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Development of Licensee Event Report Sequence Coding and Search Procedure

Prepared by R. B. Gallaher

Nuclear Safety Information Center
Oak Ridge National Laboratory

Prepared for
U.S. Nuclear Regulatory Commission

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FOREWORD

The Nuclear Regulatory Commission's (NRC's) Office for Analysis and Evaluation of Operational Data (AEOD) was established in October 1979. One of the responsibilities of this new office is to review Licensee Event Reports (LERs) to identify safety-significant events, trends or patterns. Manual searching of the previously submitted LERs (over 20,000) is a time-consuming process and does not ensure that some area not presently considered significant will not be of interest at a later time. Because none of the presently available storage and retrieval systems was capable of meeting all the search requirements of AEOD, a new system for processing and storing data contained in the LERs in a computer-readable and computer-searchable format was desirable. The Nuclear Safety Information Center (NSIC) at Oak Ridge National Laboratory (ORNL) was asked to develop the coding procedure and compatible software to determine if this approach is feasible and practical. A draft coding form and coding tables were provided by AEOD as a starting point, along with a preliminary search "Watch List."

Personnel involved in the development of the procedures and the processing of LERs were R. B. Gallaher, K. E. McCormack, J. P. Sanders, and W. E. Thomas of the Engineering Technology Division at ORNL and F. A. Heddleson of JBF Associates, Inc. The software development was handled by B. L. Alspaugh, P. S. Meredith, and D. S. Wichmann of the Computer Sciences Division of Union Carbide Corporation Nuclear Division. T. R. Wolf of AEOD provided systems engineering support and was the coordinator between NRC and NSIC. F. J. Hebdon of AEOD was NRC Program Manager.

DEVELOPMENT OF LICENSEE EVENT REPORT SEQUENCE CODING AND SEARCH PROCEDURE

R. B. Gallaher

ABSTRACT

At the request of the Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD), the Nuclear Safety Information Center (NSIC) has undertaken the development of a detailed computer-compatible coding system for events and sequences of occurrences described in Licensee Event Reports (LERs). This task was conceived by AEOD and is designated the "LER Sequence Coding and Search Procedure." The coding system is intended to describe in a computer-readable and computer-searchable format the sequence of events described in the LER. NSIC has developed coding tables, a coding form, and compatible computer software to permit storage and on-line computer search capability. The AEOD draft "Watch List" has been revised to categorize and retrieve all identified situations of interest. Phase I of this program, which involved the coding and computer storage of some 100 LERs as well as development of some Watch List search strategies, has been completed. Phase II, which was completed before January 5, 1981, included writing and testing additional search strategies, refining coding tables, and coding additional LERs.

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1. INTRODUCTION

Since late 1978, the use of operating experience as a tool for increasing the safety and reliability of nuclear power reactors has received growing emphasis. Much of this operating experience is contained in the Licensee Event Reports (LERs) that are submitted to the Nuclear Regulatory Commission (NRC) by the utilities. Reporting requirements for LERs are included in Title 10, *Code of Federal Regulations*, Parts 20, 40, 50, 70, and 73 and are described in detail in NRC Regulatory Guide 1.16 (Ref. 1) and NUREG-0161 (Ref. 2). Since 1967, LERs have been abstracted and stored in the computer file of the Nuclear Safety Information Center (NSIC), a part of Oak Ridge National Laboratory at Oak Ridge, Tennessee, with keywords used as the primary means of retrieval. Since 1973, LERs have also been stored in a computer by the NRC Office of Management and Program Analysis. Searching these data bases is done with keywords and coded fields plus the use of a search feature for words of interest in titles and abstracts. As the number of LERs increases (currently being generated at the rate of 300 per month), the need for improved use of LERs becomes evident. This was the principal conclusion of the 1979 Advisory Committee on Reactor Safeguards (ACRS) review of LERs.[3]

In May 1980, NRC's Office for Analysis and Evaluation of Operational Data (AEOD) approached the NSIC about the development of a new system for storing data contained in the LERs called "LER Sequence Coding and Search Procedure." A letter from C. Michelson (director of AEOD) to W. B. Cottrell (director of NSIC) dated May 30, 1980, outlined a proposed system that would codify the incidents described in each LER in a computer-readable format including cause(s), effect(s), and failure mode(s). Events would be assigned by the computer to subject areas termed "Watch List" items, each having a specific characteristic of the event for which a unique computerized search strategy could be established. A draft coding procedure, along with a preliminary coding form, tables of codes, and the Watch List, was included. These items were to be used as a starting point for the development of a computerized sequence coding and retrieval system.

If development and verification of the new system is successful and if the procedure proves to be cost effective, information contained in all current LERs, supplements, and some portion of the over 20,000 existing LERs would be coded and placed in the data base.

2. SCOPE AND SCHEDULE

For this program, NSIC is responsible for the development of the coding format, coding tables (except those for reactor systems and components, as discussed later), and computer software for the storage, processing, and retrieval of data. The project includes a pilot program that will (1) code and store the information contained in a number of selected LERs and therefore further refine and verify the procedure and (2) estimate the cost effectiveness of implementing the coding and search procedure on a continuing basis.

The pilot-program schedule is based on the desire for AEOD to reach a decision in early 1981 on the practicality of this program as a tool in evaluating operating data. This schedule consists of two phases.

Phase I, completed on October 1, 1980, included the following objectives:

1. Refine the coding procedure proposed by AEOD to capture the maximum amount of information about an event, using a reasonable commitment of resources, in a manner to be compatible with computer software described in objective (2).
2. Develop computer software to permit storage and on-line computer searching of the data base using Boolean logic applied to any combination of data elements. The software must be capable of performing routine searches required to identify specific characteristics of events defined by AEOD.
3. Provide remote access to the data base using a compatible computer terminal (provided by AEOD) at NRC Headquarters in Bethesda, Maryland.
4. Conduct a pilot program to code and store a selected number of LERs (selected and provided by AEOD) using interim procedures.
5. Use the results of the pilot program to further refine the coding and search procedures into a final form.

Phase II, which was completed before January 5, 1981, included the following objectives:

1. Present draft 1 on the procedure to AEOD personnel in Oak Ridge, Tennessee, on October 2, 1980.
2. Resolve comments on draft 1, and produce draft 2. Brief NRC personnel on draft 2 in Bethesda, Maryland, on October 16 and 17.
3. Resolve comments on draft 2, and produce draft 3.
4. Arrange a workshop with representatives from industry on November 24 at the American Museum of Science and Energy in Oak Ridge, Tennessee, for a review of draft 3.
5. Resolve industry comments on draft 3, and produce a final draft of the "LER Sequence Coding and Search Procedure" by January 5, 1981.
6. Code the information contained in about 200 LERs, and enter the coding in the data base by Janaury 5, 1981.
7. Complete and test search strategies for the presently defined Watch List categories.
8. Refine coding tables and Watch List.

3. CODING DEVELOPMENT

Implicit to any coding development* is an understanding of the information required for retrieval. A preliminary Watch List, included here as Appendix A, was assembled by AEOD before the project was turned over to NSIC. The Watch List indicates categories into which events may be sorted and serves as an example of the types of information that the search strategies must be able to identify. Discussions between AEOD and NSIC have resulted in changes in the Watch List as well as in the identification of the information that may be retrieved via computer searches of the data file. Additionally, a modified version of the highly developed Tennessee Valley Authority (TVA) UNID system,[4] which permits unique identification of systems and components, was incorporated into this LER coding system. The TVA UNID system is currently being developed into an industry standard by the Institute of Electrical and Electronic Engineers Working Group on Unique Identification. Desired information will be extracted from the LER (Fig. 1) and supplemental information and stored in the computer in a searchable form. This section describes both the development of a coding form and the search strategies employed in the retrieval of information from the computer file, as well as experience to date in coding LER information.

3.1 Definitions

For the purposes of this coding procedure, the following definitions are used:

- Event - a happening (consisting of one or more sequences) that the utility is required by NRC to report as an LER;
- Sequence - a connected or related series of steps that occurred, or that are described as having a potential to occur, as part of the reported event;
- Occurrence - one step in a sequence that describes the system, cause of occurrence, number of trains or channels involved, effect, and failure mode.

3.2 Information on Coding Form

A new coding form (Fig. 2) has been developed to provide an orderly presentation of the occurrences, causes, effects, and modes of failure of each sequence described in an LER. The order in which the LER analyst inserts information on each line of the form is based generally on the sequences of occurrences included in the event. Each required entry is described further on in this report.

Many LERs involve only one occurrence, however, other events involve multiple occurrences, related as well as unrelated (e.g., multiple independent failures or common-cause failures), that can be entered on the coding form.

*Coding development refers to the characteristics of information in the LERs, not to computer programming.

(7-77)

LICENSEE EVENT REPORT

CONTROL BLOCK: 1 ... 6 (1) (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

0 1 — 7 8 — 9 LICENSEE CODE 14 (2) 15 LICENSE NUMBER 25 (3) 26 LICENSE TYPE 30 (4) 57 CAT 58 (5)

CON'T

0 1 — 7 8 — REPORT SOURCE 60 (6) 61 DOCKET NUMBER 68 (7) 69 EVENT DATE 74 (8) 75 REPORT DATE 80 (9)

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

0 2

0 3

0 4

0 5

0 6

0 7

0 8 — 7 8 9 ... 80

0 9 — 7 8 — SYSTEM CODE 9 10 (11) — CAUSE CODE 11 (12) — CAUSE SUBCODE 12 (13) — COMPONENT CODE 13 18 (14) — COMP SUBCODE 19 (15) — VALVE SUBCODE 20 (16)

(17) LER/RO REPORT NUMBER — EVENT YEAR 21 22 — 23 — SEQUENTIAL REPORT NO. 24 26 — 27 — OCCURRENCE CODE 28 29 — REPORT TYPE 30 — 31 — REVISION NO. 32

ACTION TAKEN 33 (18) — FUTURE ACTION 34 (19) — EFFECT ON PLANT 35 (20) — SHUTDOWN METHOD 36 (21) — HOURS 37 40 (22) — ATTACHMENT SUBMITTED 41 (23) — NPRD-4 FORM SUB. 42 (24) — PRIME COMP. SUPPLIER 43 (25) — COMPONENT MANUFACTURER 44 47 (26)

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

1 0

1 1

1 2

1 3

1 4 — 7 8 9 ... 80

1 5 — 7 8 — FACILITY STATUS 9 (28) — % POWER 10 12 (29) — OTHER STATUS 13 44 (30) — METHOD OF DISCOVERY 45 (31) — DISCOVERY DESCRIPTION 46 80 (32)

1 6 — 7 8 — ACTIVITY RELEASED 9 (33) — CONTENT OF RELEASE 10 (34) — AMOUNT OF ACTIVITY 11 44 (35) — LOCATION OF RELEASE 45 80 (36)

PERSONNEL EXPOSURES

1 7 — 7 8 — NUMBER 9 11 (37) — TYPE 12 (38) — DESCRIPTION 13 80 (39)

PERSONNEL INJURIES

1 8 — 7 8 — NUMBER 9 11 (40) — DESCRIPTION 12 80 (41)

LOSS OF OR DAMAGE TO FACILITY (43)

1 9 — 7 8 — TYPE 9 (42) — DESCRIPTION 10 80

PUBLICITY

2 0 — 7 8 — ISSUED 9 (44) — DESCRIPTION 10 68 (45) — NRC USE ONLY 69 80

NAME OF PREPARER ______________________ PHONE: ______________________

GPO 917-924

Fig. 1

LER SEQUENCE CODING FORM

DOCKET | YEAR | LER | REV. | EVENT DATE | DCS NO. | NSIC NO.

STEP	LINK	SUBLNK	CAUSE	SYSTEM	COMPONENT	QUAN	TRAIN	DIFFER	EFFECT			FAILURE

WATCH LIST ________ ________ ________ ________ ________ ________ ________

Fig. 2

3.2.1 LER unique identification

Each coding form includes the LER unique identification number, which is a combination of the docket number (not including the "50" prefix), the year of the report, the sequential LER number assigned by the licensee, the revision number, and the date of the event (furnished by the utility on the LER form). The NRC Document Control System (DCS or TERA) and NSIC accession numbers are also included as reference to a word description of the event.

3.2.2 LER coded description

A description of the function of each column in the LER sequence coding form follows

- STEP* – Each step (or occurrence) in each event is numbered starting with 1. Steps are normally arranged according to the approximate time frame in which they occurred, beginning with the earliest occurrence.

- LINK – The link identifier relates its step to the prior step to which this step is directly related. The identifier may be either a number or a letter. Use of the letter identifier is discussed in "SUBLNK" (next paragraph). If a step does not tie to any previous step, the link number is "0." Step 1 always has a "0" in the link column. Step 2 will usually be linked to step 1. Step 3 may be linked to steps 1, 2, or 0 depending on the sequence. One or more steps may refer to the same step (i.e., a single occurrence may cause one or more additional occurrences).

- SUBLNK (Sublink) – The sublink column is used when two or more occurrences combine to cause another occurrence. In this case, a letter is entered into the sublink column of each step that results in the future step. The same letter is then entered in the link column of the resulting future step. For example, if steps 1 and 4 cause step 5, an "A" would appear in the sublink column in steps 1 and 4 and in the link column in step 5. Subsequent steps that are linked would use other letters. If a given step has two sublinks, a new step is added, putting the prior step number in the link column and a new letter in the sublink column. That is, if an occurrence (step 9) is a result of the above step 4 and also of step 7, a "B" will appear in the sublink column of step 7, and step 8 will have a 4 in the link column and a "B" in the sublink column. The rest of step 8 will be blank. Then step 9 will have "B" in the link column.

- CAUSE – The cause column provides the cause for a particular step. A specific cause appears in each step where an actual (e.g., mechanical) failure occurs. Cause codes are presented in Appendix B. When a component fails to perform its intended function because of a preceding step but does not sustain an actual mechanical failure, an "R" is used to indicate that the step is a result of a previous step.

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*Computer input/output title

• SYSTEM — The system column identifies which plant system is involved in the indicated step. Codes used here are a modified version of those developed by TVA for their UNID system.[4] If the system is not clearly identified in the LER, a "ZZ" is entered as the system code (e.g., snubber failures in several systems when reported as a single occurrence.)

The entire plant, instead of individual systems, can be identified in the system column with the code "XX"; this code will be used to indicate the initial plant status and also the effect of the event on the plant. System code "YY" is used to identify releases to the environment and personnel exposures. Coding for these effects is discussed later under "EFFECT."

• COMPONENT — The component column identifies the component(s) involved in the indicated step. Coding for this column is also a modified version of UNID. Entire code tables for systems and components are not included in this report because of their length. A sample of these tables, however, is included as Appendix F.

The component column also is used to designate major portions of a system or the entire system instead of individual components in the system. The following designations, where "A" and "B" are numbers, are used in this case:

Component code	
XXX	Entire system is involved
AXB	"A" trains out of a total of "B" trains in the systems
AXZ	"A" trains out of an unknown total number of trains in the system

• QUAN (Quantity) — The quantity column indicates the number of components identified in the component column that were involved during the indicated step. Usually, the quantity in each step is the number of components involved in a single train or channel of the system identified in the step. If the number is not specified in the LER but is clearly more than one, "M" (for multiple) is used. The total number of components in the train or channel is also included, if known (e.g., 1X4 means one out of four components). If the total number of components is unknown, "Z" is used.

• TRAIN - If more than one functional train or channel of the same tem is involved in an event, this column identifies the functional train or channel. This is not the actual train or channel designation used in the plant but is simply an identifier to indicate that different trains or channels were involved. Two or more separate trains or channels may be so indicated. Numerals are used for trains, and letters are used for channels. If more than one component failure occurs in a given step (i.e., QUAN > 1), the 'n column is used to indicate that the components are in the same functional train or channel ("S") or in multiple trains or channels ("M").

• DIFFER (Differentiator) — If the same system/component code pair (e.g., ND→MPMU) is used more than once on a coding form, the differentiator column is used to identify whether the same component or a different component with the same system/component code pair is involved. If a different component is involved, a "2" is used in the differentiator column the second time the code pair is used. If a third different component with the same code pair is involved, a "3" is used. If the column is blank, a "1" is assumed.

• EFFECT — The effect column codes the functional effect caused by the component failure identified in the given step in the sequence of occurrences. The effect code (Appendix C) consists of one letter from each of three categories. The categories identify actual or potential effect, the type of effect, and the method of detection. For each occurrence, the effect is specified.

If the letters "XX" are entered in the system column, the effect column identifies the effect on the plant and the initial plant condition. More than one plant effect may be listed by including more than one step with system code "XX." When "XX" is used to indicate the entire plant, the first two columns contain the plant effect codes from Appendix D (Table D.1). The third column identifies the initial plant condition code from Table D.2. Also, the effect on the environment and personnel, if any, is specified by (1) entering "YY" in the system column, (2) an environment code from Table D.3 in the first column, and (3) personnel exposure codes from Tables D.4 and D.5 in the second and third effect columns.

• FAILURE — The failure column identifies the mode of failure of the component identified in that step. Failure-mode coding is provided in Appendix E. If the component failed but the mode of failure is not explicitly stated, "AY" is used. When the step refers to a train or to an entire system, the column may be blank.

3.2.3 Watch List assignment

One or more Watch List numbers requiring technical judgment beyond the capabilities of the computer may be assigned to each event by the analyst. The current Watch List is included as Appendix A.

3.2.4 Coding process

When occurrences are considered, a failure is broadly defined as a failure of a component or system to perform as intended by the designer and/or as assumed in the safety analysis and/or as expected by the operator. A failure may be an actual mechanical failure (e.g., a pump shaft breaks) or a performance failure, which occurred when an initiating signal was not provided because of a previous failure (e.g., a relay fails and, as a result, a pump fails to start when it should). A failure also may be an unexpected effect or the functioning of a component or system when it should not have operated [e.g., a relay fails and causes the emergency core cooling system (ECCS) to actuate when it should not have; the ECCS actuation is a failure].

All failures described in the LER are included in the listed steps. Assumptions are not made unless they can be obviously inferred from the information contained in the LER. The purpose of this procedure is to encode the information in the LER, not the analyst's opinions (unless clearly identified by the coding).

If a sequence is quite complex (e.g., the Crystal River event of February 26, 1980) and the reviewer is not confident that the coding accurately reflects the event, the event is coded as completely as possible and then manually assigned to Watch List 990 (in addition to any other Watch List items assigned by the computer). Watch List 990 will be maintained by the AEOD program management lead engineer and will be periodically reviewed by all AEOD lead engineers.

3.2.5 Development of coding tables

Tables formulated by AEOD were used as the starting point in the development of descriptive coding tables. Many LERs were reviewed to determine what additional entries were needed to describe the occurrences. Watch List items were reviewed to see how retrieval might be achieved using the enlarged table. The tables used in coding the Nuclear Plant Reliability Data System (NPRDS)[5] Form 4, Report of Failure, were reviewed to compare entries. Some entries were used from this source as they were obtained, and some were modified for this new usage. The "Method of Detection" is very similar to NPRDS. "Initial Plant Condition" coding followed NPRDS closely, with enlargement to more accurately describe the reactor mode. Component identifiers from NPRDS have been incorporated into the appropriate table by modifying several UNID codes.

3.3 Retrieval of LERs

The LER sequences may be retrieved through two major types of search techniques. One type is use of the Watch List items. The Watch List contains over a hundred specified areas of interest. Each event, assigned by computer, should be included in one or more items on this list. A second retrieval technique will be developed as one-time requests for searches are received from individuals.

A few additions have been made to the initial Watch List items with their assigned numbers provided by AEOD to NSIC. This amended list, which is still under development, is included as Appendix A. An individual search strategy is needed for each Watch List item. Some items are primarily "counters" to determine the number of entries for each available code (e.g., plant, system). Development of the search strategy is still in progress and will remain an active project; modifications will be made as new Watch List items are assigned or current items are redefined. Several search strategies have been developed to search for multiple failures, both common-cause and random failures. Several more specific searches have also been completed.

The search capability allows for searching by each individual code entered and by combinations of entries and for one step or a combination of steps. The step, link, and sublink columns can be included as part of the search parameters.

Because the component codes in UNID are very specific, a subroutine has been developed for the computer to assign a number to related components so general component types can be retrieved without inputting each type. For example, all instrument valves are assigned the number 3240, and mechanical valves are assigned 4240. To structure a search that would include all valves, the four-character component code would be "space 240." If only mechanical isolation valves are wanted, the component code "MISV" from UNID would be used.

3.4 Coding Experience

The experience of translating information from LERs to a coding form has been limited to the approximately 200 LERs analyzed to date. However, this experience has been extremely valuable not only in highlighting problems, which have been resolved as they were identified, but also in training analysts and in developing data on training and production times. Appendix G contains a listing of five completed code forms.

3.4.1 Problems

The LERs coded to date have ranged from simple three-step events to more complex ones requiring up to 30 steps to describe all occurrences. Five reviewers, having diverse backgrounds, coded these initial LERs. All completed forms were reviewed by one individual who made changes and corrections as required. Many of these changes were discussed with the initial reviewer to resolve any differences of opinion. This procedure was used to reveal problems with the system and with training procedures.

One major difficulty is understanding the event in detail from the LER form and the supplemental information. The nuclear steam supply system vendors do not use standard names for similar systems (e.g., auxiliary feedwater vs emergency feedwater). Also, the interrelationship of systems differs from plant to plant (e.g., the high-pressure injection pump may also be called the charging pump). Therefore, system identification is difficult. A written description of each system which includes the interfacing systems [such as those TVA, NPRDS, and the Institute of Electrical and Electronics Engineers (IEEE) Working Group on Unique Identification are preparing] would be of great benefit.

Many components are called by general terms such as "relay." Additional information is often insufficient to determine the type of relay. If a system such as UNID is adopted as an IEEE standard or if it becomes part of the LER description, both of these problems will be greatly reduced.

Finally, LER event descriptions are sketchy at times with insufficient detail to code the complete event. In a few cases, a component is reported only by its plant identification number without specifying whether it is a pump, valve, or instrument. A utility contact person who could identify these numbers and provide additional clarifying details would be useful.

3.4.2 Training

All personnel involved in reviewing LERs had prior nuclear experience, but none had been reactor operators. Therefore, pressurized-water reactor (PWR) and boiling-water reactor (BWR) training manuals developed by NRC and a TVA draft of PWR system descriptions were made available. Several work sessions were held in which a few LERs were reviewed step by step to explain the desired sequence order and the information needed. During routine processing, when differences of opinion occurred, discussions were held with various individuals to reach agreement. Average processing times for various types of LERs ranged from 30 min to 2 h. Remember, however, that the sample of LERs was selected to include a disproportionately large number of complex events. Also, processing time includes manual assignment of all relevant Watch List numbers, which will be done only during the program development period as a check against the computer-assigned Watch List codes.

Review of all sequence codings is desirable to ensure maximum capture of information and to add more consistency and accuracy to the input, which in turn improves retrieval.

3.4.3 Production

Fifteen LERs per work day are being generated. As new plants are licensed, the rate will increase, especially during the start-up period. (Sequoyah 1 issued over 125 LERs in the first 6 months after receiving its operating license.) Coding incoming LERs would require about 2 1/2 man-years of effort. Ideally this effort would be drawn from a pool of reactor system engineers who would work part-time coding LER information. Computer input would require an additional person.

4. COMPUTER SOFTWARE DEVELOPMENT

The study of LER sequences, including examination and classification of past events and ongoing analysis of current events, makes computer processing of LERs a necessity. Using the computer to store LER information, search for various items coded from an LER, and print out desired codings relieves the user of manual data management and facilitates LER analysis. To accomplish this end, the Digital Equipment Corporation (DEC) PDP-10 was chosen as the host computer. Software consists primarily of DEC10 COBOL programming language[6] and System 1022 Data Base Management System.[7] A text editor, TECO,[8] and PDP-10 monitor commands[9] were also necessary tools for development. After "LOGIN" to the PDP-10 System,[9] LER processing can be broken down into three steps: input, processing, and output.

4.1 Input

Input of LER sequence coding to the PDP-10 may be achieved by at least four methods, two of which allow on-line data entry and code verifications. The remaining two methods use batch input, and one of those also does code verifications. The choice of method depends on factors such as (1) the volume of coded information to be input, (2) manpower available to do inputting, (3) familiarity of the person doing the inputting with the data, and (4) degree of timeliness desired. One of the on-line forms of input has detailed prompting for data and instant verification of codes. Generally, if the volume of information is not too great, on-line inputting is probably preferred over batch.

Code verifications are made possible by use of an authority file containing all currently defined codes for CAUSE, EFFECT, FAILURE, and SYSTEM and COMPONENT codes. As data from a step of the sequence coding form is being input, the codes are checked against the authority file. For a file of great size or many LER steps, sequential searching for these codes could become a bottleneck to the entire system, which is why the authority file has been created as an indexed sequential access method (ISAM)[10] file. The ISAM permits essentially direct lookup of a code, thereby avoiding a possibly lengthy search for verification. If a code is in error, an error message is generated; if inputting is on-line, the person doing the inputting is asked to supply a replacement code or indicate retention of the original code. After one or more coding forms have been entered into the PDP-10 system, the steps must then be added to the existing System 1022 LER master file; the event date, DCS and NSIC accession numbers, and any Watch List codes that were assigned by the coder must be added to the LER supplemental file (LERSUP). The LERs are added via the execution of a PDP-10 command file, "APPEND.MIC," containing the appropriate System 1022 commands. Generally, once this has been done, one is ready to proceed to the second stage—actual processing of the data.

4.2 Processing

Several processing options are currently available, and still others are planned. One available option is the Watch List code assignment program (see Appendix A). When this program is executed, each LER is examined step by step and, based on a predetermined combination of data fields, the program assigns Watch List codes and adds them to the LERSUP. (Also contained within the LERSUP file are such fields as DCS and NSIC accession numbers and the LER event date.) If no Watch List code is assigned, the program will assign Watch List Code 980 to that LER. Therefore, every LER is in at least one Watch List code; this ensures that every LER will be reviewed by one member of the AEOD technical staff. At present, the Watch List code definitions are constantly changing, and the program that assigns these codes is also in a state of flux. This program will be capable of (1) assigning codes for all events or subsets thereof and (2) retroactively assigning newly developed Watch List codes without any recording or rereading of old LERs.

Another available option is to update the LER master and/or make corrections to existing information under the System 1022 monitor. Updating the LER master file with new events by means of the 1022 "APPEND" command was mentioned previously. Corrections or changes to existing events in the master file are accomplished via System 1022 "CHANGE" commands. Changes may also be made to the DCS and NSIC accession numbers, date of event, and the assigned Watch List codes stored in the LERSUP. Each step has associated with it a change date reflecting the last time that step was altered. This change date is particularly useful when one wants to run the Watch List code assignment program but does not want to run it against the entire LER master. Instead, one might only wish to run it against all events that have been changed, because a change in a step could affect Watch List codes already assigned.

A third and powerful processing option is searching both the LER master and supplemental files. Another file, DOCINF, may also be searched. Organized by docket number, DOCINF contains the plant name, unit number, reactor type, utility name, manufacturer, architect/engineer, and NRC region number. Searching may be performed on any coded field (see Appendixes B through F) or on a combination of fiel Full Boolean logic (AND, OR, NOT) may be employed; this is similar to logic used in searching the RECON system.[11] Additionally, much more complex searching is possible by means of Watch List codes assigned to the events.

4.3 Output

The last step of computerized handling of coded information is output, without which none of the foregoing is very useful. Several System 1022 command files have been developed; some will print the entire LER master file or a subset thereof, while others prompt for a desired Watch List code or LER identification (DOCKET, YEAR, LER, REVision, EVENT DATE) and then print the appropriate information. When printing the LER master or subset, the format varies from primitive working printouts (no special handling) to formatted printouts with titling and page breaks. Two forms of printout are available with Watch List codes. The first command file (1) prompts for the desired Watch List code, (2) searches for all events containing that code, and (3) then prints DOCKET number, YEAR, LER number, REVision number, EVENT DATE, and all Watch List codes for each event identified. The second command file goes further by printing all the coded steps associated with each event identified.

5. PLANNED FUTURE WORK

5.1 Work Through March 31, 1981

5.1.1 LER processing

Starting January 1, 1981, and continuing through March 31, 1981, all LERs received at NSIC will be coded and entered into the computer file using the present coding form. This will require four part-time professional coding engineers, one full-time supervisor-reviewer, and the necessary computer and computer support personnel. During this time, only minor changes will be allowed in the sequence coding tables.

1. Time records will be kept in order to obtain a reasonable estimate of average processing times and costs per LER.
2. The PDP-10 computer with the System 1022 software will be used for this trial program.
3. A preliminary cost estimate for the continuation of the program beyond April 1, 1981, will be made by February 15, 1981.
4. A QA program for the coding process is very important and will be instituted concurrently with the coding activities. This cost will be included as an overhead item.
5. Update LER reports will replace the initial report in all cases where updates are issued by the utility.

5.1.2 Sequence coding development

Concurrent with the trial LER processing described in Sect. 5.1.1, further development of the sequence coding will be evaluated, although anticipations are that no further changes will be implemented until after the January–March trial period. Although additional modifications will be considered as appropriate, these modifications are currently being considered:

1. A coding system will be developed to identify data sources other than LERs from which to obtain additional information for coding an event.
2. A method for coding "personnel" as a component will be studied. This would permit identification of different types of human error under the "Cause" and "Failure" codes.
3. The coding of the time between steps in the sequences is being considered as a possible later option.
4. Considerations will be given to adding the NPRDS component identifier number.
5. Consideration will be given to adding to the SCSP textual abstract of the LER, which would be available upon request.
6. Consideration will be given to the incorporation of some measure of licensee performance evaluation into the coded fields.

5.1.3 Watch List development

The Watch List is being revised by AEOD. Programming and testing o' the revisions will continue throughout this time period.

5.1.4 Computer programming development

Concurrent with the trial LER processing described in Sect. 5.1.1, further development of computer programming will be undertaken, although these changes will not be incorporated into the operating LER-SCSP computer program until after March. Although other areas will be added as appropriate, currently identified areas of development are listed:

1. Modification of computer programming to accommodate those coding changes contemplated in Sects. 5.1.1 and 5.1.2 will be evaluated.
2. The computer pr gram will be revised to provide a definition of all codes on reques but not as routine output.
3. The addition of word descriptions of LERs will be evaluated. While the space requirements and retrieval mechanism will be determined, anticipations are that this data will be in a separate file.
4. The computer coding will be capable of identifying data sources other than the LER from which additional information is obtained for coding an event.
5. Programming will be developed to prompt the personnel in the use of SCSP programs.
6. The requirements for processing and storing the NPRDS data file. PNs, and IE Inspection reports in a computer system that can communicate with the SCSP data file will be determined.

5.1.5 Other tasks

In addition to the activities described under the preceding headings, other work of a more general nature is noted:

1. A preliminary reviewer's manual (for internal use only) will be ready by January 15, 1981. A more formal version will be completed during March 1981.
2. A draft of a software manual for computer personnel working with the SCSP Program will be completed by January 15, 1981, with a more formal report completed during March 1981.
3. As a result of comments from all sources, possible changes and additions to SCSP will be considered and evaluated.

5.2 Remainder of FY-1981

While :tivities in the remainder of FY-1981 are expected, many details are dependent on the experience of the January-March trial LER processing and AEOD decisions based upon the experience and/or concurrent program evaluations. However, some possible activities are listed:

1. LERs will continue to be processed as they are received.
2. LERS prior to 1981 may be coded and incorporated in the file if or when AEOD decides that it is cost effective to do so.
3. After April 1, 1981, a user's manual will be prepared that will include a short (3 or 4 words) definition of the codes or a more complete definition where necessary.
4. Modifications to sequence coding discussed in Sect. 5.1.2 will be evaluated by AEOD: cost-effective changes will be incorporated.
5. Computer programmi g development implicit to (4) will be implemented.
6. Search strategies will be developed for the revised Watch List (Sect. 5.1.3).
7. Additional modifications to the computer programming discussed in Sect. 5.1.4 will be evaluated by AEOD: cost-effective changes will be implemented.
8. A permanent location for the SCSP program will be selected by AEOD before April 1981. If the program remains at NSIC, coding work will continue (as described in Sect. 5.1.1) with any needed changes incorporated in the program. If another location is chosen, work at NSIC will be phased out by the end of FY-1981. During the phase-out period, the new contractor personnel will be trained at ORNL.
9. A final report by R. B. Gallaher entitled *Trial Use and Refinement of Licensee Event Report Sequence Coding and Search Procedure* (NUREG-0771) will be issued in May 1981.

REFERENCES

1. Nuclear Regulatory Commission, *Reporting of Operating Information — Appendix A: Technical Specifications*, Regulatory Guide No. 1.16, Rev. 4 (August 1975).
2. Nuclear Regulatory Commission, *Instructions for Preparation of Data Entry Sheets for Licensee Event Report (LER) File*, NUREG-0161 (July 1977).*
3. Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, *Review of Licensee Event Reports (1976–1978)*, NUREG-0572 (September 1979).**
4. Tennessee Valley Authority, *Unique Identification (UNID) of Structures, Systems and Components*, EN DES-EP 8.01 (Bellefonte and Later Plants) (Feb. 27, 1974).
5. Southwest Research Institute, *Reporting Procedures Manual for the Nuclear Plant Reliability Data System (NPRDS)*, San Antonio, Texas (December 1979).
6. Digital Equipment Corporation, *DECSYSTEM 10, COBOL Programmer's Reference Manual*, DEC-10-LCPRA-B-D (January 1976).
7. *System 1022 — Data Base Management System*, Software House, Cambridge, Mass. (January 1978).
8. Digital Equipment Corporation, *TECO: Text Editor and Corrector Program*, DEC-10-UTTRA-A-D (April 1975).
9. Oak Ridge National Laboratory, *How to Use the PDP-10 System*, Computer Sciences Division Manual (September 1980).
10. Digital Equipment Corporation, *DECSYSTEM 10, COBOL Utilities Manual*, DEC-10-LCUTA-A-D (January 1976).
11. U.S. Department of Energy, Technical Information Center, *DOE/RECON User's Manual*, TID-4586/UPD6 (Mar. 12, 1979).

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*Available for purchase from the National Technical Information Service, Springfield, VA 22161.

**Available for purchase from the NRC/GPO Sales Program, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and the National Technical Information Service.

Appendix A

OPERATIONAL DATA AND INFORMATION WATCH LIST

A.1 General Overviews (100-199)

100. Plants

110. Systems

120. Structural Components

130. Electrical Components

140. Instrumentation and Control Components

150. Mechanical Components

160. Causes

170. Functional Effects

180. Failure Modes

190. Plant Effects

A.2 General Concerns (200-349)

200. Multiple Failures Without Common Cause

    201. Three or more actual component failures in the same train of the same system
    202. Three or more actual component failures with different causes
    203. One or more actual component failure(s) in multiple trains of the same system
    204. Actual component failures in three or more systems

210. Total System Failure Without Common Cause

    211. Total actual failure of one or more systems
    212. Total failure of one or more systems if potential system failures are included

220. Common-Cause Failures

    221. Common-cause actual failure of multiple components
    222. Common-cause actual failure of one or more systems
    223. Common-cause failure of one or more systems if potential system failures are included

230. Unexpected Responses

    231. Unexpected system action or response
    232. Unexpected component action or response
    233. Transient proceeds in a way significantly different from what would be expected

240. Undetectable Failures

241. Component failures that could easily escape detection by normal testing or examination until needed

250. Reactor Trips

251. Consequential reactor trips
252. Inadvertent reactor trips

260. Engineered Safety Features (ESF) Actuations

261. Required ESF actuations
262. Inadvertent ESF actuations

270. Departures from Specifications

271. Setpoint drift
272. Out of tolerance
273. Minor performance degradation

280. Operation Outside Design Bases

281. Operating conditions or transients not enveloped by the plant design bases
282. System operation outside design bases
283. Component operation outside design bases

290. Major Damage or Outage

291. Event results in a long outage or major equipment damage

A.3 System Performance Concerns (350-499)

350. Unusual System Transients

351. BWR reactor vessel overfill
352. Steam generator overfill
353. Pressurizer overfill
354. Excessive RCS temperature/pressure changes
355. RCS natural circulation performance

360. Degradation of Essential Services

361. Loss of offsite power
362. ac electric power degradation (frequency/voltage changes)
363. dc electric power degradation (voltage changes)
364. Control air degradation (pressure/contamination)
365. Cooling water degradation (pressure/contamination/debris)
366. Environmental degradation (temperature/humidity)
367. Diesel generator problems

370. Operating Environment Influences

371. Temperature/pressure/humidity
372. Flooding considerations
373. Water cascades or sprays
374. Steaming considerations

375. Smoke or dust deposits
376. Electromagnetic interference

380. <u>Primary Containment Considerations</u>

381. Purging problems
382. Blowdown isolation capability
383. Hydrogen recombination
384. Use of fibrous insulation
385. Paint stripping

390. <u>Unusual System Interactions</u>

391. System pressure interfaces
392. Isolation of nonsafety fluid system loads
393. Isolation of nonsafety electrical loads
394. Internal loose parts
395. Environmental interactions
396. Fire protection influences

400. <u>Unusual External Challenges</u>

401. Vulnerability of buried components
402. Railroads and heavy transport influences
403. Heavy equipment handling (including above exposed fuel)
404. Construction interactions
405. Hazardous fluids and gases

A.4 Component Performance Concerns (500-649)

500. <u>Pressure Boundary Integrity</u>

501. RCS pressure boundary defects or leakage
502. ESF pressure boundary defects or leakage
503. Essential service systems pressure boundary defects or leakage
504. Balance of plant pressure boundary defects or leakage
505. Primary containment pressure boundary defects or leakage
506. Steam generator tube defects or leakage
507. ESF heat exchanger tube defects or leakage

510. <u>Pump Considerations</u>

511. RCP seals and seal cooling
512. ECCS pump seals and seal cooling
513. Degradation of pump NPSH
514. Pump priming and venting problems
515. Minimum flow considerations
516. Bearing lubrication and cooling problems
517. Mechanical components (shaft, speed control)

520. <u>Valve Considerations</u>

521. Check valve closure
522. Throttling effects
523. Motor operator problems
524. Air operator problems

525. Mechanical binding
526. Mechanical component problems (stem, disc)

530. Auxiliary Turbine Considerations

531. Bearing and speed-reducer lubrication and cooling problems

540. Unusual Electrical Situations

541. Liquid-cooled transformer problems

550. Unusual Instrumentation and Control Situations

551. Failure modes and effects of solid-state electronic components
552. Adverse effects of instrument snubbing

560. Unusual Mechanical Situations

561. Pipe support and snubber failures
562. Heat exchange problems

570. Unusual Structural Situations

580. Reactor Fuel Performance

590. Piping Problems

A.5 Natural and Process Fluid Phenomena Concerns (650–749)

650. Fluid-Hydraulic Effects

651. Water hammer/water slugging
652. Steam condensation knocking
653. Cavitation
654. Fluid-induced vibration
655. Siphon effects
656. Vortex formation
657. Air or steam binding

660. Natural Circulation

670. Corrosion

671. BWR stress-corrosion cracking
672. PWR stress-corrosion cracking
673. Corrosion of bolting

680. Fluid Instability

681. Boron precipitation

690. Natural Phenomena Vulnerability

691. Floods
692. Wind/tornado
693. Rain
694. Ice/severe cold
695. Waves
696. Seismic

A.6 Deficiencies and Human Performance Concerns (750–849)

750. Design or Analysis Deficiency or Error

760. Fabrication Deficiency or Error

770. Procedural Deficiency or Error

780. Plant Personnel Deficiency or Error

- 781. Operating error
- 782. Testing or calibrating error
- 783. Maintenance or repair error
- 784. Maladjustment
- 785. Installation error

790. Fundamental Misunderstandings

- 791. Administrative, procedural, or operating errors resulting from a fundamental misundertstanding of plant performance or safety requirements

800. Administrative Deficiency or Error

810. Security Considerations

A.7 Radiological and Environmental Concerns (850–899)

850. Radiological Events

- 851. Liquid or gaseous offsite radiological release
- 852. Onsite radiological release
- 853. Personnel exposure

860. Nonradiological Environmental Occurrences

A.8 General Administrative Concerns (900–999)

900. Postevent Data Availability

910. LER Reporting Deficiencies

- 911. Misfiled information
- 912. Unkept promises to follow up
- 913. Update needed
- 914. Inadequacies

970. Possible Watch List Items

980. Items Not Included Elsewhere in Watch List

990. Complex Events

Appendix B

CAUSE OF AN OCCURRENCE

B.1 Personnel Error

OA — Maintenence
OB — Installation
OC — Surveillance/testing
OD — Licensed operator
OE — Nonlicensed operator
OF — Radiation protection
OG — Fabrication
OH — Administration
OI — Calibration
OX — Other
OZ — Unknown

B.2 Procedural Error

PA — Maintenance
PB — Installation
PC — Surveillance/testing
PD — Operation
PE — Calibration
PX — Other
PZ — Unknown

B.3 Design Error

DA — Input data
DB — Calculational techniques
DC — Nonconservative assumptions
DD — Unanticipated modes of operation
DE — Change in criteria
DF — Failure to meet criteria
DX — Other
DZ — Unknown

B.4 Mechanistic Failure

B.4.1 Mechanical

AA — Normal wear
AB — Insufficient lubrication
AC — Incorrect lubrication
AD — Corrosion
AE — Excessive internal pressure
AF — Excessive external pressure
AG — Mechanical vibration
AH — Crud buildup
AI — Overspeed
AJ — Mechanical fatigue or failure
AK — Excessive mechanical loads
AL — Foreign/wrong part
AM — Foreign/wrong material
AN — Weld-related failure
AP — Drift
AQ — Improper previous repair
AR — Required maintenance/modification
AS — Prior removal from service
AT — End of life/aging
AU — Spurious event
AV — Loose nut/fastener/component
AW — Failure to seal/seat
AY — Fell/dropped
BA — Insufficient clearance
BB — Response time

B.4.2 Electrical/Instrument

CA — Overcurrent
CB — Overvoltage
CC — Excessive electrical loads
CD — Undervoltage
CE — Undercurrent
CF — Drift
CG — Instrument/component/card failure
CH — Failure of contacts to function
CI — Broken cable/connector
CJ — Coil failure
CK — Instrument snubbing
CL — Electromagnetic interference

B.4.3 Environmental

EA — Low ambient temperature
EB — High ambient temperature
EC — Moisture/water damage
ED — Aquatic growth
EE — High radiation
EF — Wind/tornado
EG — Lightning
EH — Flood
EI — Ice
EJ — Waves
EK — Rain
EL — Steam leak
EM — Humidity
EN — Smoke

B.4.4 Hydraulic

FA — Cavitation
FB — Erosion
FC — Water hammer
FD — Loss of pump suction
FE — Abnormal flow
FF — Pressure pulse/surge
FG — Low flow
FI — Steam condensation, knocking
FJ — Flow-induced vibration
FK — Vortex formation
FL — Air/steam binding
FM — Boron precipitation

B.5 Other

UU — Normal testing result
WW — Condition for event
XX — Other
YY — Normal system transient result
ZZ — Totally unknown

Appendix C

EFFECT CODES

Select one entry from each section to provide a three-letter code.

C.1 Timing

A — Actual (occurred when the component was called on to function)
B — Actual (cause of occurrence is reviewer's opinion)
C — Actual (failure mode is reviewer's opinion)
D — Actual (cause of occurrence and failure mode are reviewer's opinion)
P — Potential (could have occurred if the component had been called on to function)
R — Potential (cause of occurrence is reviewer's opinion)
S — Potential (failure mode is reviewer's opinion)
T — Potential (cause of occurrence and failure mode are reviewer's opinions)
E — Actual, preexisting (existed for some time prior to the occurrence and had been identified but not corrected)
U — Actual, preexisting, undetected (existed for some time prior to the occurrence and had not been detected)

C.2 Type of Performance

A — Performed a desired or expected function
B — Operated outside design bases
C — Failed completely to perform a desired function
P — Partially performed a desired function
D — Performed an expected function but at an undesired time
E — Performed an unexpected and undesired function
F — Developed an expected out-of-specification reading
G — Improper configuration
X — Other
Z — Unknown

C.3 Method of Detection

A — Operational abnormality
B — A-E notification
C — Testing/inspection/observation
D — Maintenance
E — Special inspection
F — Audio/visual alarm
R — Review of procedures
X — Other
Z — Unknown

Appendix D

EFFECTS ON THE PLANT, ENVIRONMENT, AND PERSONNEL AND INITIAL PLANT CONDITION

When using system code "XX," at least one entry from Table D.1 shall be included in the first and second Effect columns. Select one entry from Table D.2 and enter in the third column for the first plant effect using "XX" as the system code. When using system code "YY," at least one entry from Table D.3 shall be included in the first Effect column and one entry from Tables D.4 and D.5 in the second and third columns.

Table D.1. Effect on the plant

Code	Description	LER form	
		Field 20	Field 21
--	Plant outage	A	A
AA	Manual shutdown	A	B
AB	Manual scram	A	[illegible]
AD	Inadvertent manual scram	A	B
AC	Automatic scram	A	C[a]
AE	Inadvertent automatic scram	A	C
BZ	Forced power reduction	B	Z
CZ	Extension of pre-existing outage	C	Z
DZ	Delay in construction	D	Z
EA	Required ESF actuation		
EB	Inadvertent ESF actuation		
FA	Forced long outage or major equipment damage		
GZ	Natural circulation		
[illegible]	Affected other unit(s)		
LZ	Plant in LCO condition	None	None
TR	Transient		
XX	No significant effect	Z	Z
ZZ	Unknown	X	X

[a]Sometimes incorrectly "A."

Table D.2. Initial plant condition

Code	Description	LER form, Field 28
A	Under construction	A
B	Preoperational, start-up or power ascension tests (prior to commercial operation)	B
C	Routine start-up operation	C
D	Routine shutdown operation	D
E	Steady-state operation (mode or condition 1)	E
F	Load changes during routine power operation	F
G	Hot shutdown (PWR — mode 4, BWR — condition 3)	G
H	Refueling (PWR — mode 6, BWR — condition 5)	H
I	Cold shutdown (PWR — mode 5, BWR — condition 4)	G
J	Hot standby (PWR — mode 3)	G
X	Other (includes special tests, emergency shutdown operation)	X
Z	Item not applicable	Z

Table D.3. Effect on the environment

Code	Description
C	Radiological release to containment only
L	Radiological release to environment less than 10 CFR Part 20
G	Radiological release to environment greater than 10 CFR Part 20
A	Radiological release to environment less than 10 CFR Part 50 Appendix I
Z	Radiological release to environment, quantity unknown
B	Nonradiological release to environment
D	Thermal release in excess of technical specifications limits
N	No release

Table D.4. Personnel exposure

Code	Description	LER form, Field 38
I	Internal exposure	I
E	External exposure	E
B	Both	B
A	Extremities	
N	No exposure	Z
W	Whole body	

Table D.5. Maximum dose

Code	Rem	Code	Rem
A	<0.10	L	7–8
B	0.10–0.25	M	8–9
C	0.25–0.50	N	9–10
D	0.50–0.75	O	10–11
E	0.75–1.00	P	11–12
F	1–2	Q	12–25
G	2–3	R	25–50
H	3–4	S	50–100
I	4–5	T	100–1000
J	5–6	U	1000 and over
K	6–7	Z	Unknown

Appendix E

FAILURE MODES OF COMPONENTS

AA — Mechanical failure
AB — Malposition or maladjustment
AC — Leak/break (pipes, valves)
AD — Break (structural)
AE — Crack (structural)
AF — Seizure
AG — Collapse
AH — Flow blockage/decrease
AI — Shaft or stem shear
AJ — Insulation breakdown
AK — Bind
AL — Open circuit/high impedance
AM — Short circuit/low impedance
AN — Grounded circuit
AO — Excessive clearances/wear/questionable integrity
AP — Plastic deformation
AQ — High level/volume/pressure/flow
AR — Low level/volume/pressure/flow
AS — High concentration
AT — Low concentration
AU — No failure
AV — Operation with failure(s)
AW — Manual removal from service
BA — High temperature/humidity
BB — Low temperature/humidity
BC — No/bad electrical contact
BD — Deterioration
BE — Erroneous/no signal
BF — Broken lead/coupling
BG — Test not performed
BH — Gasket/seal failure
BI — Missing/loose component
BJ — End of life
BK — Erratic operation
BL — Random drift
BM — Erroneous test conditions
BN — Response time
BO — Deenergized
BP — Contact failure
BQ — Security violation
BR — Thermal transient
BS — Pressure transient
BT — Contamination
BU — Open
BV — Closed
BW — Cladding failure
AX — Other
AY — Not stated
AZ — Unknown

Appendix F

SAMPLE SYSTEM AND COMPONENT IDENTIFIER LISTING

F.1 System Identifiers

CA — Emergency Feedwater System
CS — Condensate Storage and Transfer System
EH — 4160-V Class IE ac Auxiliary Power Distribution System
EI — 480-V Class IE ac Auxiliary Power Distribution System
EJ — 120-V Class IE ac Vital Power Distribution System
EU — 125-V Class IE dc Vital Power Distribution System
IE — ESF Actuation System
IP — Reactor Protection System
JK — Containment Instrument Room Panel System
KE — Essential Raw Cooling Water System
NC — Reactor Coolant System
ND — Decay/Residual Heat Removal System
NL — Passive ECCS Injection System
NS — Containment Spray/Iodine Removal System
NX — Borated/Refueling Water Storage and Transfer System
RT — Standby Diesel Generator and Controls System
SM — Main and Reheat Steam System
XR — Reserve Service Station Transformer System

F.2 Component Identifiers

EFU — Fuse
EINV — Inverter
ET — Transformer (power)
52KI — Circuit breaker, kirk key interlock, ac
52N — Circuit breaker, normal feeder, ac
65 — Governor
67 — Relay, ac directional overcurrent
IFFI — Indicator, flow (ratio)
IPT — Transmitter, pressure (measuring)
IPIT — Transmitter, pressure, indicating
IMOD — Module, instrument
ISC — Control, speed, nonindicating
ITA — Alarm, temperature
ITIK — Control station, temperature, indicating
MDSL — Engine, diesel
MFAS — Fastener
MFCV — Valve, flow control
MISV — Valve, isolation
MPMU — Pump (unknown type)
MSEL — Seal
MSMV — Valve, sample
MTNK — Tank
MVXV — Valve (unknown type)

Appendix G

SAMPLE LISTING OF LER DATA*

G.1 NSIC Accession Number 155475

All salt-water cooling pumps fail at San Onfore 1

Southern California Edison Co.

Ltr W/LER 80-006 to NRC, Region 5, Mar. 24, 1980, Docket 50-206, Type — PWR, Mfg. — West, AE — Bech

Date of event — 031080. Power level — 100%. Cause — vibration, valve failure, and inadequate prime. During normal operation, the south salt water cooling pump (SSWCP) discharge pressure dropped sharply. The north salt water cooling pump (NSWCP) automatically started on low pressure. However, its discharge POV failed to open. The auxiliary salt water cooling pump (ASWCP) was then started but flow could not be established. As a result of (1) excessive vibration, the shaft of the (SSWCP) sheared; (2) mechanical failure, the (NSWCP) POV did not open, (3) apparent inadequate prime, the (ASWCP) lost suction. The POV on the (NSWCP) was manually opened, and the (ASWCP) regained suction. Design of the POV and (ASWCP) is under investigation. Shaft of (SSWCP) being replaced.

DOCKET	YEAR	LER NUMBER	REVISION	DATE OF EVENT
206	1980	006	0	3/10/1980

STEP	LINK	SUBLNK	CAUSE	SYSTEM	COMPONENT	QUAN	TRAIN	DIFFER	EFFECT	FAILURE
1	0		AG	KE	MPMU	1X1	1	1	ACF	AI
2	1	A	R	KE	1X3		1	1	ACF	
3	0		AJ	KE	MVXV	1X1	2	1	ACC	BV
4	3		R	KE	MPMU	1X1	2	2	ACC	AU
5	4	A	R	KE	1X3		2	2	ACC	
6	0		FD	KE	MPMU	1X1	3	3	ACC	AU
7	6	A	R	KE	1X3		3	3	ACC	
8	A		R	KE	XXX				ACC	
9				XX					LZE	
10				XX					XX	
11				YY					NN	

WATCH LIST 205 211 365 514 517 526 913

*Textual data are from the LER forms. The SCS coded fields include additional data from transmittal letters and attachments to the LER forms.

G.2 NSIC Accession Number 156338

Transfer switch trip results in loss of power to safeguards at Robinson 2

Carolina Power & Light Co.

Ltr W/LER 80-004 to U.S. NRC, Region 2, Apr. 14, 1980, Docket 50-261, Type — PWR, Mfg. — West, AE — EBASCO

Date of event — 031680, Power level — 000%. Cause — installation error. While Unit 2 was shut down with the primary system at 350 psig and 235°F in the RHR recirculation mode, an overcurrent trip of the MCC-5 main transfer switch resulted in the loss of power to all MCC-5 and MCC-10 loads. This resulted in certain safeguards equipment being out of service which constituted a limited condition of operation permitted by tech specs.

DOCKET	YEAR	LER NUMBER	REVISION	DATE OF EVENT
261	1980	004	0	3/16/1980

STEP	LINK	SUBLNK	CAUSE	SYSTEM	COMPONENT	QUAN	TRAIN	DIFFER	EFFECT	FAILURE
1	0		OG	EI	52KI	2X2			UEA	AB
2	1		R	EI	52E	1X1			AEA	BO
3	2		R	EI	52	2X2			ADA	BU
4	3		R	EI	1XZ				ADA	BU
5	3		R	KE	MPMU	1XZ			PCA	BU
6	3		R	NL	MFCV	2XZ	M		PCA	BV
7	6		R	NL	MACC	2X4			PCA	AH
8	7		R	NL	2X4				PCA	
9	3		R	NX	MPMU	1XZ			PCA	AU
10	3		R	EJ	ETX	1XZ			ACA	BO
11	10		R	NS	IPT	MXZ			ACA	AU
12				XX					ACG	
13				XX					XX	
14				YY					NN	

WATCH LIST 760 223 251 281 510 520

G.3 Lightning Strike Causes Safety Injection at Salem 1

Public Service Electric & Gas Co.

Ltr. w/LER 80-031 to U.S. NRC, Region 1, July 8, 1980, Docket 50-272, Type — PWR, Mfg. — West., AE — Public Service.

Date of event — 060880. Power level — 100%. Cause — lightning. During a lightning storm, the South Penetration area was hit resulting in a severe transient on 7 main steam pressure transmitters causing 2 to fail. A safety injection occurred for 4 minutes. Transmitters were replaced in kind.

DOCKET	YEAR	LER NUMBER	REVISION	DATE OF EVENT
272	1980	031	0	6/08/1980

STEP	LINK	SUBLNK	CAUSE	SYSTEM	COMPONENT	QUAN	TRAIN	DIFFER	EFFECT	FAILURE
1	0	A	EG	SM	IPIT	5XZ	M	1	ADA	BE
2	0	A	EG	SM	IPIT	2XZ	M	2	AEA	AA
3	A		R	IP	XXX				ADA	AU
4	A		R	IE	XXX				ADA	AV
5	4		AJ	CA	65	1X1			ACA	AI
6	5		AI	CA	MPMU	1X3			ACA	AU
7	6		R	CA	1X3				ACA	
8	4		ZZ	SM	MVOC	1X4			ACA	AR
9	8		R	SM	MISV	1X4			ACA	BU
10	9		R	SM	1X4				ACA	
11	5		YY	ND	MTNK	1X1			ACA	AT
12	11		R	ND	XXX				ACA	
13	0		ZZ	NC	MSEL	1XZ			UCA	AA
14	13		R	NC	MVOD	1XZ			ACA	AA
15	14		R	NC	MSMV	1XZ			ACA	BV
16				XX					AEE	
17				XX					EB	
18				XX					LZ	
19				YY					NN	

WATCH LIST 202 222 517 524 913

G.4 Leaks Found on Reactor Coolant System Pumps at Fort Calhoun 1

Omaha Public Power District

Ltr to U.S. NRC, Region 4, May 22, 1980, Docket 50-285, Type — PWR, Mfg. — Comb. AE — G&H

Date of event — 051580. Power level — 000%. Cause — corrosion of studs. While performing a cold-pressure test of the RCS at 180 psig, an inspection revealed leakage from reactor coolant pump RC-3C. Leakage was from the shaft seal. Tightening the seal reduced but did not terminate the leakage. Further inspection revealed leakage from the gasketed surface between the pump casing and pump cover. Leakage was also coming from RC-3A and RC-3B. Corrosion damage had occurred on a number of closure studs on RC-3A and RC-3B. Studs for RC-3C had some corrosion.

DOCKET	YEAR	LER NUMBER	REVISION	DATE OF EVENT
285	1980	0522S	0	5/15/1980

STEP	LINK	SUBLNK	CAUSE	SYSTEM	COMPONENT	QUAN	TRAIN	DIFFER	EFFECT	FAILURE
1	0	A	AD	NC	MFAS	MX48	S		UPC	ED
2	0	A	AV	NC	MSEL	1X4	1	1	UPC	AC
3	0	A	AV	NC	MSEL	3X4	1	2	UPC	AC
4	A		R	NC	MPMU	3X4	1		UPC	AU
5				XX					CZI	
6				XX					FA	
7				YY					NN	

WATCH LIST 221 240 501 511 673 913

G.5 Emergency Core Cooling System Actuated at North Anna 1

Virginia Electric & Power Co.

Lrt w/LER 80-047 to U.S. NRC, Region 2, June 4, 1980, Docket 50-338
Type — PWR, Mfg. — West., AE — S&W

Date of event — 052380. Power level — 000%. Cause — loss of vital bus. At 0146, with the unit at hot standby, actuation of the emergency core cooling system was initiated on high steam line flow signal coincident with LO-LO T-AVE. This was an inadvertent actuation (equipment performed the intended injection function) and the reactor was already shut down. The high steam flow signal resulted from a loss of vital bu 1-III. The LO-LO T-AVE signal resulted from the tripping of all three reactor coolant pumps which was required due to the loss of vital bus 1-III. Corrective action was for the control room operators to perform the applicable emergency procedure and return the plant to stable conditions.

DOCKET	YEAR	LER NUMBER	REVISION	DATE OF EVENT
338	1980	047	0	5/23/1980

STEP	LINK	SUBLNK	CAUSE	SYSTEM	COMPONENT	QUAN	TRAIN	DIFFER	EFFECT	FAILURE
1	0		XX	NC	MPMU	1X3			AAA	AU
2	1		CD	XR	XXX				ABA	BO
3	2		R	EG	67	MXZ			AAA	AU
4	3		R	EG	52N	1XZ			AAA	AU
5	4		R	RT	EGEN	1XZ	1	1	ACA	AU
6	5		CA	EU	EFU	2XZ			ADA	AL
7	6		R	EU	EINV	1XZ			ACA	BO
8	7		R	EU	1XZ				ACA	BO
9	8	A	R	SM	IFI	MXZ			ACA	BE
10	8		R	KC	XXX				ACA	AH
11	10		R	NC	MSEL	3X3	M		AAA	BA
12	8		R	NC	MPMU	3X3	M		ACA	AW
13	12	A	R	NC	IT1K	MXZ			ADA	AU
14	A		YY	IE	XXX				ADA	AV
15	14		YY	ND	MTNK	1X1			AFA	AT
16	15		R	ND	XXX				AFA	
17	14		YY	NX	MTNK	1X1			AFA	AR
18	17		R	NX	XXX				AFA	
19	14		YY	CS	MTNK	1X1			AFA	AR
20	19		R	CS	XXX				AFA	
21	14		CH	RT	65	1XZ			UCA	AD
22	21		R	RT	MDSL	1XZ	2	2	ACA	AV
23	8		CA	JK	EFU	ZXZ	M		AAA	AL
24	23		R	JK	IMOD	ZXZ	M		ACA	AL
25	24		R	JK	IPA	1X1			ADA	AU
26				XX					EBJ	
27				XX					LZ	
28				XX					CZ	
29				YY					NN	

WATCH LIST 202 203 211 222 232 262 551 362 363 511 990

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At the request of the Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD), the Nuclear Safety Information Center (NSIC) has undertaken the development of a detailed computer-compatible coding system for events and sequences of occurrences described in Licensee Event Reports (LERs). This task was conceived by AEOD and is designated the "LER Sequence Coding and Search Procedure." The coding system is intended to describe in a computer-readable and computer-searchable format the sequence of events described in the LER. NSIC has developed coding tables, a coding form, and compatible computer softward to permit storage and on-line computer search capability. The AEOD draft "Watch List" has been revised to categorize and retrieve all identified situations of interest. Phase I of this program, which involved the coding and computer storage of some 100 LERs as well as development of some Watch List search strategies, has been completed. Phase II, which was completed before January 5, 1981, included writing and testing additional search strategies, refining coding tables, and coding additional LERs.

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