system.

The discussion of switching instructions is divided into four parts:

1. Overall document format
2. Administrative information on the switching instruction document
3. Content and presentation of action steps
4. Evaluation and recommendations

Overall Format of Switching Instructions

Common formatting features of switching instructions document are shown in Table 3-1. (Formatting of the actual instructions is the subject of a subsequent table).

Table 3-1
Formatting of the Switching Instructions Document

Item #	CC/Field N= 27		Field Only N=8	
	%	#	%	#
Physical features of the instructions				
Is the form typed?	100	27	50	4
(or) handwritten?	—	0	50	4
Printed in "landscape" format	19	5	—	0
Instructions start at least 1 inch from top of page	89	24	100	8
Typography				
Switching Instruction lines single spaced	15	4	38	3
(or) Lines double spaced	30	8	13	1
(or) Table format (with lines/cells)	56	15	50	4
Instructions printed in all capital letters?	44	12	—	0
Instructions printed in all bold lettering?	7	2	13	1
Organization of information				
Location of switching given on instructions	85	23	100	8
Multiple locations on single sheet?	70	19	—	0
Remove and restore sections on same sheet(s)	89	24	63	5
Restore numbering continuous with remove	45	13	25	2
Grouping of steps Obvious where appropriate	56	15 [1]	—	0
Groups labeled	30	8	—	0
(or) Extra white space (or skipped line in table)	30	8	—	0
Numbering				
Steps numbered sequentially	85	23	38	3
(or) Step/substep structure	15	4	—	0
Pages numbered	78	21	13	1
Pages numbered in “Page X of N” style	59	16	—	0

1. One form had both labeled groups and extra white space.

Format of Instructions Used by Both Control Center and Field Switchpersons

- "Landscape" format similar to that shown in Sample 6 is used by 5 utilities. This format allows more elaborate formatting as shown in the examples below (examples have been reduced in size to fit on the page).

	Date	Time	Opr	Ck	Location	Action	Device Description	Remarks
1			EMS		Big Creek TS	Verify	115KV BUS Normal	
2			EMS		Big Creek TS	Open	634-A	
3			EMS		Big Creek TS	Open	634	

In the example above, the columns provide a uniform structure for all action steps, and include both "who" and "where" in every line of instruction. It is not clear that the format offers any other advantage over a more conventional page orientation, and use of 8-pt. font is required to fit information within the columns.

Step No.	*Switch* Equipment Number	*Location/Remarks*	*Open*	Close	Place		Remove		Control *Off or* Disabled	Step *Done* By	Date	Time	*Card Number*	Card *Placed* For	Card *Number* Removed
					H.C.	C.C.	H.C.	C.C.							
1	76-S	@NOR	X												
2	68-S	@GSS	X												
3	68-B	@GSS	X		X										

In the example above, the use of columns for actions eliminates verbs (though this is not self-evidently a good thing) and allows real-time recording of information on the individually numbered tags placed and removed (note that there are two kinds of tags possible). The hold card information is also recorded on a separate hold card record. This form also includes "where" in every line of instruction, and allows recording of "who" for every action performed.

Typography

- For those who do not use a table-like format, double (or more) spacing of lines is about as common as single spacing. One utility provided 30 point spacing between instructions.
- Table-like formats with cells (boxes rather than lines) for instructions and other information are used in about half of pre-printed forms (as opposed to those to be filled in by hand). Sample 7 in Appendix B is an example of such a form.

- Instructions are printed in all capital letters on about half of the forms examined. Two of the sets of instructions reviewed also used all bold lettering in instructions. Use of all capital letters is specifically discouraged by experts in the field for reasons discussed later.

Organization of information

- The location (or the principal location) of the switching is given on the majority of instruction documents. In the samples examined, two thirds of the instructions included switching at more than one location.
- Most companies in the study have switching instructions for removal and return of lines or equipment on the same document. In the sample of instructions examined, steps for removal and restoration were either literally on the same piece of paper or on different numbered pages of what was obviously a single package.
- Those that do not have removal and return of equipment on the same document use an "order" format in which the remove and restore instructions are issued to the field as documents with separate numbers. Field forms for recording dictated instructions are more likely to use the "order" format than are the printed instructions used by both the dispatcher and field switchperson.

Numbering

- For about half the samples, the numbering of action steps after clearance return is continuous with the numbering of the steps for removal from service. For the others, the numbering starts over again with "1." In some cases issue and return of clearance are also numbered steps.
- About half of the instructions employed some form of grouping of lines, either by labels or by additional space before the first line in the group. This was usually done to set off instructions for switching at different locations.
- All but one of the forms numbered each step, either sequentially or in a step-substep fashion. The step-substep structure was used for switching performed at different locations.
- All multiple-page instructions were numbered, as were a number of single-page examples, which were often page 2 of a package that included a cover sheet. The majority of page numbered instructions were numbered in the "Page X of N" format.

Format of Field Order Pads

Field Order Pads are used for recording switching instructions dictated by the dispatcher or, in one instance, created by the field operator using the pad (i.e., the field person used the pad to document instructions for his or her own execution).

- These forms are usually smaller than 8 ½" x 11".
- Formats for the printed forms used by both the dispatcher and field switchperson were more structured than for (most) field order pads. Most of these pads are used for "Orders."

Instructions are given separately for remove and restore, and different identifying order numbers are assigned to the two sets of instructions.

- Three of the four field order pads examined had no marked or separate space for checkoff.
- The four pre-printed field order pads examined had no step numbers, or had only one or two numbered steps at the beginning that are reminders to do a tailboard review or use proper safety equipment.
- Only one of the field order pads (shown below) provided a highly structured format for recording switching information dictated by the dispatcher. This utility uses the same format for the instructions used by the dispatcher.

SWITCHING ORDER

(GENERAL SWITCHING OR SWITCHING REQUIRED TO OBTAIN A CLEARANCE)
Dispatcher _____ Issued to _____
At _____ Order No._____ Date _____
Time Issued _____ Time Executed _____
_____ Sw. No._____ Place Hold Card No. _____ For _____
_____ Sw. No._____ Place Hold Card No. _____ For _____

Administrative Information

Like outage requests, switching instructions often contain some administrative information on the preparation and approval of the proposed switching. This is shown in Table 3-2.

Table 3-2
Administrative Information Contained on Switching Instructions

Item #	CC/Field N=27		Field Only N=8	
	%	#	%	#
Administrative information				
Switching order #	74	20	100	8
Clearance #	41	11	50	4
Prepared by (name/initials)	70	19	13	1
Checked by (name/initials)	74	20	25	2
Average number of checks required (spaces on form)	2 see discussion below			
Name of switchperson	82	22	100	8
Name of switchperson supervisor	7	2	—	0
Name of dispatcher directing	63	17	88	7
Time/Date(s) done	100	27	100	8
Day of week done	37	10	13	1
Supplemental Information				
Purpose of switching given on instructions	78	21	50	4
Additional info (e.g., drawings, etc) attached?	11	3	—	0
CC/Switchperson review noted on sheet	22	6	13	1
(field) Walkthrough noted on sheet	7	2	—	0
Clearance issue				
Hold for clearance indicated in sequence	70	19	25	2 [1]
Added wording re clearance in sequence	26	7	--	0
Clearance info (names, times) in sequence	48	13	25	2 [2]
Clearance issue on cover sheet	26	7	13	1 [2]
Other clearance issue (clearance card, log etc)	30	8	75	6

1. Utility 37 switching is written and performed by the substation operator: the form submitted has an annotation to issue a work permit to self. This is functionally the same as a clearance.

2. Utility 12 has clearance information on both the form used by the operator and a cover sheet maintained by the system operator: the system operator's version is the "official" clearance.

Administrative Information

- A variety of formats are used for identifying documents (clearance #, outage request #, order #): some forms contain both the switching instruction number and the clearance number. However, a number of utilities use the clearance number as the number for the switching instructions.
- The majority of forms identified the person who wrote the instructions and the persons checking them for accuracy/completeness, and usually both. However, neither the author nor the checker was recorded on 5 of the 27 forms for CC/Field use.
- The number of spaces provided on the document to be initialed by persons checking the instructions prior to use ranged from 0 to 8. Seven (26%) of the forms for CC/field use had no labeled space for indicating that the instructions had been checked by a second person. For the remaining 20, the average number of sign-offs for which spaces were provided was 2.6. Three had spaces for up to 8 initials, but 12 had only 1 space to be initialed by a checker. Where more than 2 spaces were provided, many had not been initialed on the documents examined. For example, the utility that provided spaces for 8 sets of initials usually had 2 or three, never all 8. Two utilities provided spaces for the instructions to be initialed by a dispatcher on every shift.
- Many forms provided no labeled space to write name of dispatcher or switchperson. On several such forms, names were penciled in the white spaces. Such spontaneous additions by users suggest that a dedicated space should be provided. Because this information is potentially important, we consider this omission a deficiency.
- All included spaces for recording the date and time the instructions were executed, and about a third also included the day of the week.

Supplemental information

- A majority of instructions include the purpose of the switching at the top of the instructions, even when a coversheet or copy of the outage request containing the same information accompanies them.
- We believe that the inclusion of the reason for performing the switching and other key elements from the Outage Request is potentially helpful when a cover sheet is not present, e.g., where the dispatcher's copy of the instructions has a cover sheet but the field persons' copy does not.
- Three of the 27 of switching instructions in this group had additional information such as a drawing attached to the instructions.

Clearance Issue

- Hold for work or clearance issue was marked in some way in 19 (70%) of general forms and 2 (25%) of field-only forms. This could be as simple as the annotation "ISSUE CEARANCE IN LOG." Or the clearance itself could be issued on the instructions as in the example below. (The 30-point vertical separation of steps is a feature of this utility's instructions.):

_____ 11. ISSUE C.O.#_____ ON WHITE TANKS WT222 FROM WT221 TO WT223.

_____ 12. CREW REPORT WORK COMPLETED.

In some cases, the spaces for indicating and recording clearance included important safety elements as steps (with checkoff) or reminders, as shown in the two examples below. Field switching 'fill-in' forms usually included at least one such reminder.

All blades are open and in the clear; you can test the line, install ground and go to work.

Fault current available at worksite _____ Number of ground locations _____

Clearance granted: Date _____ Time _____ Dispatcher _____

Clearance _____ for _____ on _____
From: _____ To: _____
Tagging Arrangement: _____
_____ √ AREA FOR ANY HAZARDS AND PPE IN USE
_____ √ TAILBOARD DISCUSSION HAS BEEN COMPLETED
Clearance Issued: _____ Date: ____/____/____

Similar reminders are also sometimes included for clearance release:

Line is ready to be returned to normal per existing switch map? ☐ Yes ☐ No

Are all personnel in the clear? ☐ Yes ☐ No

Have all grounds been removed? ☐ Yes ☐ No

Clearance release by: Name _____ Date _____ Time _____

Clearance _____ for _____ on _____
From: _____ To: _____
_____ Workers Grounds Removed
_____ Men and Equipment Clear
_____ Equipment can be Restored to Normal Service
Clearance Canceled: _____ Date: ____/____/____

One utility includes a sometimes very elaborate review of what the clearance holder is expected or permitted to do under the clearance and the conditions expected upon release of clearance, as shown below. The dispatcher is expected to review this information with the clearance holder, and to document this review just like any other step.

CLEARANCE RELEASED ON 69-12KV MOBILE TR KP5 AT SIDNEY, GROUNDS REMOVED, PERSONNEL AND EQUIPMENT IN THE CLEAR, AND THIS EQUIPMENT CAN BE RETURNED TO SERVICE.

CLEARANCE RELEASED	DATE	TIME	CLR CK
TOM JONES	_____	_____	[ ]
_____	_____	_____	[ ]
_____	_____	_____	[ ]

TOM JONES REPORTS THE FOLLOWING:

[ ] HE HAS LEFT MOBILE TR KP5 MOAB, GND SW & 12KV CB OPEN, AFTER TRIP (GREEN FLAG) ON CTRL SW TO MOAB & CB, ALSO LEFT CB RECL SW IN MAN POS.

[ ] HE HAS CONNECTED LOW SIDE OF MOBILE TR TO THE SPARE (MOBILE) 12KV DISCS.

[ ] HE HAS CONNECTED HIGH SIDE OF MOBILE TR TO THE SPARE (MOBILE) 69KV DISCS.

[ ] HE HAS CONNECTED TEMPORARY REGULATORS BETWEEN LOW SIDE OF THE MOBILE TR KP5 AND THE SPARE (MOBILE) 12KV DISCS.

[ ] MOBILE TR SET TO OPERATE AT 69KV ON THE PRIMARY SIDE AND 12KV ON SECONDARY SIDE.

HIGH SIDE TAP CHANGER # 1 ON POSITION 2
HIGH SIDE TAP CHANGER # 2 ON POSITION 2
HIGH SIDE SERIES-PARALLEL SWITCH ON POSITION 1
LOW SIDE SERIES PARALLEL SWITCH ON POSITION 2

OPERATING VOLTAGE OF 70,500-13,090 VOLTS

- For about a third of the CC/Field instructions and 6 (75%) of the forms for field use, the issue of clearance is documented somewhere other than on the switching instructions or cover sheet – in the log or a separate clearance record. These documents are discussed briefly in Section 4.

Content and Presentation of Action Steps

"Instructions" specify how to perform a task. For any kind of instructions, the required content may be described by the "4 W's":

- **Who:** Action performed locally or remotely (via SCADA from the Control Center)
- **What:** what action, what object
- **Where:** location of component to be operated
- **When:** usually given by sequence

The content of action steps is summarized in Table 3-3 below.

Table 3-3
Information Included in the Sequence of Action Steps

Item #	CC/Field N=27		Field only N=8	
	%	#	%	#
Who performs the switching				
Switching by SCADA or supervisory explicitly identified	82	22	25	2
Actions included in action steps (what) [1]				
Relays/cutouts	70	19	63	5
Recloser enable/disable	41	11	25	2
Placement of locks	30	8	—	0
Placement of grounds	15	4	—	0
Call-ins	7	2	—	0
Notifications	59	16	13	1
Notes/explanations	48	13	25	2
Presentation of information within each instruction or step				
Each device a separate step	59	16	63	5
Only one verb/step	33	9	38	3
(or) Multiple verbs per step	67	18	50	4
Abbreviations (of verbs) or symbols used in steps	22	6	63	5
Equipment # or name	100	27	100	8
Equipment type	52	14	25	2
Voltage class referenced with equipment type	7	2	—	0
Associated circuit/line identified	4	1	—	0
Placement of each tag a separate line of instruction	19	5 [2]	25	2
(or) Tags in same line as action	59	16	63	5
(or) Tag check box	7	2	--	0
(or) Tag column	15	4	13	1
Conditional steps (if, do) used	19	5	13	1
Where switching is performed				
Switching location in every instruction	44	12	13	1
(or) instructions grouped by labeled location	41	11	25	2
Job aids included in instructions				
Space for time each step completed (may serve checkoff)	96	26	13	1
Space for initial or checkoff of each step	22	6	38	3
Spaces for recording Voltages/Amps	15	4	0	0

1. Operation of breakers and disconnects is included in all instructions: omitted from table to save space.
2. The four tagging items in the "General" column do not add to 100% because the switching forms submitted by utility # 1 do not include tagging instructions. For this utility, tagging is taught as a part of their switching technique, and the placement of appropriate tags is considered skill-of-the-craft and NOT routinely included in written instructions.

Who Performs the Actions Required

- The majority of CC/field-use forms and 25% of the Field-Only forms explicitly identified switching to be performed by SCADA or supervisory control (*who* executes the instruction). In a few cases of utilities that include location in every instruction, this was indicated by specification of the control center as the switching location, rather than the substation at which the switch was located.
- For one utility submitting forms, the specification of "who" is implicit rather than explicit. Certain classes of equipment are switched by supervisory, and both the field switchperson and the dispatcher can readily identify these components by their numbers, but there is nothing written on the instructions to indicate to someone who does not know this convention who is expected to do the switching.

What Actions are Included in Action Steps

- Aside from the fact that operation of relays/cutouts was included in the instructions on about 2/3 of both kinds of forms, there seems to be little consistency and no clear majority practice in the sample examined. This could be because these items were not required for the switching described by the sample submitted. We believe that all of these actions should be included in the written instructions if they are expected to be performed.
- Many (48% of general forms and 25% of field-only forms) also included comments on the objectives to be accomplished for step or sequence of steps. These may be thought of as addressing the fifth *W – why.* For example:

Close N.O. Group Operated Switch 4044 at 25 ST & 4 AV, ROCK ISLAND Making Parallel

Presentation of information within each instruction or step

- Sixteen (59%) of the 27 CC/Field forms included multiple devices in the same instruction step or same line. The devices were generally logically related in some way – often pairs of disconnects or the disconnects associated with a particular breaker. Although common, this practice makes it easier to overlook a component to be operated, especially if three or more are mentioned in the same instruction, or if significant time elapses between the actions on the listed components.
- Number of actions (verbs) per line. Only a third of the instructions reviewed used the generally recommended format of one action per line of instruction. Where multiple verbs were present, they were usually "open" and "tag" on the same line.

  Some instructions contained no verbs at all, but used check boxes to convey the control action and tag placement or removal desired, as in the following example.

Step No.	Switch Equipment Number	Location/Remarks	Open	Close	Place		Remove		Control 0ff or Disabled	Step Done By
					.C.	C.C.	.C.	.C.		
	76-S	**@NOR**	**X**							
	68-S	**@GSS**	**X**							
	68-B	**@GSS**	**X**		**X**					
	CCVT	**@GSS ON X30 TO GROUND**			**X**					
	CCVT	**@NOR ON X30 TO GROUND**			**X**					
	1000-CS	**@NBD TO MANUAL**		X						

- Abbreviations were common for equipment types (OCB, etc.). Abbreviations for verbs were relatively uncommon in preprinted forms. However, some use abbreviations liberally, as shown in the examples below.

> DC CONT FU & LK @ DC Panel "E" Cir 14
> CL, BK, & T__ R__ 30G-12K-9
> 14 RLT-CLOSE 4809 BUS SWJONES SUB

- Other than the use of the Greek letter Ø for "phase," use of symbols on written instructions was rare. However, one utility used plus and minus signs (+, –) for "close" and "open" respectively. Another used a checkmark for "check" as shown below.

> – Line Disc
> ✓ OP, BK, & TAG R 30G-12k

- All forms examined included the name or number of the equipment to be operated (*What*) in every instruction. Far fewer included the type of equipment (e.g., OCB, Disconnect, etc.) in each instruction, and fewer still referenced the voltage class or identified the associated circuit or line. Although the number is logically sufficient, the other information can be useful as a sanity check, especially in cases where duplicate component numbers exist in the system and the added information is useful for absolutely positive identification of the component. We have seen incident reports in which duplicate component numbers was a major factor in the error.

- Relatively few instructed placement of tags as a separate step. The majority included hanging or removal of tags as additional actions in steps directing operation of equipment. Two indicated tagging operations with check boxes, as illustrated in the "verb-less" form shown above. Tagging could also be included in an instruction by means of a separate column reserved for tags as in the next example, where the *R*'s just before the breaker number indicate that red tags are to be hung.

13)	CL, BK, & T	R	30G-12K-12
14)	TEST, 3Ø POT		30G-12K-9
15)	If None, CL, BK, & T	R	30G-12K-9
15)			

- A minority of switching instructions employ conditional ("if") statements. Sometimes these appear to indicate uncertainty as to the condition of equipment (which we feel is itself an undesirable situation). In others, the conditional appears to be an economical way of saying "proceed when such-and-such condition is established," as in the sample above.

Where Switching is Performed

About half of the instructions examined included the switching location in every instruction, usually by means of a three-character location or substation code, but sometimes by a phrase such as "at Longwood, Check . . ." Others grouped instructions by labeled location, and some utilities that included the location code in every instruction also labeled the groups of instructions for different locations.

Job Aids Included in Instructions

- All but two of the forms provided place-keeping aids, blanks for checking off completion of a step or recording the time it was performed (or separate blanks for both).
  - One of the two utilities that did not include this feature used sheets from what appeared to be a station instruction book for most routine switching. A portion of this procedure is shown below. It is not formatted as a checklist with place-keeping aids, though place keeping was evident from the multiple check marks next to, above, or below every action, times written in white spaces, and the insertion of several commas by the person who performed the actions.

> Place supervisory local remote switch on front of Panel No. 3 for Transformer No. 2 load ratio control to "local" position and tag.
>
> Open and tag Disconnect No. 1118-D2.
>
> Open and tag Disconnect No. 1118-D1.
>
> Disable the out of step and distance relays 21-3P 213PR 21-1S and 21-2S on the rear of Panel No. 2 for line No. 1179 by opening the red lever inside the case for each relay (See general information page for explanation)

  - The other set of instructions had space for recording when the set of instructions was issued and when it was completed, but not for each step. These were formatted the same way as the field order blank, see the example in the "Format of Field Order Pads" section, and were from the same utility.

- Very few of the switching instructions had labeled spaces for recording voltage or amp readings. Those that did were for distribution switching.

Delivery of Switching Instructions to Field Switchpersons

Delivery to field switchpersons seems to be mostly of paper forms that are transmitted either by fax or as computer files (typically Excel files) and printed out for use in the field. The latter method avoids possible degradation that may be experienced by faxed documents – an important concern when small fonts are used.

In some cases, computer generated documents are sent to the field. An example of an instruction generated by a computerized scheduling system is shown in Sample 8 in Appendix B. The document is produced on an Excel template generated by the company's electronic scheduling system, and is transmitted to the field as an Excel file that is printed out by the crew before going to the job. The document has the instructions pre-printed but has blank spaces for the users to fill in the names of the dispatcher, switchperson performing the work, and the switching order number assigned when the instructions are officially issued by radio.

Evaluation

Unlike outage requests, switching procedures are step-by-step instructions that are intended to direct the performance of specific actions. There is a good deal of information on the features of such documents that can contribute to their effective use and error-free performance of the actions presented. We first set out some of these accepted principles, then evaluate our findings against these principles, and finally make recommendations based on the accepted principles and common utility practice.

Some Accepted Principles of "'Good" Operating Instructions

Content

- Include everything that is expected to be done: verifications, notifications, etc.
- Every instruction (action step) must convey the 4 W's listed below:
  - What is to be done (action verb),
  - Where is it to be done (component and sometimes geographic location),
  - Who is to do it (field or control center). In the absence of a specified person, "Who" is, implicitly, You, the reader and
  - When it is to be done (usually indicated by sequence on the page).

Other useful but not essential information includes the "Why" and the "What else" details.

Step Format

- Each instruction should (ideally) consist of **one** action and **one** object of that action:
  - Start each instruction with an action verb
  - Include complete official nomenclature (name and number of device) for equipment named in a step
- Place each instruction on a separate line.
- Number every step (numbering facilitates discussion).
- Provide place-keeping aids to keep track of progress. (Effective use of place-keeping aids is one benefit of the one action-one object rule: where there are multiple actions or objects in an instruction, the competent operator will check off each as it is done.)
- Clearly identify steps to be performed by system operator via SCADA e.g., append the phrase "by supervisory" as in the example below where?.
- Leave space for "fill-ins" to record readings.
- Font Size (NOTE: lettering size varies among fonts of the same nominal "point" size):
  - 10 point (8 pt Arial) or larger for Control Center use
  - 12 point (10 pt Arial) or larger for field use (possible degradation by being faxed, variable lighting in field)
- Avoid all caps if possible (can reduce reading speed and possibly accuracy
- Within instructions, use highlighting sparingly:
  - Bold and all caps can be used for highlighting, though both should be used sparingly.
  - Avoid underlines (they can interfere with legibility)
  - Although highlighting should be used sparingly, highlight action verbs if – in contradiction to the rules given above – an instruction contains more than one verb, e.g., OPEN and TAG
- At least "double-spaced" line spacing.

Document Structure

- Provide spaces for recording the names of the dispatcher and the switchperson(s), especially if multiple locations are involved.
- Group steps where appropriate or possible (e.g., by physical location):
  - Different substations
  - Control house and switchyard (to avoid unnecessary motion and associated time)
- Use labels or white space to indicate organization of information.

- Number with "Page X of N" on every page (even if there is only one).

Undesirable format features

Undesirable format features in many of the documents examined included:

- Very small fonts (8pt). These are simply more difficult to read under adverse conditions such as poor lighting in a substation, being read through a scuffed plastic protector, or the degradation often evident in faxed documents. If used at all, small fonts should be reserved for documents to be used in the near optimal conditions of the control room, or for information such as headings that does not change from document to document (a person familiar with the document type can make out the heading, even if he can't read it perfectly).
- Steps not numbered.
- No place-keeping aids (spaces for checkoff of initials). Presence of spaces encourages checkoff each step as it is completed, which is a significant aid in error reduction.
- All caps. All caps are not easier to read unless the text is very degraded. Their use has the unfortunate effect of making words look more alike. Instructions were printed in all capital letters on about half of the forms examined. When used in a table format with heavy lines defining the cells and only 2-3 points above and below the lettering, this can detract from legibility. This effect is even more pronounced when the all caps text is also bolded, as in the example below.

SWITCHING STEPS			
SUB	**TIME**	**#**	
	:		
724S	:	1	CHK, LOAD TRANSFER REF# 84156 COMPLETED
HINES CK	:		
	:	2	THIS IS _____DOIC_____ AT FAIRVIEW REQUESTING ___ OIC AT SCC
	:		TO OPEN & TAG 501B,5L42D2 AT 724s SUB, UNDER CONDITIONAL GUARANTEE
	:		
	:	3	TURN, 5L377 (BKR 501) A RECL, OFF
	:		
	:	4	S/C, OPEN, BKR 501, CHK
	:		
	:	5	OPEN, S B DISC 510B, CHK
	:	6	TAG, SB DISC 501B FOR JOHN DOE, REF # 84160, DATE JAN14 2004,TAGGED BY JIM BRIDGER
	:		
	:	7	S/C, OPEN, MOD 5L42D2,CHK
	:	8	CHK, MOD 5L432D2, OPEN, DISABLE, LK
	:	9	TAG, MOD 5L432D2, FOR JOHN DOE, REF # 84160, DATE JAN 21 2004, TAGGED BY JIM BRIDGER
	:		

- All bold lettering. All bold lettering adds nothing and can actually reduce legibility.
- Multiple components per step, e.g.,

  OPEN DX'S 3223 AND 3225, LOCK OPEN, & RED TAG

- Single spacing over an entire page, e.g.,

OPEN Bus Disconnect 3223, LOCK open, & PLACE red tag
OPEN Line Disconnect 3225, LOCK open, & PLACE red tag

Single spacing within a table format can result in the text being separated from the cell borders above and below it by only one or two stroke widths, which further degrades legibility.

A set of instructions exhibiting four of these defects is shown below (interestingly, the utility from which this example is taken nonetheless has a very low error rate).

Check for Open, Set Green Flags 1571, 1570, 8336
Remove Jones' B/T, R/T for Dispatcher CH 1571
Remove Jones' R/T's, Close 1570 E, 8336 S
Remove Jones' R/T's from TD 1571, and Decoupler MOS 8338
Remove Jones' B/T's, Close, Cut in Automatics, Supervisorys 1570, 8336
Open, R/T for Dispatcher Switch 8332
Cut in 69 KV Bus #2 Differential Relay, and 69 KV Bus #3 Overcurrent Relay (Panel 12 R)

Recommendations

Recommended Content for Switching Instructions

Supported by the majority practice, we believe the following is *important* content that should be included in every set of switching instructions:

- Some kind of identification number (order, clearance, outage #)
- Date (many also include the day of the week)
- Purpose of the switching (may be conveyed by a field on the switching form or by a cover sheet or attached outage request)
- Space for recording the names of both dispatcher & field person (critical where switching is being performed at multiple locations)
- SCADA switching identified ("CC, supervisory, SCADA")
- Locations clearly identified if switching is performed at multiple locations
- Use complete official nomenclature for equipment named in a step
- Spaces for recording readings if required

Note that while the writer and checker of the instructions are important from an administrative point of view, they are not critical information for user. It is the fact that the review has been performed (which is often a procedural requirement), rather than the identity of the person performing it, that is primarily signaled by the signature or initials.

The following are items that we consider to be *useful* content:

- ***Items common to many of the forms examined:***
  - Information from the Outage Request on the switching instructions themselves. Or the Outage Request or a cover sheet included as part of a package with the switching instructions.
  - Remove and restore instructions on the same document, or, if separate orders, included in the same package.
  - Clearance issue and release documented on the switching instruction document. This means *both* that the place in the sequence of instructions for issue and return is marked (e.g., numbered steps) *and* that the record of clearance issue and release is physically a part of the instructions instead of a separate document that may be overlooked, as it could be if it *only* appeared in a separate log, card, or form. A common alternative is to document clearance issue/release on a cover sheet attached to the switching instructions.
  - Type of component in every step (again useful for sanity checking)
- Items that are less common but probably useful for understanding and error avoidance; these help the user to "sanity check" (verify) the correctness of the document for him or her self.
  - Drawing numbers (including revision) for one lines used to prepare/check switching
  - Comments explaining the effect of (some) steps
  - Labeled spaces for writing switchman and dispatcher names on forms
  - Notifications to be made (on forms for Dispatcher use per accepted principles above)

An additional "nice to have" feature that was recently implemented by one participating utility is sequencing as it will actually be done in the field; e.g., separate locking and tagging at the component from operating a switch in the control room. An example is shown in the example below.

1. ____ Check open & tag OCB 2342
2. ____ Open & tag MOD 2341
3. ____ Open & tag MOD 2343
4. ____ Check open, block open & tag OCB 2342
5. ____ Check open, lock open & tag MOD 2341
6. ____ Check open, lock open & tag MOD 2343

Recommended Format for Switching Instructions

There is a good deal of information on the formatting of instructions that can contribute to their effective use and error-free performance of the actions presented. Instruction steps should be formatted in accordance with the generally accepted principles of "good" operating instructions as discussed in the "Evaluation" section above.

Example of a Good Format that Incorporates Most Recommendations

The format shown below was a revision to an existing format in accordance with a presentation on switching forms given at the 2003 Switching Safety and Reliability Conference in Columbus, OH.

_____ ***1 ABC System Operator NOTIFY XYZ System Operator 69 kV line H-60 is being removed from service***

Wells St SCO: Field Person:

_____ ***2 ABC System Operator OPEN H-60 OCB by supervisory***

_____ ***3 PUT 43 switch to manual position for H-60 OCB***

_____ ***4 CHECK H-60 OCB open***

_____ ***5 OPEN disc line side H-60 OCB***

_____ ***6 INSTALL Hold Card for ABC System Operating on disc line side H-60 OCB at Wells St SS***

Scott Paper Co SCO: Field Person:

_____ 7 OPEN 77 switch

4
OTHER DOCUMENTS RELATED TO PLANNING OR EXECUTION OF SWITCHING

A few participating utilities submitted additional documents with the switching instructions and outage request forms.

Clearance Records

Documenting the issuance of a clearance (date, time, and individual to whom issued) can be done on the switching instructions themselves, a cover sheet or outage request used as cover sheet, or on separate documents, which may be called "Clearance Records," "Hold Card Records," etc.

There were a few separate clearance documents submitted. These are apparently a part of the switching instruction package. An example of a Clearance Record sheet is included in Appendix B as Sample 9.

It appeared to be a more common practice to document the clearance on either the cover sheet or the switching instructions. Documenting clearance issue on or in the switching instructions is discussed in Section 3.

Planning Documents

Two utilities submitted planning documents that supplement or expand upon the information provided by the person submitting the Outage Request. One of these is shown in Appendix B as Sample 10. Information entered on such documents may include:

- Type of clearance/permit required
- Personnel performing switching (operations, maintenance crew, etc.)
- Work order number
- Responsible switching center
- Installation of grounds
- Customer outage information
- System risks created by outage (e.g., line or device trip, voltage changes, etc.)
  - Estimated probability of such risks (low-medium-high)

  - System consequences if risk is realized (e.g., line or transformer overload, loss of load, etc.
  - Estimated severity of system consequence if risk is realized (low-medium-high)
- Contingencies created by proposed outage
- Plans for dealing with such contingencies

Pre-Dispatch Checklists

A brief pre-dispatch checklist supplied by one utility is presented as Sample 11 in Appendix B. Similar information was included in one utility's electronic outage request form, which included the schedule for internal notifications and pre-switching meetings.

Lists of Required Safety Equipment

One utility included spaces for listing required safety equipment on its Outage Request form. Another has such a list as a separate document that was included in the request/switching instruction package.

5
CONCLUDING REMARKS

Comparison of the data presented in Table 3-3, information included in the sequence of action steps, against the accepted principles of "good" operating instructions suggests that there is room for improvement in the presentation of many utility's switching instructions.

The three most commonly observed faults are:

- Absence of place-keeping aids (spaces for checking off the step or recording the time it was performed) on the forms for field use.
- Presentation of actions on multiple components in a single line of instruction (it is hardly a single "step" if multiple components are involved).
- Absence of spaces to write in the names of the dispatcher directing the work and the field person(s) executing it.

Many utilities have "gotten by" with sub-optimally presented procedures for years. However, sooner or later these features of the instructions will be found to have been a contributing factor in a switching error that will no doubt have other causes as well. While these format defects will seldom be the principal cause of an error, every day they present an additional and unnecessary opportunity for something to go wrong.

Though most readers will probably dismiss this assertion with "if it ain't broke don't fix it," at least one utility that has followed the recommendations presented above has been very pleased with the results.

Additional observations on examples supplied (both switching forms & requests):

- Many fields on the examples reviewed were not filled in. This rather surprised us, as thoroughness is one of the hallmarks of safe and reliable operating. If there are fields that are never used, they should be removed from the document.
- Some documents had additional annotations or initials in the margins. The name of the switchman was the most common such annotation on switching forms that did not have a field for this purpose. Human Factors Engineering practitioners believe that such spontaneous additions, especially if made by multiple users, indicate that the information is considered useful, and that there probably should be a field for it. You can use this to evaluate whether your own forms need to be revised.

A large variety of formats are represented in the data presented here. It is hoped that the reader may find some item of information or way of presenting it used by another utility a worthwhile addition to their own companies' documents.

A
UTILITIES CONTRIBUTING MATERIALS

AEP

Arizona Public Service

ATCO Electric

ATC We Energies

ATC WPS

Alabama Power

Bonneville Power Administration

CenterPoint Energy

Consumers Energy

CONVEX

Dairyland Power

Decatur Utilities

DTE Energy

Duke Energy

East Kentucky Power

Electric Energy (SO)

Georgia Power

Hawaiian Electric

Imperial Irrigation District

Mid American

NPPD

NYPA

OG&E

Progress Energy

PSNH

PSNM

SCE

United Illuminating

WAPA

B
SAMPLE FORMS

Sample 1

COMPANY NAME

Clearance and Hot Line Order Request Form

[LOGO]

Distribution Operations Center

Tom Jones III
Ext. 1234
Fax 1235
Email: tjonesii@electco.com

Systems Operations Center

Joe Smith
Ext. 5678
Fax 5679
Email: jsmith@electco.com

APPROVED 03/05/04 – T JONES III

(This Section to be Completed by Requesting Party)

Requesting Party: _____ **Clearance:** ☐ **Hotline Order:** ☐

Equipment to be cleared:

_____

SUBSTATION: _____

Reason for Clearance or Hot Line order: _____

	From:		T0
Date:	03/11/04		03/12/04
Hour	07:30		20:00

Will the Service Department be Needed For Switching? _____

Extension that You Can Be Reached At: _____ **Radio #** _____

Immediate Supervisor: _____ **Extension:** _____

==========

(This Section to be Completed by Outage Coordinator)

- ✔ All Clearances will require at least 48 hours Advance notice. The deadline to request will be 12:00 Noon.
- ✔ All hot line orders shall be requested at least 24 hours in advance. Clearances/Hot Line Orders involving interconnections with other utility will require at least 72 ours notice. This will allow time for analysis and contact with the other utility.

Sample 2

[COMPANY NAME] **NO. _____**
SCHEDULED WORK REQUEST
Transmission Operations fax # 555-666-7777
Distribution Operations fax # 555-666-7778

CIRCUIT/EQUIPMENT _____
_____
REQUESTED BY _____ PHONE # _____ FAX # _____
PRINTER _____
PLANNED OUTAGE DURATION FROM: TO:

DATE	TIME	DATE	TIME
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

DESCRIPTON OF WORK:

POINTS OF VISIBLE ISOLATION:

CLEARANCE FOR: _____ RADIO # _____
SWITCHPERSON: _____ RADIO # _____
_____ RADIO # _____

TIME REQUIRED TO RESTORE SERVICE IN EMERGENCY _____
SPECIAL INSTRUCTIONS, PRECAUTIONS:

CONTROL CENTER USE ONLY

RISK ANALYSIS – Has the first contingency risk to distribution load been reviewed by Coordinator? YES ___ N.A.___ Initials____
If a Distribution risk doers exist, has the Distribution Supervisor been notified? YES ___ Initials_____ Approved YES ___ NO ___

STUDY REQUIRED: YES____NO____ SUBMITTTED TO SYSTEM OPERATIONSSUPPORT Date _____ Initials _____
SEE SPECIAL OPERATING GUIDES: YES ____ NO ____ Guide prepared by _____
WORK REQUEST APPROVED NOT APPROVED Initials ____
REQUEST PARTY NOTIFIED DATE _____ TIME _____ FAX _____ Initials _____
PLACE ON OUTAGE SCHEDULE: _____ ON CALENDAR _____

PARTIES TO INFORM OR APPROVE	DATE & TIME OF CONTACT – INITALS	DATE & TIME OF APPROVAL - INITALS
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Sample 3

[Company] **TRANSMISSION OPERATIONS WORK REQUEST**

☐ EHV ☐ ST *Use Procedure No.:*_____

REQUESTED BY:	DATE:	TIME:	WA. NO.:	WR CROSS REFERENCE

☐ FUNCTIONAL TEST ☐ SUBSTATION ☐ LINE ☐ CUSTOME OUTAGE ☐ RELAYS
☐ CONSTRUCTION ☐ MAINTENANCE ☐ MICROWAVE / PLC ☐ FIBER OPTICS ☐ OTHER

WORK LOCATION AND JOB: _____

WORK STATEMENT REQUIRED: ☐ CLEARANCE ☐ CONTACT TAG ☐ WORK RELEASE ☐ INFORMATION ONLY
☐ DNC TAG ☐ WORK PERMISSION ☐ OTHER

EQUIPMENT AFFECTED OR OUT OF SERVICE: _____

SCHEDULED	TIME		DAY	DATE
START SWITCHING	_____	M.S.T	S M T W T F S	____ _____
START WORK	_____	M.S.T	S M T W T F S	_____
COMPLETE WORK	_____	M.S.T	S M T W T F S	_____
RETURN TO SERVICE	_____	M.S.T	S M T W T F S	_____

ADVISED:
☐ XYZCO ☐ MNOPQ ☐ PON ☐ FED
☐ ABC ☐ MAINT ☐ MLKJ ☐ IHG
☐ DIV ☐ RSC ☐ SI/COMM ☐ WTUN
☐ DEF ☐ TUV ☐ SI/P&C ☐ NIAM
☐ GHI ☐ WXY ☐ SI/TS ☐ VWCC
☐ JKLC ☐ PLANT ☐ CBA ☐ OTHER

REQUEST GRANTED BY: _____ FIELD CONTACT: _____

SWITCH BY: ☐ SWITCHMAN ☐ CREW ☐ PLANT ☐ OTHER _____
☐ ADVISED _____ FOR SWITCHMAN AT _____
☐ ADVISED _____ FOR SWITCHMAN AT _____

COPY OF REQUEST SENT TO: ☐ GCC ☐ OTHER _____

PROCEDURE SENT TO: ☐ ECC ☐ CREW ☐ SWITCHMAN ☐ OTHER _____

REMARKS: _____
☐ LINE TO REMAIN OUT OF SERVICE: _____
☐ LINE TO BE PLACED IN SERVICE EACH NIGHT: _____
☐ USE T_BUS OR SPARE BREAKER: _____
☐ DIVISION TRANSFER LOAD TO ALTERNATE SOURCE: _____

UNIT TRIP
GUIDELINES _____ ☐ TABLE_____
☐ ITEM NO _____ ☐ GRAPH _____ ☐ WFL _____ ☐ FC-CH _____

DEVICE ON: ☐ LOCAL ☐ REMOTE

DIFF RELAYS: ☐ NO BUZZ C.T.S ☐ SUMM SW _____

AUTO RECLOSER DISABLE: ☐ By S/C ☐ AT STATION ☐ NONE

GTR DISABLE: ☐ YES ☐ NO

LINE RELAYS: ☐ PLC ☐ M/W ☐ TT ☐ F/O ☐ PW ☐ OTHER _____

☐ CONSTRUCTION RELEASED TO OPERATIONS REQUIRED ☐ OPERATIONS RELEASE TO CONSTRUCTION REQUIRED

SWITCHING PROCEDURES WRITTEN BY: ☐ OPERATION PLANNIG ☐ ECC

REMARKS: _____

Sample 4

138kv line 8252 between St. Lawrence. Pleasant Valley and Saukville

[BIG LOGO]

[Company Name]

SWITCHING PROCEDURE FOR SCHEDULED INTERRUPTION

Snellville FTC Outage No. 104894 Page 1 of 10

Switching Start Date/Time: Thursday, Feb 26 2004 @1500

Work Start Date/Time: Friday, Feb 27 2004 @0700

Work Complete Date/Time: Sunday, Feb 29 2004 1600

Requested By: JIM BRIDGER(414-651-1830) Requested Date: 2/10/2004

Facilities out of Service: 138kv line 8252 between St. Lawrence, Pleasant Valley and Saukville

Reason for Job: Disconnect jumpers at Pleasant Valley to allow Pleasant Valley to be supplied from St. Lawrence only for line work on section of 8252 between Pleasant Valley and Saukville.

Person in Charge of Job: Jim Bridger Hold for Person:

Emergency Availability: Ongoing Availability: No

Clearance Zone: for line work: Open line and bus disconnects for 8252 at Saukville, T7-138kv disconnects at Pleasant Valley(from Alamo Electric DCS, jumpers disconnected between East and West 8252 at Pleasant Valley.

Work To Be Done: see reason/cause

Work Location: on line Between Saukville and Pleasant Valley

Switch Map Number: LDC: Alamo Electric

Powerflow Notes: ran _powerflow/ca using "dailysavecase2004O22018 "simulated line 8252 out ... no basecase, no unsolved, no volt bar, brings up CTG; OL of EDG T21flo either SFL 345/138 trf

Contingency Plan: Direct EDG-5 output reduced by 80MW's and run GT-5 if necessary to reduce Post loading on EDG T-21.mjl

Notes: See attached photograph of Pleasant Valley as a guide as to which-jumpers need to be disconnected to allow Pleasant Valley to he fed exclusively from St. Lawrence.mjl

Outage Schedulers: ISO ☐ FTC Sys OP CAL ☐

Other Utilities Notified:

LDC Contacts: David Crocket 123-456-8910

Line and SS Work Coordinated? No Generation Affected? No Redispatch Required? No

Prepared By: dboone Approved By: _____

Sample 5

HOLDOFF REQUEST

REQUEST TO WORK ON DE-ENERGIZED SUBSTATIONS, LINES OR EQUIPMENT
THIS REQUEST, BY ITSELF, DOES NOT CONSTITUTE CLEARANCE
CLEARANCE TO BE GIVEN VERBALLY BY LOAD DISPATCHER

\ No.: _____

Date: _____

Full name of person protected _____

Name of Line, Station or Equipment _____

From station _____ To station _____

Equipment on which work is to be performed _____

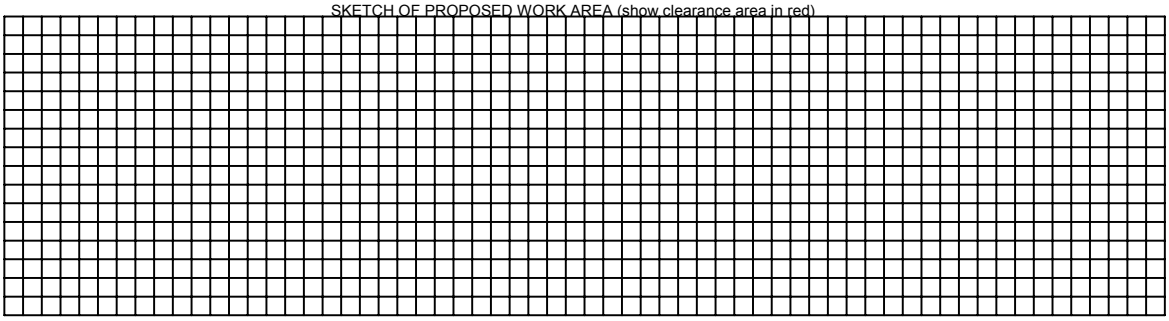
Switching devices to be held out _____

Date wanted _____ Time to start _____ Duration _____ Minutes Hours

Reason for holdoff _____

_____

SKETCH OF PROPOSED WORK AREA (show clearance area in red)



Project /Component No. _____ Job No. _____ Drawing no. _____

NOTE: where lines or equipment are to be changed, request will be accompanied by a sketch or print showing proposed changes. Requests are to be filed with the Switching Coordinator at least two full working days prior to time of clearance.

Suggested Hot Phasing Site(s) _____ Supt. O.K. _____
Division Requesting Holdoff

VERBAL CLEARENCE RECEIVED FROM LOAD DISPATCHER: DATE _____ Time _____ LD _____
TESTED AND GROUNDED EQUIPMENT OR CIRCUIT: TIME _____ BY _____

The following to be filled in by the Switching Coordinator

Request received _____ Time _____ Action Taken _____

_____

Holdoff postponed to _____ Reason _____

_____
Switching Coordinator

Planned Hot Phasing Site(s) _____

Approved: _____
Chief Dispatcher

_____
Operating superintendent

AUTHORIZATION TO CANCEL HOLDOFF

☐ No change in hot phasing site(s)
☐ Planned hot phasing site(s) need to be checked.
This was discussed with Load Dispatcher.

VERBAL CLEARANCE RETURNED TO LOAD DISPATCHER
Date _____ Time _____ Load Dispatcher _____

_____
Signature of Person Protected

NOTE: Return clearance and sign only when all workmen are in the clear, all grounds removed; hot phasing site(s), if any, have been determined and discussed with Load Dispatcher and equipment is ready for Service

Sample 6

Control Center – System Switching Order **[Company Name]**

Switching Order No: 85949 WR #: 69792
Revision Date: 01/0/04 **Revision Time:** 01:23:57AM **By:** ANBEARE

To be performed:
Faxed By: _____

Plant Location: 00500 **Facility Name:** Big Creek
Equip. Type: Breaker **equipment:** 634

From: 02/02/2004 12:00
To: 02/02/2004 15:00

Order Issued By:	**Order Received By:**	**Switched By:**	**Issued To:** Sub Maint Crew
Created By: HAW	**DateCreated:** 10/08/04	**Checked By:**	**Date Checked:**

Comments: Major Breaker Inspection Substation Maintenance crew will perform switching.

	Date	Time	Opr	Ck	Location	Action	Device Description	Remarks
1			EMS		Big Creek TS	Verify	115KV BUS Normal	
2			EMS		Big Creek TS	Open	634-A	
3			EMS		Big Creek TS	Open	634	
4					Big Creek TS	Open	634-SC	
5					Big Creek TS	Check for Open	634	
6					Big Creek TS	Open	633	
7					Big Creek TS	Tag	633	
8					Big Creek TS	Open	635	
9					Big Creek TS	Tag	635	
10					Big Creek TS	-		
11					Big Creek TS	Post TransMap		
12					Big Creek TS	-		
13					Big Creek TS-PCB 634	Issue Clearance	633, 635	**TO:**
14					Big Creek TS	-		**BY: ECC/**

Sample 7

Page 1 of 2

Note:_____
Day: _____
Date:_____

ESCC SWITCHING ORDERS			
Job Description:			**BT30 OCB MTCE.**
Written by:	**JED**	**03/12/2004**	**Reviewed by:**
STEP	TIME	VEHICLE ID LOCATION	SWITCHING DESCRIPTION
			Print # D-4996-2
1.			TAILBOARD DISCUSSION COMPLETED WITH THE INTENT OF IDENTIFYING HAZARDS.
2.			APPROPRIATE PPE IN USE.
3.		ESCC	NOTIFY ISO-NE APPL.# 3664
4.		CC/GREGGS	OPEN OCB BT30
5.		GREGGS	PLACE ON LOCAL OCB BT30
6.		"	OPEN DX'S 3003A and 3003B AND RED TAG TO DIAMOND
7.			
8.			RED TAG CLEARANCE TO DIAMOND ON OCB BT30
9.		GREGGS	TURN TO OFF 69-87BA SW.
10.		"	**Etc.**

Sample 8

Switching Order

SWR		Order Number	
		Day/Date/Time Issued	
System Operator			
Switching Personnel		Day/Date/Time Completed	
		by System Operator	

Check for Open, Set Green Flags 1571, 1570, 8336
Remove Jones' B/T, R/T for Dispatcher CH 1571
Remove Jones' R/T's, Close 1570 E, 8336 S
Remove Jones' R/T's from TD 1571, and Decoupler MOS 8338
Remove Jones' B/T's, Close, Cut in Automatics, Supervisorys 1570, 8336
Open, R/T for Dispatcher Switch 8332
Cut in 69 KV Bus #2 Differential Relay, and 69 KV Bus #3 Overcurrent Relay (Panel 12 R)

Sample 9

<COMPANY> CLEARANCE			No: _____
PROCEDURE NO:	CROSS REFERENCE NO:	ADDITIONAL CROSS REFERENCE NO:	
SWITCHING DATE:	SWITCHING ORDERED BY	SWITCHING DONE BY:	SWITCHING DONE BY:

CLEARANCE STATEMENT

STEP	DEVICE	LOCATION	POSITION	TAG	TIME	DATE

1	Issued/Transferred By:	Time:	Released/Transferred To	Time:
	Issued/Transferred To:	Date:	Released/Transferred By	Time:
2	Issued/Transferred By:	Time:	Released/Transferred To	Time:
	Issued/Transferred To:	Date:	Released/Transferred By	Date:
3	Issued/Transferred By:	Time:	Released/Transferred To	Time:
	Issued/Transferred To:	Date:	Released/Transferred By	Time:
4	Issued/Transferred By:	Time:	Released/Transferred To	Time:
	Issued/Transferred To:	Date:	Released/Transferred By	Time:

WORK RECORD

Sample 10

<Company>
HOLD OFF CLEARANCE REQUEST – SE
FAX TO WXYZ WRITE UP ROOM 123-456-7891

N0TICE: Requestor shall consult outlook Switching Schedule Calendar prior to submitting this form. This schedule Is used to levelize work on any given day. Hold Off Requests are scheduled on a first come, first served basis.
Guidelines to follow:

- If more than four outages are already shown on the calendar between 0600 and 0900, select another day or time.
- If more than seven outages are already shown on the calendar, select another day.

Also note that schedule is not firm until confirmation is returned to requestor. In addition, Requestor shall submit form at least 72 hours (three full normal working days) in advance of the time clearance is required.

A. GENERAL INFORMATION

A.1. Today's Date: _____

A.2. Request Type:

☐ Customer Requested ☐ <Company> Requested ☐ Contractor Requested

A.3. Operating Desk/Service Center.

☐ ABCD-EFGH-IJSC ☐ QRST-UVSC ☐ CSPO-LKSC
☐ KLMN-OPSC ☐ WXYZ-DCBA-MNSC ☐ HGEF-NMSC-POSC

A.4. <Own Company> Requestor: _____

A.5. Requester Phone No.: _____

A.6. Requestor Phone No: _____

A.7. Requestor Fax Number: _____

B. SPECIFIC INFORMATION

B.1. Requests Clarence On:

☐ Feeder(s)/line ☐ Equipment

B.2. Identification of Feeder/Equipment for Clearances:

_____
_____
_____

B.3. Voltage:

☐ Secondary Voltages (480 V or less) ☐ 13.2 kV ☐ 34.5 kV
☐ 4 kV ☐ 24.9 kV ☐ 69 kV
☐ 8 kV ☐ 26.4 kV ☐ 138 kV

B4.a Order To Do Work (OTDW) No.: _____

B.4.b Trouble Order:

☐ Yes ☐ No

B.5. Internal Order No.: _____

B.6. Map/Drawing Identification:

_____

_____

C. HOLD OFF DETAILS

C.1. Description of Work Location, Identification of Clearance points, Nature of Work:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

C.2. Switching to Be Done by:

☐ Crews ☐ Troubleshooters ☐ Both

C.3.a System Grounds to be installed:

☐ Yes ☐ No

C.3.b System Grounds to be Installed by:

☐ Trouble ☐ Crews ☐ N/A

C.3.c Location of System Grounds:

_____

_____

_____

_____

_

C.4.a Cable Phase Identification Required:

☐ Yes ☐ No

C.4.b Trouble to Pick Phases

☐ Yes ☐ No

C.4.c Trouble to Verify Voltage and Phase Rotation Prior to Re-Energization

☐ Yes ☐ No

D. CUSTOMER OUTAGE INFORMATION

D.1. Planned Outage for 3 Phase Business/Industrial Customer(s)

☐ Yes (Attach Supplement to Hold Off Request Form for each Customer Outage)
☐ No

D.2. Managed Outage for Customer(s)

☐ Yes ☐ No

E. SCHEDULE

E.1	Outage Start	Date _____	Time _____
E.2.	Hold Off Start	Date _____	Time _____
E.3.	Estimated Hold Off Release	Date _____	Time _____
E.4.	Estimated Completion	Date _____	Time _____

F. CONFIRMATION

Line Feeder: _____

Between: _____

Date: _____

Location of System Grounds: _____
_____
_____
_____
_____

Remarks (any changes): _____
_____
_____

Sample 11

Ref. WO# _____
Job No. _____
Supervisor Name
_____

Dispatch Check-Off Sheet

Switching Request Received in Dispatch Office on _____.
Dispatcher assignment _____.

Emergency Switching ☐ Routine Switching ☐

Number of clearance points required _____ and trucks to perform switching _____.

Load study complete with before/after currents attached to switching list. ☐

Load study is NOT complete and additional information is required. ☐

1st Draft written and checked off by _____ on _____, 200 _____.
1st Draft approved and walk through completed by dispatcher and the field supervisor _____, _____ on _____, 200 _____.
Field visit competed by _____ on _____, 200 _____.
Pre switching meeting held by _____ on _____, 200 _____.
Actual switching date has been scheduled for _____ on _____, 200 _____.

☐ Switching list checked against mimic board for errors (labels/inverted numbers and etc.) This gives us a better understanding of system configuration before and after switching activities.

☐Power system configuration allows for switching schedule and clearance points.

☐ Additional copies of switching list will be generated from original list held by Dispatch office. This will be the one with names and truck numbers listed at time of switching meeting.

☐Clearance and Hold Tag(s) numbers will be confirmed with field supervisor.
☐Identified person(s) to hold specific clearance for individual job.
☐ Notification given to internal and external customers where system changes would impact daily operation such as scheduled interruptions or place limits on individual system operation.

Export Control Restrictions

Access to and use of EPRI Intellectual Property is granted with the specific understanding and requirement that responsibility for ensuring full compliance with all applicable U.S. and foreign export laws and regulations is being undertaken by you and your company. This includes an obligation to ensure that any individual receiving access hereunder who is not a U.S. citizen or permanent U.S. resident is permitted access under applicable U.S. and foreign export laws and regulations. In the event you are uncertain whether you or your company may lawfully obtain access to this EPRI Intellectual Property, you acknowledge that it is your obligation to consult with your company's legal counsel to determine whether this access is lawful. Although EPRI may make available on a case-by-case basis an informal assessment of the applicable U.S. export classification for specific EPRI Intellectual Property, you and your company acknowledge that this assessment is solely for informational purposes and not for reliance purposes. You and your company acknowledge that it is still the obligation of you and your company to make your own assessment of the applicable U.S. export classification and ensure compliance accordingly. You and your company understand and acknowledge your obligations to make a prompt report to EPRI and the appropriate authorities regarding any access to or use of EPRI Intellectual Property hereunder that may be in violation of applicable U.S. or foreign export laws or regulations.

Printed on recycled paper in the United States of America

The Electric Power Research Institute (EPRI)

The Electric Power Research Institute (EPRI), with major locations in Palo Alto, California, and Charlotte, North Carolina, was established in 1973 as an independent, nonprofit center for public interest energy and environmental research. EPRI brings together members, participants, the Institute's scientists and engineers, and other leading experts to work collaboratively on solutions to the challenges of electric power. These solutions span nearly every area of electricity generation, delivery, and use, including health, safety, and environment. EPRI's members represent over 90% of the electricity generated in the United States. International participation represents nearly 15% of EPRI's total research, development, and demonstration program.

Together...Shaping the Future of Electricity

Program:

Substations

1013109

ELECTRIC POWER RESEARCH INSTITUTE

3420 Hillview Avenue, Palo Alto, California 94304-1395 • PO Box 10412, Palo Alto, California 94303-0813 USA

800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com