SIMULATOR SCENARIO TEMPLATE

USER'S GUIDE

MUHP-2014

WESTINGHOUSE OWNERS GROUP

OPERATIONS SUBCOMMITTEE

TRAINING WORKING GROUP

DRAFT 4

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1.0 BACKGROUND

In 1987 the Nuclear Regulatory Commission (NRC) published NUREG-1021, Operator Licensing Examiner Standards, to assist NRC examiners and facility licensees in better understanding the examination process and to provide equitable and consistent administration of the examinations to all applicants by NRC examiners. This document quickly went through several successive revisions.

Revision 5 to NUREG-1021, published in January 1989, was a watershed in the evolution of licensed operator requalification (LOR) examinations. The examination process detailed in Revision 5 was the result of an extensive cooperative effort (spanning more than a year) between the NRC staff and the nuclear industry. The Nuclear Management and Resources Council (NUMARC) represented the industry and coordinated the industry's involvement in the joint effort to develop and test a revised requalification examination program.

The examination program of Revision 5 (and of subsequent revisions) evaluates individual, crew, and facility performance. The program includes an operating test and a written test. The operating test contains a dynamic-simulator portion and a walkthrough portion consisting of job performance measures. The written test is a two-section, open-reference test, one section administered on a static ("frozen") simulator and the other section administered in the classroom.

All parts of the examination are developed by an examination team consisting of NRC examiners and facility personnel. The facility's examination materials are supposed to be used to the maximum extent possible. The examinations are graded in parallel by NRC examiners and facility evaluators. The facility involvement in examination preparation and the parallel grading introduced by Revision 5 were significant departures from past NRC practice, as were the evaluations of crew and facility performance.

A section of NUREG-1021, Examiner Standard ES-604, "Requalification Dynamic Simulator Examination," is the standard used by NRC examiners to prepare and administer all NRC dynamic simulator requalification examinations. ES-604 has received much attention over the years because of difficulties that NRC examiners and facility licensees have had in consistently and fairly implementing the requirements contained therein.

Both the NRC and the industry have struggled with issues pertaining to the scope, depth, and complexity of simulator scenarios used in requalification examinations.

Early in 1991, responding to concerns expressed by industry representatives and by NRC staff and examiners, the Operator Licensing Branch of the NRC conducted a study to evaluate the consistency and complexity of simulator scenarios. The study evaluated scenarios administered over a 6-month period by the NRC regions as part of the NRC's requalification program.

The results of the study were presented to the Commission in SECY-91-279, "Semi-Annual Report on the Status of the NRC Requalification Program, and the Status of the Operator Stress and Simulator Examination Studies." The study showed that simulator scenarios of varying scope and complexity were being administered. And it showed that the existing guidance contained in ES-604 (then at its Revision-6 stage) did not provide a means to ensure consistent scope, depth, and complexity of simulator scenarios.

The NRC staff met with NUMARC several times on the scenario-complexity issue. This issue also received much attention in other forums such as the national meetings on Operator Requalification and Related Topics, which NUMARC sponsored and in which NRC staff participated. In May 1991, as a result of all these discussions, NUMARC was requested to develop industry guidelines pertaining to scenario development and complexity.

NUMARC convened an ad-hoc advisory committee of utility and INPO personnel with experience in both training and operations to make recommendations on the form and content of guidelines for simulator scenario development and examination administration. The result of this effort was published in NUMARC-91-05, "Guidelines for Scenario Development and Administration of Dynamic Simulator Examinations." A draft of NUMARC-91-05 was reviewed by the industry during October and November 1991. In February 1992, NUMARC-91-05 was provided to the NRC.

The NRC staff used some of the concepts contained in NUMARC-91-05 to formulate its own set of guidelines for the development of dynamic simulator scenarios. In SECY-92-154, the NRC staff informed the Commission of the scenario attributes, qualitative and quantitative, that it intended to include as guidance in Revision 7 to NUREG-1021.

The quantitative attributes essentially focus on required numbers (or specified ranges) of scenario aspects such as the following: total malfunctions, malfunctions after EOP entry, abnormal events, major transients, EOPs used, EOP contingency procedures used, simulator run time, EOP run time, and crew critical tasks.

In July 1992, the NRC issued a preliminary draft of Revision 7 to NUREG-1021, which contains the quantitative attributes of SECY-92-154. Both SECY-92-154 and the preliminary draft of Revision 7 generated much comment within the industry.

In a letter (dated 09/29/92) to Mr. Larry Walsh, Chairman of the Westinghouse Owners Group, Mr. Thomas E. Tipton of NUMARC assessed industry sentiment as follows:

"...many in the industry feel that an undue emphasis is placed upon quantitative measurements, e.g., numbers of malfunctions and transient events. There is a justifiable concern that examiners' preoccupation with bookkeeping will cause the important qualitative aspects of a scenario to fade into the background. The lack of consistency in the development and implementation of the exam standards has long been an issue, and this revision to the NUREG does not fully address it."

In the same letter, Mr. Tipton wrote:

"...we [NUMARC] are again looking at a concept that was first raised some months ago during the drafting of the NUMARC simulator scenario development guidelines. The development of vendor-specific event sequences that are acceptable to both the industry and the NRC staff would promote consistency and define the 'box' in which examination scenarios must remain....In preliminary discussions on this subject, representatives from both PWR and BWR plants have evaluated this concept to be both feasible and beneficial."

Mr. Tipton went on to discuss a promising approach that uses the flow paths found in current emergency operating procedures to construct basic scenario templates. He continued as follows:

"Since these scenario templates would be vendor-specific, NUMARC considers that their development would most appropriately be carried out by each of the NSSS Owners' Groups. Each group could construct the basic templates...for its member plants. Obviously, plant-specific differences must be considered as well. Upon NRC approval and licensee implementation, a collection of these scenario templates would introduce an unprecedented degree of consistency...into the requalification examination process. NUMARC urges each Owners' Group to evaluate this concept carefully and to take steps to develop its own assemblage of scenario templates as it deems appropriate."

In response to NUMARC's recommendation, the Training Working Grou, (TWG) has requested (and the Operations Subcommittee has sponsored) a WOG project authorization to develop generic simulator scenario templates.

2.0 PURPOSE AND GOALS OF THE GENERIC TEMPLATES

The purpose of the generic simulator scenario templates is to provide WOG members with a methodology for developing dynamic simulator examination scenarios exhibiting a degree of complexity that is both adequate and consistent. The templates also provide a mechanism to develop an evaluation tool (dynamic simulator scenario) to evaluate crew performance on both critical tasks and normal tasks. Taking into consideration the systematic approach to training, this helps complete the link between tasks tagged as important in the analysis phase and the evaluation of those tasks in the evaluation phase.

The templates are derived from the procedure flow paths that already exist within the ERG network. To each template, menus of initial conditions, instrument and component failures, and major event sequences have been added. The options offered in the menus can be used to significantly alter the details of the scenario without significantly altering the degree of complexity.

Part of the project methodology is to verify that the options offered on a given template will not cause the scenario to deviate from the intended degree of complexity. After verification, the option menus are finalized to prevent the addition of unverified deviations that could adversely affect the scenario progression. Thus, provided that they remain within the bounds of the options specified for the template, any changes to the scenario will not invalidate the intended scenario progression nor significantly affect the complexity.

The specific goals of the generic template demonstration and validation project are as follows:

1. Provide an industry-developed (WOG-developed) approach to resolving the scenario-complexity issue that can serve as a complement to the quantitative approach described in Revision 7 to NUREG-1021.

2. Provide more consistency in the scope, depth, and complexity of dynamic simulator examinations from exam to exam, facility to facility, and region to region.

3. Provide a systematic method for incorporating the critical tasks documented per MUHP-2013 into the development of scenarios for dynamic simulator requalification examinations.

4. Provide a controlled method for allowing validated changes to dynamic simulator requalification examinations. This will ensure that telegraphing can be avoided without invalidating the scenario.

5. Provide a variety of initial conditions, failures, and major events within the template menus. This will enhance the integrity of template-derived examination scenarios. As plant-specific menu items are validated and added to the templates, users can evaluate the feasibility of maintaining a single bank of simulator scenarios, instead of two (one for training and one for evaluation).

3.0 LIST OF THE GENERIC TEMPLATES

The WOG has developed ten generic simulator scenario templates, which are as follows:

ES1213, LOCA with or without cooldown required
ECA1112, Loss of ECR and/or LOCA outside containment
E2ECA21, Faulted SG(s)
E3ECA33, SGTR
ECA3132, SGTR-and-LOCA or ruptured-and-faulted-SG
ECA00, Loss of all ac power
FRS1, ATWT
FRC12, Inadequate/degraded core cooling
FRH1, Loss of secondary heat sink
FRP1, Imminent PTS

4.0 CONTENT OF THE GENERIC TEMPLATES

Each template consists of the following elements and menus:

- o Initial conditions
  - -- IC set
  - -- Out-of-service/degraded component(s) (OOS/DC) menu
  - -- Shift turnover

- o Failures
  - -- Instrument failure (IF) menu
  - -- Component failure (CF) menu

- o Optional transient (OT) menu

- o Non-CT component failure menu

- o Major event sequence (MES)
  - -- Each template has two or more MESs
  - -- Each MES has at least one major event

- o For each MES, the following elements are provided (if applicable):
  - -- Sequencing requirements, if applicable
  - -- Prerequisites, if applicable
  - -- Options, if applicable
  - -- Critical tasks (tasks that are inherently critical for the MES)
  - -- Optional critocal tasks (i.e., tasks that can be made critical for the MES by adjusting the plant conditions)
  - -- Procedure transitions
  - -- Endpoint

- o List of plant conditions required in order to make optional tasks critical (Attachment 1 to each template)

The initial conditions (including the menu of OOS/DCs) and the instrument and component failure menus are presented on the first page of each template, which is titled Conditions and Failures. The second page of each template, titled Major Event Sequences, maps out (in flow-chart format) all major event sequences for that template. Detailed information pertaining to each MES (A, B, etc.) is presented on subsequent template pages.

4.1 Initial Conditions

The initial conditions presented on a generic template consist of the following elements:

- o IC set
- o Out-of-service/degraded component(s) (OOS/DC) menu
- o Shift turnover

4.1.1 IC Set

For purposes of converting the generic template into a plant-specific template, this template element directs the user to enter (develop) a menu of plant-specific simulator IC sets (initial condition sets) for initial power levels between 5 and 100%. This refers to the IC sets that are used to initialize the simulator at various power levels and system lineups.

If necessary, the user should restrict the IC sets offered on the plant-specific menu for a given template, based upon any of the following considerations:

- o Table-top analysis of the template, factoring in plant-specific design features, procedures, etc.
- o Previous experience
- o Validation results
- o Prevention of telegraphing

The TWG did not want the generic template project to expend resources on developing IC sets on a generic basis when they already exist in considerable numbers for each plant-specific simulator. Accordingly, the subject of simulator IC sets is mentioned only very briefly on the generic templates.

Individual users should evaluate the suitability of their existing IC sets for each template. Only existing IC sets that are suitable for a given template should be listed on the IC set menu for that template. In some cases, the user may have to develop an IC set that does not already exist in the plant-specific bank.

4.1.2 Out of Service/Degraded Components (OOS/DC) Menu

The Out of Service/Degraded Components (OOS/DC) Menu presents a selection of 8 instruments/components that are inoperable/degraded at the time of shift turnover. The template user is instructed to select none or more menu items, not to exceed 4.

(The TWG's positions regarding numbers of items incorporated from template menus into a single scenario and regarding numbers of items offered on template menus are presented in sections 7.1 and 7.2, respectively.)

4.1.2.a Plausible Precursors

The OOS/DC menu items are divided into plausible precursors and non-precursors. Items on the Instrument Failure Menu and on the Component Failure Menu (section 4.2) are similarly divided.

On all three menus, plausible precursors are components or instruments that can be plausibly linked in some fashion to a major event in one or more of the MESs. For example, in Template ECA1112 (Loss of ECR and/or LOCA outside containment), an RHR train is listed as a plausible-precursor-OOS/DC because it can be linked to the loss of ECR capability that occurs in MES A and in MES B.

4.1.2.b Non-Precursors

On the three menus mentioned in section 4.1.2.a (OOS/DC, Instrument Failure, and Component Failure), non-precursors are components or instruments that cannot be plausibly linked to the major events of the template. A component or an instrument listed as a non-precursor on a given menu in one template may be listed as a plausible precursor on the same menu in another template.

Non-precursors are identified to help reduce telegraphing. They provide the scenario writer with an opportunity to select a particular component/instrument in a template for which it is a non-precursor so that a particular component/instrument does not become uniquely and exclusively associated with an MES in another template for which the same component/instrument is a plausible precursor.

For example, SG tube leakage from a pin-hole leak that does not cause secondary plant radiation alarms is listed as a plausible-precursor-OOS/DC in Templates E3ECA33 and ECA3132, whereas in all other generic templates it is listed as a non-precursor. Occasional use of this particular OOS/DC as a non-precursor avoids the situation in which the only time that crews see SG tube leakage as an OOS/DC is prior to an MES involving an SGTR.

4.1.3 Shift Turnover

For purposes of converting the generic template into a plant-specific template, this template element directs the user to enter (develop) a menu of evolutions, maintenance, or testing that is scheduled or in progress. It reminds the scenario writer to specify any T.S. action statements in effect, including any related to OOS/DCs.

The TWG did not want the generic template project to expend resources on developing shift turnover items on a generic basis when individual users can do so more effectively and efficiently on a plant-specific basis. Accordingly, the subject of shift turnover is mentioned only very briefly in the generic templates.

In addition to T.S. action statements related to OOS/DCs, other action statements (independent of OOS/DCs) may be in effect at shift turnover. Examples of technical specifications for which action statements can be in effect independent of OOS/DCs are as follows: RCS leakage, reactor coolant chemistry, reactor coolant specific activity, containment integrity, secondary coolant specific activity.

For instruments/components/systems covered by T.S., include the type of information normally given in plant-specific turnovers.

4.2 Instrument Failure (IF) and Component Failure (CF) Menus

The Instrument Failure (IF) and Component Failure (CF) Menus present a selection of instruments and components that fail prior to the beginning of the MES. The template user is instructed to select none or more, not to exceed a total of 2 IFs and/or CFs.

The TWG's intent is that the user must maintain a high level of complexity and diversity in the scenario. To accomplish this with the templates, the user must select the maximum number of IF/CF menu items, or a total of 2. The only offsetting consideration is the effect on the overall scenario time. The TWG believes that the scenario must include at least two ERG CTs, and this often requires complex simulator manipulations and time to establish initial conditions for the CTs. When this occurs with the addition of maximum IF/CF menu items, the overall scenario time may exceed accepted standards of NUREG-1021. In these situations, the user may reduce the number of IF/CF menu items. That is, if the developed scenario exceeds the time standards, the user may reduce the IF/CF selections to 1. If the scenario time still exceeds standards, then the IF/CF selection may be reduce to none.

(The TWG's positions regarding numbers of items incorporated from template menus into a single scenario and regarding numbers of items offered on template menus are also presented in sections 7.1 and 7.2, respectively.)

The intent of the TWG with respect to IFs and CFs is as follows:

- o They should occur before the MES.
- o They can be active or passive failures.
- o They should require a response from the crew before onset of the MES.
- o Before onset of the MES, the crew should receive a cue that a response is required and should be allowed sufficient time to demonstrate its response to the IF and/or CF.

The IF and CF menu items are divided into plausible precursors and non-precursors. (Plausible precursors and non-precursors are defined in sections 4.1.2.a and 4.1.2.b., respectively.)

For an IF example, in Template ES1213 (LOCA with or without cooldown required), an RCS loop flow instrument failure is listed as a plausible-precursor-IF because it can be linked to the small-break LOCA that occurs in MES B. This linkage is predicated on the "leak-before-break" model. It can be plausibly postulated that the LOCA initiates as leakage from the instrument tap. Increasing leakage causes the instrument to fail. Some time after the instrument failure, the initial flaw propagates into the range of a small-break LOCA.

As another example, a steam flow instrument failure is listed as a plausible-precursor-IF in Template E2ECA21, whereas in Template ECA00 it is listed as a non-precursor. Occasional use of this particular IF as a non-precursor avoids the situation in which the only time that crews see a steam flow instrument failure is prior to an MES involving a faulted SG.

For a CF example, in Template FRH1 (Loss of secondary heat sink), loss of a main feed pump is listed as a plausible-precursor-CF because it can be linked to the loss of secondary heat sink that occurs in MESs A through D.

As another example, loss of a main feed pump is listed as a plausible-precursor-CF in Template FRH1, whereas in Template ECA00 it is listed as a non-precursor. Occasional use of this particular CF as a non-precursor avoids the situation in which the only time that crews see a loss of main feed pump is prior to an MES involving a loss of secondary heat sink.

4.3 Optional Transient (OT) Menu

The Optional Transient (OT) Menu presents a selection of 3 optional transients that precede or lead into the MES. The template user is instructed to select one or none (and no more than one) OT.

(The TWG's positions regarding numbers of items incorporated from template menus into a single scenario and regarding numbers of items offered on template menus are presented in sections 7.1 and 7.2, respectively.)

In this case, "optional" transient means that it is optional for the scenario writer to include one (but no more than one) of these transients in a scenario derived from the template, or not to include any of the optional transients offered. The intent of the TWG with respect to optional transients is the following:

- o It may either precede the MES or lead into it
- o It shall have a plant-specific form of procedural guidance for the crew (i.e. AOP, annunciator response, etc.)

Optional transients are provided to give the scenario writer flexibility in designing scenarios by accommodating potential needs or desires, such as the following:

- o Increase the scenario run time
- o Provide an opportunity for exercising procedures other than EOPs
- o Provide more opportunity for evaluating the competencies of ES-604 Form 2
- o Provide an opportunity for incorporating utility-defined non-ERG CTs, if any

Note: Some utilities have defined CTs outside the ERG network. One of the reasons for including optional transients on the generic templates is to give these utilities a mechanism for incorporating such CTs into template-derived scenarios. To do this, it may be necessary for the template user to substitute and validate optional transients other than those listed on the generic templates.

The relationship between some optional transients and the subsequent major event sequences of the template may be stronger in some cases than in others. This fact can be used to discourage the crew from keying on a given transient as a precursor to a particular major event.

4.4 Non-CT Component Failure Menu

The Non-CT Component Failure Menu implicitly identifies a large selection of ESF components that fail to automatically actuate after the beginning of the MES. The template user is instructed to select none or more non-CT component failures, not to exceed 3.

(The TWG's positions regarding numbers of items incorporated from template menus into a single scenario and regarding numbers of items offered on template menus are presented in sections 7.1 and 7.2, respectively.)

The selection of ESF components is implicitly identified by the following language: "Failure of one or more ESF components to auto actuate, provided that the components are not redundant to each other and that each has a redundant component that does actuate." In this context, an ESF component that fails to automatically actuate can be any ESF motor, valve, or relay that fails to automatically fulfill its safety-related design function.

For motors (pumps and fans), this would generally be failure to automatically start. For valves, it could be either failure to automatically open or failure to automatically close, depending upon the safety-related design function of the valve. Similarly, for relays the automatic failure can be either failure to close or failure to open, depending upon the function of the relay.

Thus, any ESF component can be failed provided that it is backed up by a redundant component and provided that the redundant component automatically actuates. And, therefore, the implied menu of non-CT component failures is quite long. (The user is instructed to select none or more of the implied menu items, not to exceed 3.)

Non-CT component failures are optional in the sense that it is optional for the scenario writer to include up to 3 of these auto-actuation failures in a template-derived scenario, or not to include any non-CT component failures.

These component failures are called non-CT component failures because they do not establish the requisite conditions for manual action to be a critical task. Manual action (such as manual actuation of the failed component) is not critical in these cases because the redundant ESF component does automatically actuate.

Because non-CT component failures have no impact on where the scenario goes, the scenario writer has the added option of denying the crew the ability to be successful in manually actuating the failed component. If the crew members cannot manually actuate the failed component, they will have to devise and prioritize further action. This provides additional opportunity for evaluating crew competencies such as understanding of plant/system response and crew operations.

Non-CT component failures are provided to give the scenario writer flexibility in designing scenarios by accommodating potential needs or desires, such as the following:

- o Provide more opportunity for evaluating the competencies of ES-604 Form 2

- o Provide an opportunity for incorporating component failures (malfunctions) after the ERGs are entered

4.5 Major Event Sequences

Each template has two or more major event sequences (MESs). Each MES has at least one major event.

On generic templates involving optimum response guidelines (ORGs) or emergency contingency actions (ECAs), the major events composing a sequence are fairly singular and distinct. For example, on Template E3ECA33 (SGTR), MES B consists of the following major events: a faulted SG and a tube rupture in a non-faulted SG.

On some generic templates involving function restoration guidelines (FRGs), multiple failures may be implicit within one major event. For example, on Template FRC1 (Inadequate/degraded core cooling), MES C contains one major event, ICC with RCP start required. This single major event implies all of the following failures:

- o Plant conditions that lead to and result in ICC

- o No form of high-head injection available (loss of all CCPs and SIPs)

- o No form of alternate injection available (loss of PDP)

- o Loss of secondary heat sink (loss of main feedwater and of AFW)

When such multiple failures are implied by a single major event, the implied failures are listed as prerequisites for the MES. See the Prerequisites listed for MES C on Template FRC1.

4.5.1 Sequencing Requirements

This section specifies whether, for a given MES, the major events must be run in the same order in which they are listed on the template.

4.5.2 Prerequisites

This section lists any sequence-specific prerequisites that must exist in order for a given MES to run as desired.

4.5.3 Options

This section identifies options, for a given MES, that the scenario writer can include at his/her discretion.

4.5.4 Procedure Transitions

This section lists a sequence-specific procedure flow path through the ERG network. The flow path listed is not necessarily the only valid path that the crew can take for a given MES. The flow path listed in this section demonstrates that at least one valid path does exist and that the crew can receive sufficient procedural cues to perform the tasks identified as critical for the MES.

4.5.5 Endpoints

An endpoint is identified for each MES. The endpoint identified for a given MES is the last ERG procedure that the crew must enter in order to receive procedural cues for all CTs identified for that MES.

The endpoint identified for a given MES on a generic template is not necessarily the endpoint for the scenario. It may be desirable to allow the crew sufficient time to transition to additional procedures beyond the endpoint that do not contain any CTs but are needed for stabilizing plant conditions or for reaching closure on a particular evolution.

4.5.6 Critical Tasks (CT)

The templates list both Critical Tasks (CT) and Optional Critical Tasks (OCT), which are explained in this section and section 4.5.7, respectively. It is intended that the scenario writer select a minimum of 2 from these menus. The selection must include the CT(s) and can include any number of OCTs, provided that a minimum of 2 is selected.

This CT section lists the WOG ERG-based tasks that are **inherently** critical for a given MES. For example, on Template ECA1112 (Loss of ECR and/or LOCA outside containment), MES A involves a LOCA with loss of ECR capability followed by emptying of the RWST. For this MES, WOG task ECA-1.1--B is always critical (i.e., inherently critical).

4.5.7 Optional Critical Tasks (OCT)

This section lists the WOG ERG-based tasks that can be made critical, OCTs, for a given MES, provided that certain conditions are inserted into the scenario. These OCTs are extrinsically critical in that they do not become critical unless and until the necessary conditions are inserted into the simulation.

(The TWG's positions regarding numbers of items incorporated from template menus into a single scenario and regarding numbers of items offered on template menus are presented in sections 7.1 and 7.2, respectively.)

In this case, "optional" in the OCT means that it is optional for the scenario writer to include any number of OCTs, provided that the total number between the CTs and the OCTs is a minimum of 2. "Optional," in this case, does not mean that it is optional for the crew to perform the task. Once the requisite conditions have been inserted and the OCT is made critical, the crew must perform the OCT.

OCTs are identified on the generic templates in order to give the scenario writer the ability to alter a significant aspect of the MES. This ability is needed so that a given MES is not exactly the same every time that it is run. This introduces an element of unpredictability that deters the crew from relying on a routine, conditioned response to a given MES.

Remember that on Template ECA1112 (Loss of ECR and/or LOCA outside containment), MES A involves CT ECA-1.1--B which is inherently critical. For this same MES, WOG tasks ECA-1.1--A, --C, --D are listed as OCTs because they can be made critical provided that the RWST empties. This MES includes other OCTs whose criticality depends upon other conditions.

4.5.8 Attachment 1, "Plant Conditions for Optional Critical Tasks"

An abstract of the various plant conditions that must exist in order for the OCTs to be critical are listed on Attachment 1 to each generic template, which is titled "Plant Conditions for Optional Critical Tasks." This section lists the key plant conditions that must exist in order to make the OCT critical within the selected major event sequence. The scenario writer must refer to the critical task document for the complete list of conditions that must exist.

For each OCT, the plant conditions required in order for that task to be critical are summarized. Each set of plant conditions is referenced to its associated OCT. The scenario writer must ensure that plant conditions exist as required in order to make the desired task(s) critical.

The user is given the following directions for incorporating OCTs into template-derived scenarios:

"Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired OCT critical within the selected major event sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical."

This section is written in terms of plant conditions as opposed to specific malfunctions/failures. It was believed that the scenario writer would find this clearer and easier to use. A simple list of malfunctions/failures could still leave the intended plant conditions unclear. Besides, eventually the scenario writer has to create the requisite plant conditions by specifying malfunctions/failures on his/her own plant-specific simulator. It was thought that the scenario writer would find it easier to start with the required plant conditions and then select malfunctions/failures on the plant-specific simulator as needed to create those conditions.

5.0 GUIDANCE FOR DERIVING SCENARIOS FROM TEMPLATES

5.1 The TWG strongly recommends that all scenarios derived from the generic templates be validated on the plant-specific simulator before they are used in any requalification examination.

5.2 When a given major event sequence is run on different occasions {is used in different scenarios}, vary your choice of scenario elements as necessary to avoid telegraphing that sequence.

5.2.1 It may be necessary to vary one or more of the following scenario elements:

a. Initial conditions set (IC set)
b. OOS/degraded components (OOS/DC)
c. Shift turnover (STO)
d. Instrument failures (IF)
e. Component failures (CF)
f. Optional transients (OT)

5.2.2 Ensure that none of the scenario elements listed under 5.2.1 are uniquely and exclusively associated with a particular event sequence. The following are examples of telegraphing that should be avoided:

a. The only time that crews see SG tube leakage as an OOS/DC, a CF, or an OT is prior to a major event sequence involving an SGTR.

b. The only time that crews see primary leakage as an OOS/DC, a CF, or an OT is prior to a major event sequence involving a primary LOCA.

5.3 When drafting a scenario, review your selections for OOS/DC, IF, CF, OT, MES, etc. to determine whether the particular combination of selections will result in an unintended set of plant conditions.

For example, assume you make the following selections: CCP A for an OOS/DC; ac emergency bus B for the component failure; and a small-break LOCA for the MES. This combination of selections creates a set of plant conditions in which manual starting of a CCP would be a critical task, except for the fact that there is no success path (unless the crew is allowed to re-energize emergency bus B or to have CCP A returned to service).

Thus, you should examine the combined effects of all your template menu selections for a given scenario to ensure that you have not inadvertently created an unintended set of plant conditions.

5.4 Time spent in the EOPs may be relatively short for a few template-derived scenarios. For example, assume that MES A of template FRH1 is selected and that capability for restoring main feedwater flow (starting a main feed pump) exists. For some plants (plant-specific simulators), it may be possible to start a main feed pump and restore the secondary heat sink in a relatively short period.

Such a scenario, involving a relatively brief period of EOP usage, should be paired (in a scenario set) with another scenario that does result in a relatively long period of time being spent in the EOPs. The example given in the preceding paragraph (loss of heat sink with starting of a main feedwater pump possible) could be paired with a scenario involving an SGTR.

Thus, EOP run time averaged over the scenario set can be made entirely sufficient for the purpose of evaluating the crew's competency in adherence to and use of emergency procedures.

5.5 From scenario to scenario, vary the order in which scenario elements are inserted into the sequence of events. In particular, interchange the order of the IF and CF.

The intention here is to avoid conditioning of crews wherein they come to anticipate a single, specific sequence, such as the following: first, an instrument failure; second, a component failure; third, a transient; fourth, a major event. Sequencing of the front-end elements of the scenario (IF, CF, OT) should be varied as much as possible to avoid such conditioning.

6.0 GUIDANCE FOR ADDING A MAJOR EVENT SEQUENCE

6.1 To avoid introducing an inappropriate degree of complexity into template-derived scenarios, the TWG recommends that users not add major events to the major event sequences of the generic templates.

6.2 The major event sequences of the generic templates are designed to achieve an adequate and a consistent level of complexity.

6.2.1 "Adequate level of complexity" means that the major event sequences of the generic templates satisfy the following criteria:

a. The generic MESs are of sufficient scope and complexity to allow evaluators to distinguish operators/crews who are performing safely and competently from those who are not.

b. The generic MESs also require the crew members to demonstrate their ability as a team to adequately protect the public health and safety in emergency conditions, using the ERGs.

6.2.2 The TWG recognizes that it may be appropriate and feasible for users to add major event sequences to their plant-specific versions of the templates. (That is, although the existing legs on a generic template should not be changed, new legs can be added.)

6.3 The TWG recommends that users apply the following guidance when adding an MES to any template:

6.3.1 The degree of complexity exhibited by the new MES should be consistent with the degree of complexity exhibited by the MESs of the original generic template.

6.3.2 The new MES should require usage of the same general ERG sequence. The following general ERG sequences are used in the generic templates:

Template	ERG Sequence
a. ES1213, LOCA:	E-1, ES-1.1, -1.2, -1.3
b. ECA1112, Loss of ECR:	E-1, ES-1.3, ECA-1.1, -1.2
c. E2ECA21, Faulted SG:	E-2, ES-1.1, ECA-2.1
d. E3ECA33, SGTR:	E-3, ECA-3.3
e. ECA3132, SGTR-and-LOCA:	E-2, E-3, ECA-3.1, -3.2
f. ECA00, Loss of all ac:	ECA-0.0, -0.1, -0.2
g. FRS1, ATWT:	FR-S.1
h. FRC12, ICC:	FR-C.1, -C.2
i. FRH1, Loss of heat sink:	FR-H.1
j. FRP1, Imminent PTS:	FR-P.1

6.3.3 Verify that there are no contradictions between the new MES and the following template elements:

a. Initial conditions, including OOS/DC-menu items
b. Instrument- and component-failure menu items
c. Optional-transient menu items

6.3.4 Identify and validate the CTs that are inherently critical for the MES and the OCTs that can be made critical for the MES by inserting optional malfunctions/failures as appropriate. Each MES must have at least one CT and one OCT, ensuring that the user has at least two tasks to choose for complexity. As many OCTs should be included as possible for diversity.

6.3.5 Verify that the crew will receive sufficient procedural cues to perform the tasks that have been identified as critical for the MES, provided that the crew's usage of the plant-specific EOPs is valid.

6.3.6 Specify any sequencing requirements, sequence-specific prerequisites, or options that apply to the MES.

7.0 GUIDANCE FOR CHANGING OR EXPANDING TEMPLATE MENUS

7.1 The TWG strongly recommends that users adhere to the generic template limits on the number of items from a given menu that can be incorporated into any requalification examination scenario.

7.2 Users have total discretion over the numbers of menu items offered on their plant-specific versions of the templates and over the content of the plant-specific menus.

7.2.1 However, the TWG strongly recommends that users validate each menu item in their plant-specific templates by using those items in scenarios run on the plant-specific simulator.

7.2.2 The TWG does not intend that the number of items offered on menus in the generic templates be interpreted as a requirement or recommendation for the number of menu items that should appear on plant-specific versions of the templates. The number of menu items in the generic templates was determined solely on the basis of providing an adequate demonstration and validation of the template methodology. The number of items offered on a plant-specific menu may be greater or less than (or the same as) the number offered on the corresponding menu in the generic template.

7.3 The TWG anticipates that, as the template methodology matures over a period of years, the plant-specific menus of validated items will become long enough that telegraphing can be eliminated with certainty. As the plant-specific menus lengthen, the integrity of template-derived scenarios becomes virtually uncompromisable and users can evaluate the feasibility of maintaining a single bank of simulator scenarios, instead of two (one for training and one for evaluation).

7.4 As a general rule, the TWG recommends that users expand their plant-specific menus by listing the specific additions to any menu. The TWG recommends that users avoid the practice of expanding a menu by means of language such as: "use any component failure except the following."

7.5 When validating menu items for addition to plant-specific templates, users should evaluate whether the addition raises the degree of complexity to an inappropriate level. For example, the addition of a failure that affects multiple components/systems may add too much complexity to the scenario, considering the complexity that is already inherent within the template.

7.6 The TWG strongly recommends that all scenarios derived from plant-specific templates be validated on the plant-specific simulator.

8.0 GUIDANCE EXCERPTED FROM ATTACHMENT 3 TO ES-604

B. SCENARIO ATTRIBUTES

..... The scenario should be of sufficient scope and complexity to demonstrate the difference between competent operators and crews and those that are not performing at an acceptable level.....

1. Qualitative Attributes

a. Realism/Credibility

..... Piping, component, and instrument failures often occur in such a way that deterioration can be tracked over a discrete time period (e.g., a small leak that propagates over time or a pump failure preceded by a high vibration condition).....

..... A good technique inserts an event precursor (e.g., small steam generator tube leak) and maintains the plant at a slightly degraded condition to observe how the crew incorporates that condition into its conduct of subsequent plant operations.....

..... Rapid propagation of faults may occur with little, if any, warning (e.g., valve operators fail, fires occur in breakers or transformers, undetected pipe erosion results in piping failures). Although including these events into scenarios is valid, they often provide minimal evaluative benefits because they happen so suddenly that operators have little to do but watch the event unfold. These events are most useful when trying to establish a plant condition for subsequent evaluation goals or to assess a crew's ability to use its procedures in a symptom-based rather than an event-based mode.....

..... Mechanistic component failures are well documented events that occur each year, many times in multiple numbers. However, non-mechanistic failures (e.g., pipe breaks) generally occur singularly; therefore, unless there is a connective precursor, such as a seismic event, it would not be realistic or credible to have several piping systems fail during any one scenario.....

b. Event Sequencing

..... Frequently, important evaluative benefit in terms of safety significance is gained by having key components or instruments fail after entering the EOPs.....

c. Simulator Modeling

..... Despite the certification of simulators to a set standard (ANSI/ANS-3.5-1985), not all simulators are equally capable of performing major transients. The scenario should not exceed the limits of the facility licensee's configuration management system by altering a simulator model to obtain a desired effect.....

2. Quantitative Attributes

..... Some scenarios may be an excellent evaluation tool but may not fit within these ranges. However, a scenario that does not fit into these ranges should be evaluated by the examination team to ensure the scenario is appropriate.....

c. Abnormal Events

..... An abnormal event may or may not be a precursor to the major transient, although it can add to the credibility of a scenario, such as preceding a total loss of feedwater with a single feed pump trip. However, certain events may cue the operators about subsequent events. Therefore, it is important in a scenario bank to have different precursor events that lead to the same major transient. It is also important to have within a scenario bank, abnormal events that are not always predictive of the same major transient (e.g., a steam generator tube leak does not always lead to a subsequent tube rupture).....

..... Some abnormal events should require that the crew recognize and interpret technical specifications (TS) for each scenario. This recognition and interpretation can be incorporated into the scenario by giving the crew TS-related equipment that is out of service at the start of the scenario.....

h. EOP Run Time

..... most critical tasks occur in the EOPs.....

i. Crew Critical Tasks

..... Critical tasks (CTs) range between fairly simplistic but safety-significant tasks (...tripping a reactor coolant pump during a small-break LOCA) and other tasks that require a much higher level of skill involving several crew members (executing a rapid cooldown within predefined limits using steam generator power-operated relief valves...). Therefore, the difficulty level must be considered to judge the appropriateness of the number of CTs in a scenario or scenario set.....

C. INTEGRATED SCENARIO DEVELOPMENT

2. Initial Conditions

..... The initial conditions should be representative of a typical plant status, with various components, instruments and annunciators out of service. To have maintenance or surveillance activities in progress is realistic. All, some, or even none of these initial conditions may have a bearing on subsequent scenario events. Initial conditions should be frequently changed, to prevent predictability of future events.....

3. Event Selection

..... All events do not have to be linked, that is, one event need not occur for the next event to logically occur, although in many instances, such a relationship adds to the credibility of the scenario. However, the scenario should not consist of a series of totally unrelated events. A well-crafted scenario flows from event to event, giving the crew sufficient time in each event to analyze what has happened, evaluate the consequences of the crew's action (or inaction), assign a priority to the event given the existing plant conditions, and determine a course of action.....

9.0 GUIDANCE EXCERPTED FROM NUMARC-91-05 (DRAFT)

3.0 SCENARIO ATTRIBUTES

3.2 Realism

..... Many operating problems develop gradually, with complex events evolving from simpler ones. Simulator scenarios should follow this pattern. The chain of events must be logical, reflecting the sequence as it would in real life. For example, a scenario that simulates the instantaneous guillotine shear of a hot leg pipe without any precursor events is unrealistic. A better scenario might start with a small hot leg leak (leak before break) increasing gradually in size to the proportions of a major loss-of-coolant accident (LOCA). As the event progresses, changing primary and containment conditions cue the operators that something is amiss and exercise their diagnostic skills.....

3.3 Simulator Model Fidelity

..... The degree of realism that a simulator achieves is due in large part to the accuracy of its software model. Altering the model to obtain a desired effect as part of a scenario is unacceptable.....

..... All certified simulators must comply with the fidelity requirements of 10 CFR Part 55. The scenario designer must ensure that his/her scenario does not make unrealistic demands on the simulator by calling for performance that is beyond its capabilities.....

4.0 SCENARIO DEVELOPMENT METHODOLOGY

4.1.2 Endpoint

..... To prevent crews from becoming too familiar with the flow of a given scenario, its endpoints should be varied periodically to reduce its predictability.....

4.2 Credibility and Realism

..... As well as being credible, the selected events must be realistic. They should be based upon known failure mechanisms with time sequences similar to actual occurrences. For example, simulating a high vibration condition is a realistic precursor to a feed pump trip.....

4.3 Event Selection

..... The scenario designer must ensure that the events and malfunctions are consistent with the intent of the scenario. They should be linked in a logical sequence that focuses on the scenario's objective. Events intended to distract the crew from the principle flow path of the scenario may be used with discretion. They provide opportunities to evaluate the crew's ability to discriminate between competing events and to prioritize its actions effectively.....

..... While a crew must be able to react quickly when necessary, a simulator examination should not be merely a series of rapid-fire problems that demand reflexive responses.....

..... the insertion of scenario events should be chosen to allow a crew sufficient time to demonstrate its ability to analyze what has happened, evaluate the consequences, prioritize the event among existing plant conditions, and determine a course of action.....

10.0 GLOSSARY

MES Major event sequence: one or more major malfunctions simulated during a scenario for which the crew must respond by entering and implementing the ERGs. This definition is consistent with the definition of "major transient" given in Attachment 3 to ES-604, which is as follows:

"A major transient is one that has a significant effect on plant safety and that leads to an automatic (or manual, if initiated by the licensee) protective system actuation.... Examples include loss of offsite power, LOCA, steam or feedline break, steam generator tube rupture, and loss of feedwater."

Each template offers a selection of MESs; the user should select one MES per template-derived scenario.

Scenario A specific series of initial conditions, instrument/ component failures, optional transients, and a single major event sequence used to evaluate an operating crew during dynamic simulator requalification examinations.

Element One of the following recurring parts (or subparts) of dynamic simulator examination scenarios:

- o Initial conditions
  - -- IC set
  - -- Out of service/ degraded component (OOS/DC)
  - -- Shift turnover (STO) items
- o Instrument failure (IF)
- o Component failure (CF)
- o Optional transient (OT)
- o Non-CT component failure
- o Major event sequence (MES)
- o Critical tasks (CTs)
- o Optional tasks

Template An assemblage of menus and options for designing simulator scenarios that exercise one of the main procedure groupings within the ERG network. Each template consists of selections for initial conditions, instrument/component failures, optional transients, and major events. The ERG-based critical tasks applicable to each major event sequence on a given template are identified. The user should select one major event sequence per template-derived scenario.

TWG Training Working Group

WOG Westinghouse Owners Group

SCENARIO TEMPLATES
USER'S GUIDE

ATTACHMENT 1

ACRONYMS, ABBREVIATIONS, AND TERMS

Acronyms, Abbreviations, and Terms

ac	alternating current
A/ER	Action/Expected Response
AFAS	auxiliary feedwater actuation signal
AFD	axial flux difference
AFW(S)	auxiliary (emergency) feedwater (system)
ALARA	as low as reasonably achievable
AMSAC	ATWS mitigation system actuation circuitry
ANN	annunciator
AOV	air-operated valve
ARM(S)	area radiation monitor (monitoring) (system)
ATWS	anticipated transient without scram
ATWT	anticipated transient without trip
BAT	boric acid (storage) tank
BIT	boron injection tank
BWST	borated water storage tank
CARS	condenser air removal system
CAT	chemical addition tank
CCP	centrifugal charging pump
CCS	containment cooling system
CCW(S)	component cooling water (system)
CEAC(S)	control element assembly control (system)
CET	core exit thermocouple
CF	component failure
CFCU	containment fan cooler unit
CIRS	containment iodine removal system
COLSS	core operating limit support system
CPIS	containment purge isolation signal
CPS	containment purge system
CRDM	control rod drive mechanism
CRDS	control rod drive system
CRT	cathode-ray tube
crud	corrosion product material suspended in system
CSAS	containment spray actuation signal
CSF	critical safety function
CSS	containment spray system
CST	condensate storage tank
CT	critical task
CTRG	Critical Task Review Group
CVCS	chemical and volume control system

DBA	design basis accident
DC	degraded component
dc	direct current
DG	diesel-generator
DNB	departure from nucleate boiling
D/P	differential pressure, pressure difference, or pressure drop
ECCS	emergency core cooling system
ECP	estimated critical position (of control rods)
ECR	emergency cooling recirculation
EDG(S)	emergency diesel-generator (system)
EHC	electrohydraulic control
EOP	Emergency Operating Procedure
EPE	emergency plant evolution
ERG	Emergency Response Guideline
ESF	engineered safety features
ESFAS	engineered safety features actuation system
FHES	fuel handling equipment system
FPS	fire protection system
FRG	function response guideline
FSAR	Final Safety Analysis Report
FW	feedwater
HHSI	high-head safety injection
HP	high pressure
HPI/LPI	high-pressure or low-pressure injection
HRPS	hydrogen recombiner and purge control system
HVAC	heating, ventilating, and air-conditioning
IAS	instrument air system
I&C	instrumentation and control
IC	initial condition
ICS	integrated control system
IF	instrument failure
IFRM	Instrument Failure Reference Manual
INPO	Institute of Nuclear Power Operations
IR	intermediate range
ITM(S)	in-core temperature monitor (system)
JPM	job performance measure
JTA	job-task analysis

K/A	knowledges and abilities (catalog)
K-eff	subcritical multiplication factor
KSAs	knowledges, skills, and abilities
LCO	limiting condition for operation
LHSI	low-head safety injection
LOA	local operator action
LOCA	loss of coolant accident
LP	low pressure
LRS	liquid radwaste system
LVDT	linear variable differential transformer
MAC	major action category
MES	major event sequence
MD	motor-driven (in reference to pumps)
MFW(S)	main feedwater (system)
MG	motor generator
MOV	motor-operated valve
MRSS	main and reheat steam system
MSIV	main steam isolation valve
MTC	moderator temperature coefficient
MT/G	main turbine generator (system)
MWt	megawatts thermal
NIS	nuclear instrumentation system
NNIS	non-nuclear instrumentation system
NOP	normal operating power
NOT	normal operating temperature
NPSH	net positive suction head
NRC	Nuclear Regulatory Commission
NRHX	non-regenerative heat exchanger
NSSS	nuclear steam supply system
OCT	optional critical task
OOS	out of service
ORG	optimal recovery guideline
OT	optional transient
PCT	peak cladding temperature
PD	positive displacement (in reference to pumps)
P&ID	piping (or process) and instrumentation diagram
PDIL	power-dependent insertion limit
PDP	positive displacement pump
PEO	plant equipment operator (auxiliary operator)
POAH	point of adding heat
PORV	power-operated relief valve

PPDIL	prepower-dependent insertion limit
PR	power range
primary	reference to reactor coolant system
PRM(S)	process radiation monitor (system)
PRT(S)	pressurizer relief tank (system)
PTS	pressurized thermal shock
PWR	pressurized water reactor
PZR	pressurizer
PZR LCS	pressurizer level control system
PZR PCS	pressurizer pressure control system
radwaste	radioactive waste
RCCA	rod cluster control assembly (control rod)
RCP(S)	reactor coolant pump (system)
RCS	reactor coolant system
rem	roentgen equivalent in man, a measure of irradiation dose
RHR(S)	residual heat removal (system)
RMS	radiation monitoring system
RNO	response not obtained
RO	reactor operator
RPI(S)	rod position indicator (or indication) (system)
RPS	reactor protection system
RPV	reactor pressure vessel
RTD	resistance temperature detector
RVLIS	reactor vessel liquid inventory system
RWST	refueling water storage tank
SAS	station air system
SCR	silicon-controlled rectifier
SDM	shutdown margin
SDS	steam dump system
secondary	reference to steam and feedwater systems
SFPCS	spent fuel pool cooling system
SG(S)	steam generator (system)
SGB	steam generator blowdown
SGTR	steam generator tube rupture
SI	safety injection
SIP	safety injection pump
SIS	safety injection system
SOP	standard operating procedure
SR	source range
SRO	senior reactor operator
SS	shift supervisor
STA	shift technical advisor
SUO	startup operator
SUR	startup rate
SWS	service water system

T_{avg}	average reactor coolant temperature
TC	thermocouple
T_{cold}	measured temperature of core inlet
TD	turbine-driven (in reference to pumps)
TDAFW	turbine-driven auxiliary feedwater (pump)
TG	turbine-generator
T_{hot}	measured temperature of core outlet
T_{ref}	reference temperature for RCS
TS	technical specifications
TOS	Training and Operational Services
TSC	Technical Support Center
TWG	Training Working Group
UHI	upper head injection
VARS	volt-amperes reactive
VCT	volume control tank
WGDS	waste gas disposal system
WOG	Westinghouse Owners Group

ES1213

TEMPLATE ES1213: LOCA with or without cooldown required (PAGE 1) **CONDITIONS AND FAILURES**

INITIAL CONDITIONS
- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors
1. EDG
2. Containment spray/coolers
3. MD/TD AFW pump
4. CCP/ SIP/ RHR pump
5. CCW/ESW pump

Non-Precursors
6. PZR PORV
7. NIS instrmnt/chnl
8. SG tube leakage < T.S. limits; pin-hole leak detected via sampling of the Sgs. For this template, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

Plausible Precursors
1. RCS loop flow instrmnt
2. RCS temperature instrmnt
3. PZR level instrmnt
4. PZR pressure instrmnt

Non-Precursors
5. SG level instrmnt/chnl

COMPONENT FAILURE MENU

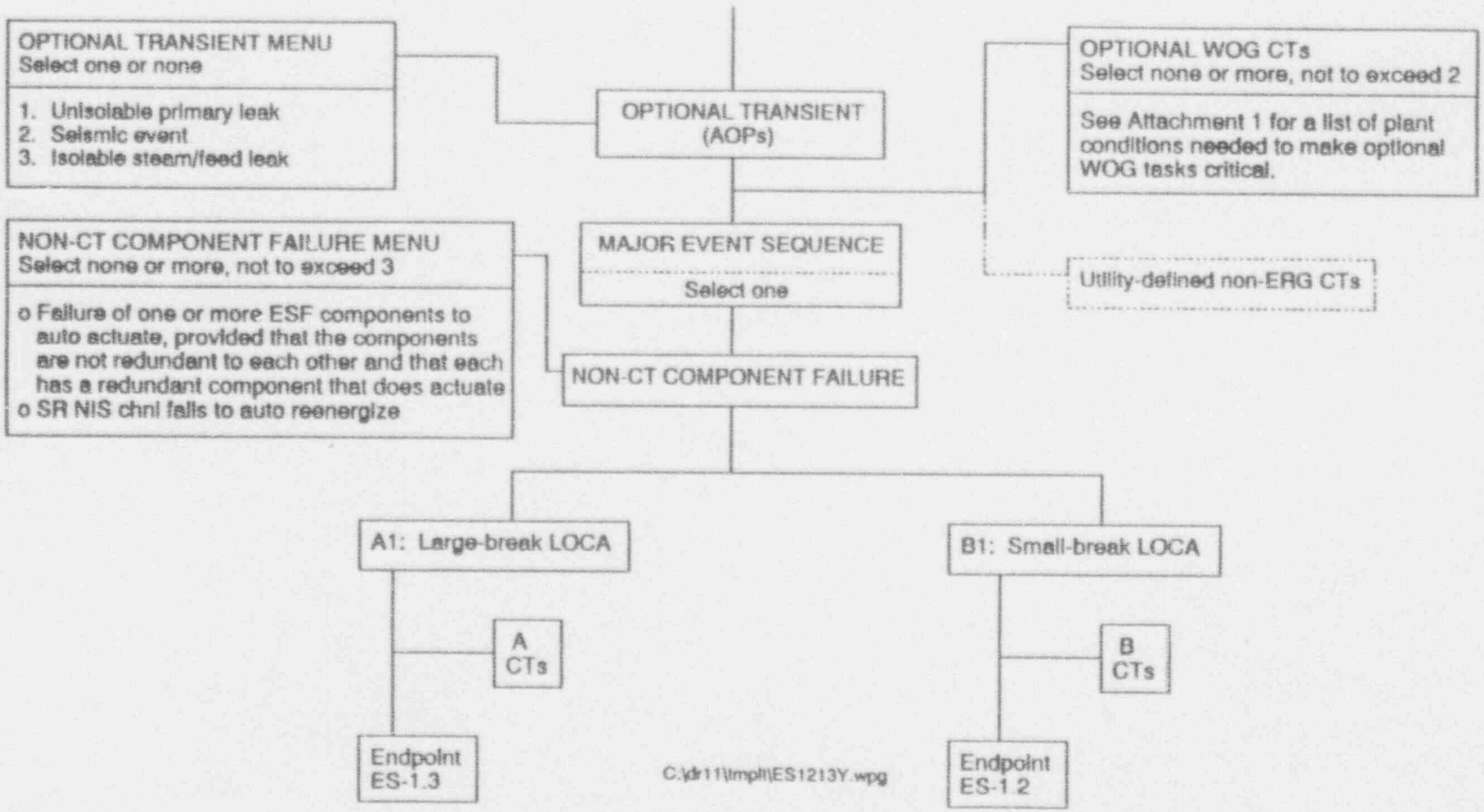
Plausible Precursors
1. PZR heater group
2. Rod position indicator/channel

Non-Precursors
2. Turbine intercept valve trip
3. Letdown leak
4. Loss of main feed pump

Continued on Next Page

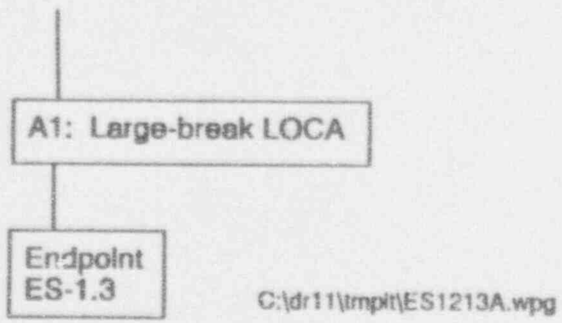
TEMPLATE ES1213: LOCA with or without cooldown required (PAGE 2) **MAJOR EVENT SEQUENCES**

Continued from page 1



SEQUENCING REQUIREMENTS
NA

Continued from Optional Transient



CRITICAL TASKS
The following WOG CT is critical for this event sequence: ES-1.3--A

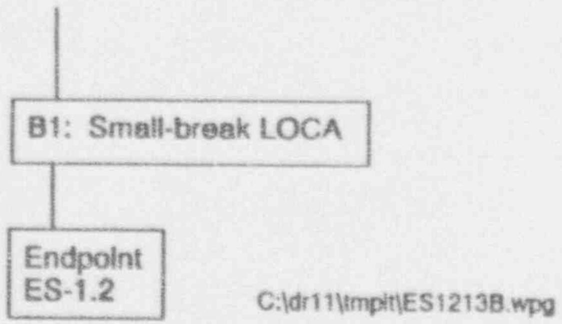
OPTIONAL CRITICAL TASKS
The following WOG Cts can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --D, --E, --H, --K, --L, --O, --R, ECA-1.1--A

Options: None

Procedure Transitions: E-0 → E-1 → ES-1.3

SEQUENCING REQUIREMENTS
NA

Continued from Optional Transient



CRITICAL TASKS
The following WOG CT is critical for this event sequence: E-1--C with the required plant-specific size SBLOCA

OPTIONAL CRITICAL TASKS:
The following WOG Cts can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --F, --I, --J, --K, --L, --O, --R Additionally, WOG CT ES-1.3--A can be critical for this event sequence, provided that RWST level decreases to the criterion for switchover to cold leg recirculation.

Options: None

Procedure Transitions:
E-0 → E-1 → ES-1.2

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG Cts critical within the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

o Reactor fails to trip automatically but is manually trippable (Refer to WOG CT E-0--A for requisite plant conditions.)

o No ac emergency bus is energized but at least one can be energized manually (Refer to WOG CT E-0--C for requisite plant conditions.)

o SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D for requisite plant conditions.)

o Minimum required complement of containment cooling equipment is not running but can be started manually (Refer to WOG CT E-0--E for requisite plant conditions.)

o Secondary heat sink required but AFW flow is insufficient; the minimum required AFW flow rate can be established manually (Refer to WOG CT E-0--F for requisite plant conditions.)

o Large-break LOCA with RCS pressure below low-head ECCS pump shutoff head; both low-head ECCS pumps fail to start automatically; at least one low-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--H.)

o Small-break LOCA with RCS pressure below high-head ECCS pump shutoff head; both high-head ECCS pumps fail to start automatically; at least one high-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--I.)

o Small-break LOCA with RCS pressure below intermediate-head ECCS pump shutoff head; both intermediate-head ECCS pumps fail to start automatically; at least one intermediate-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--J.)

o Minimum required number of CCW pumps is not running; at least the minimum required number can be started manually (Refer to WOG CT E-0--K for requisite plant conditions.)

o Minimum required number of ESW pumps is not running; at least the minimum required number can be started manually (Refer to WOG CT E-0--L for requisite plant conditions.)

o LOCA with phase-A containment isolation failure; the plant conditions required in order for the task of closing containment isolation valves to be critical are so detailed and specific that it is best to refer directly to the associated CT worksheet (Refer to WOG CT E-0--O.)

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

- LOCA with containment mini-purge in operation at accident initiation; purge isolation fails such that containment atmosphere remains unisolated via mini-purge penetrations; mini-purge can be isolated, provided that manual action is taken as necessary (Refer to WOG CT E-0--R.)

ECA1112

TEMPLATE ECA1112: Loss of ECR and/or LOCA Outside Containment (PAGE 1) **CONDITIONS AND FAILURES**

INITIAL CONDITIONS
IC SET
O.O.S. COMPONENTS
SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors
1. RHR train

Non-Precursors
2. PZR pressure instrmnt/chnl
3. CCP/ SIP
4. Containment spray/coolers
5. MD/TD AFW pump
6. CCW/ESW pump
7. EDG/ offsite ac circuit
8. SG tube leakage < T.S. limits; pin-hole leak detected via sampling of the SGs. For this template, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

FAILURES
INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

Plausible Precursors
1. RCS loop flow instrmnt
2. RCS temperature instrmnt
3. PZR level instrmnt
4. PZR pressure instrmnt

Non-Precursors
5. SG level instrmnt/chnl

COMPONENT FAILURE MENU

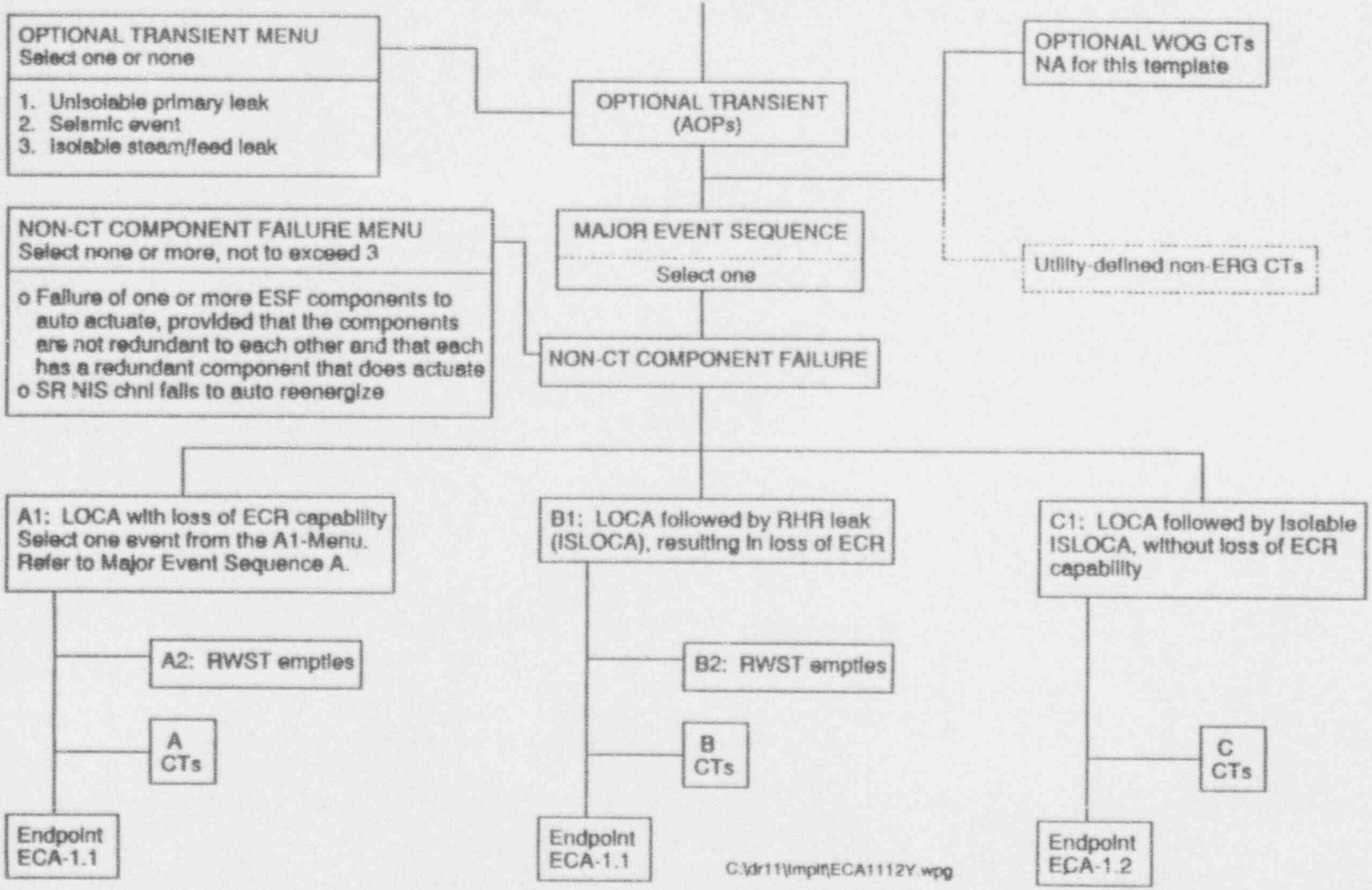
Plausible Precursors
1. PZR heater group
2. Movable control assembly

Non-Precursors
2. Turbine intercept valve trip
3. Letdown leak
4. Loss of main feed pump

Continued on Next Page

TEMPLATE ECA1112: Loss of ECR and/or LOCA Outside Containment (PAGE 2) **MAJOR EVENT SEQUENCES**

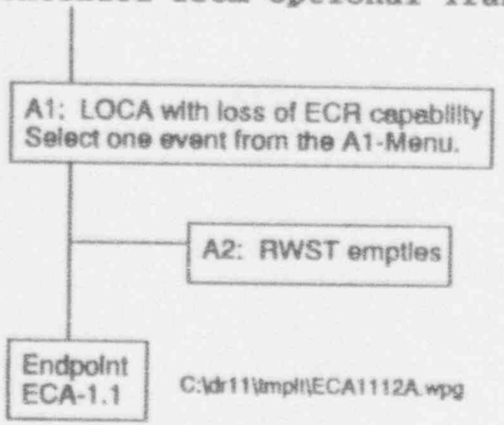
Continued from page 1



SEQUENCING REQUIREMENTS
Events must be sequenced in the order shown.

PREREQUISITES
None

Continued from Optional Transient



A1-Menu: Select one event.	
A1.1	LOCA with any combination of component malfunctions and/or electrical power failures, such that ECR is lost
A1.2	Unisolable LOCA outside of containment

Options: None

Procedure Transitions:

E-0 → E-1 → ES-1.3 → ECA-1.1

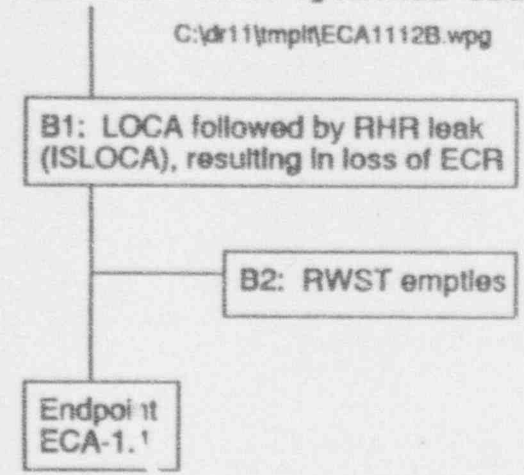
CRITICAL TASKS
The following WOG CTs is critical for this event sequence: ECA-1.1-B

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --F, --H, --I, --J, --K, --L, --O, --Q, --R E-1--C, ECA-1.1--A, --C, and --D. Regarding WOG CT E-0--F, the secondary heat sink will not be required if LOCA break flow is sufficient to remove decay heat.

SEQUENCING REQUIREMENTS
Events must be sequenced in the order shown.

PREREQUISITES
None

Continued from Optional Transient



Options: None

Procedure Transitions:

E-0 → E-1 → ES-1.3 → ECA-1.1
↓ ↑
→ → →

CRITICAL TASKS
The following WOG CT is critical for this event: ECA-1.1--B

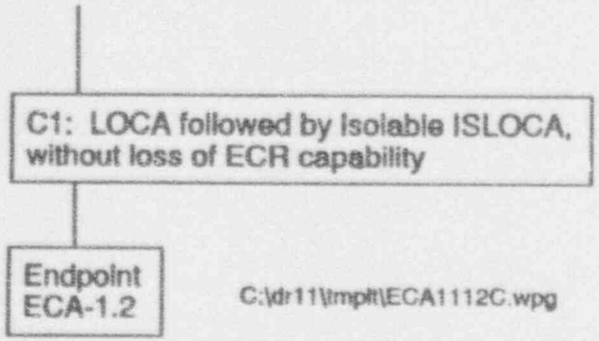
OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --F, --H, --I, --J, --K, --L, --O, --Q, --R E-1--C, ECA-1.1--A, --C, and --D Regarding WOG CT E-0--F, the secondary heat sink will not be required if LOCA break flow is sufficient to remove decay heat.

TEMPLATE ECA1112: Loss of ECR and/or LOCA Outside Containment (PAGE 5) **MAJOR EVENT SEQUENCE C**

SEQUENCING REQUIREMENTS
NA

PREREQUISITES
None

Continued from Optional Transient



CRITICAL TASKS
The following WOG CT is critical for this event sequence: ECA-1.2--A

OPTIONAL CRITICAL TASKS
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --F, --Q

Options: None

Procedure Transitions:

E-0 → E-1 → ECA-1.2
↓ ↑
→ → →

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG CTs critical within the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

o Reactor fails to trip automatically but is manually trippable (Refer to WOG CT E-0--A.)

o No ac emergency bus energized but at least one EDG can be connected to an ac emergency bus (Refer to WOG CT E-0--C.)

o SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D.)

o Containment cooling is required but the minimum required complement of containment cooling equipment is not entirely automatically actuated; the minimum required complement of containment cooling equipment can be manually actuated (Refer to WOG CT E-0--E.)

o Secondary heat sink required but AFW flow is insufficient; the minimum required AFW flow rate can be established, provided that manual action is taken as necessary (Refer to WOG CT E-0--F.)

o Large-break LOCA with RCS pressure below low-head ECCS pump shutoff head; both low-head ECCS pumps fail to start automatically; at least one low-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--H.)

o Small-break LOCA with RCS pressure below high-head ECCS pump shutoff head; both high-head ECCS pumps fail to start automatically; at least one high-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--I.)

o Small-break LOCA with RCS pressure below intermediate-head ECCS pump shutoff head; both intermediate-head ECCS pumps fail to start automatically; at least one intermediate-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--J.)

o Minimum required number of CCW pumps is not running; at least the minimum required number of CCW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--K.)

o Minimum required number of ESW pumps is not running; at least the minimum required number of ESW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--L.)

o LOCA with phase-A containment isolation failure; the plant conditions required in order for the task of closing containment isolation valves to be critical are so detailed and specific that it is best to refer directly to the associated CT worksheet (Refer to WOG CT E-0--O.)

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

- o Reactor trip from full load; main turbine fails to automatically trip; main turbine control valves fail as is; main turbine can be tripped manually from control room; main steamline isolation fails to automatically actuate; MSIVs cannot be closed from control room (Refer to WOG CT E-0--Q.)

- o LOCA with containment mini-purge in operation at accident initiation; purge isolation fails such that containment atmosphere remains unisolated via mini-purge penetrations; mini-purge can be isolated, provided that manual action is taken as necessary (Refer to WOG CT E-0--R.)

- o Small-break LOCA requiring manual trip of RCPs, i.e., break size is one that has windows for adverse consequence, only a single train of safety injection pumps is available, the RCP trip criteria are met, any RCP is still running (Refer to WOG CT E-1--C.)

- o LOCA with loss of ECR capability with depletion of the RWST inventory requiring ECCS pump trip without severe challenge to core cooling CSF (Refer to WOG CT ECA-1.1--A)

- o LOCA with loss of ECR without possibility of restoration and RWST empty with capability to establish alternate RCS makeup flow (Refer to WOG CT ECA-1.1--C)

- o LOCA with loss of ECR without possibility of restoration and RWST empty without capability to establish RCS makeup from alternate source and SG pressure higher than pressure at which accumulators start to inject (Refer to WOG CT ECA-1.1--D)

E2ECA21

INITIAL CONDITIONS

- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors
1. MD AFW pump
2. TD AFW pump
3. Offsite ac circuit

Non-Precursors
4. PZR level instrmnt/chnl
5. PZR pressure instrmnt/chnl
6. RCS temperature instrmnt/chnl
7. NIS instrmnt/chnl (PR, IR, SR)
8. SG tube leakage < T.S. limits; pin-hole leak detected via sampling of the SGs. For this template, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

Plausible Precursors
1. SG pressure instrmnt/chnl
2. SG level instrmnt/chnl
3. Steam flow instrmnt/chnl
4. Feed flow instrmnt/chnl

Non-Precursors
5. PZR level instrmnt/chnl

COMPONENT FAILURE MENU

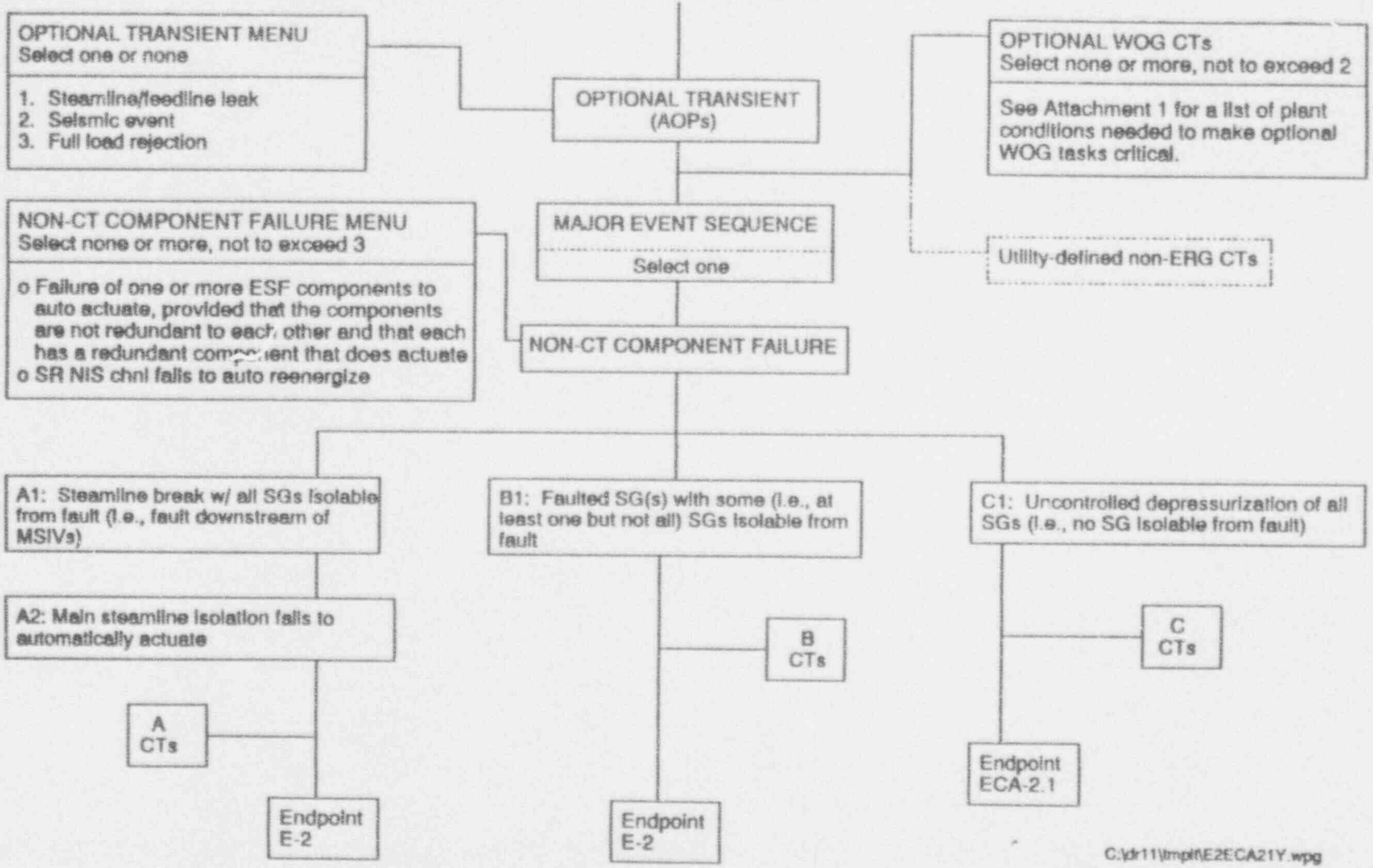
Plausible Precursors
1. SG PORV leaks or fails open
2. Feedwater heater tube leak

Non-Precursors
3. Movable control assembly
4. Letdown leak
5. Loss of ac emergency bus

Continued on Next Page

TEMPLATE E2ECA21: Faulted SG(s) (PAGE 2) MAJOR EVENT SEQUENCES

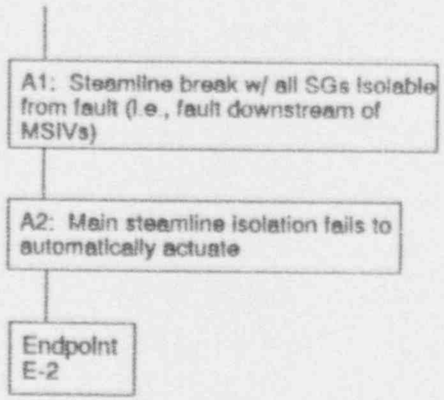
Continued from page 1



SEQUENCING REQUIREMENTS
NA

PREREQUISITES
None

Continued from Optional Transient



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CRITICAL TASKS
The following WOG CTs are critical for this event sequence: E-0--P

OPTIONAL CRITICAL TASKS
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/failures as appropriate (Refer to Attachemnt 1): E-0--A, --C, --D, --F

Options: None

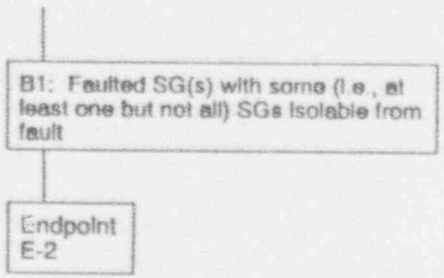
Procedure Transitions:

E-0 → E-2 → E-1 → ES-1.1

SEQUENCING REQUIREMENTS
NA

PREREQUISITES
None

Continued from Optional Transient



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CRITICAL TASKS
The following WOG CT is critical for this event sequence: E-2--A

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --F, --K, --L

Options:

o The fault can be either a steamline or a feedline break.

-- For a steamline break, the break location can be inside or outside of containment, upstream or downstream of the MSIVs.

-- For a feedline break, the break location must be inside containment and on the SG-side of the feedline check valve.

o At the scenario writer's discretion, additional plant conditions can be specified such that the critical task (WOG CT E-2--A) includes one or both of the following:

-- Manual closing of MSIVs (e.g., main steamline isolation fails to automatically actuate; at least one SG can be isolated from the fault by manual action taken in the control room)

-- Manual isolation/termination of main feedwater flow to the faulted SG(s)

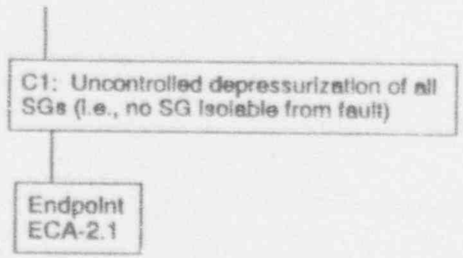
Procedure Transitions:

E-0 → E-2 → E-1 → ES-1.1

SEQUENCING REQUIREMENTS
NA

PREREQUISITES
None

Continued from Optional Transient



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CRITICAL TASKS
The following WOG CT is critical for this event sequence: ECA-2.1--A

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L

Options:

- The fault can be either a steamline or a feedline break.
  - -- For a steamline break, the break location can be inside or outside of containment, upstream or downstream of the MSIVs.
  - -- For a feedline break, the break location must be inside containment and on the SG-side of the feedline check valve.
- At the scenario writer's discretion, additional plant conditions can be specified such that the critical task (WOG CT ECA-2.1--A) includes manual isolation/termination of main feedwater flow to the faulted SGs, which in this case is all SGs

Procedure Transitions:

E-0 → E-2 → ECA-2.1

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG CTs critical within the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

- o Reactor fails to trip automatically but is manually trippable (Refer to WOG CT E-0--A.)
- o No ac emergency bus energized but at least one EDG can be connected to an ac emergency bus (Refer to WOG CT E-0--C.)
- o SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D.)
- o Containment cooling is required but the minimum required complement of containment cooling equipment is not entirely automatically actuated; the minimum required complement of containment cooling equipment can be manually actuated (Refer to WOG CT E-0--E.)
- o Secondary heat sink required but AFW flow is insufficient; the minimum required AFW flow rate can be established, provided that manual action is taken as necessary (Refer to WOG CT E-0--F.)
- o Minimum required number of CCW pumps is not running; at least the minimum required number of CCW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--K.)
- o Minimum required number of ESW pumps is not running; at least the minimum required number of ESW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--L.)

E3ECA33

TEMPLATE E3ECA33: SGTR (PAGE 1) CONDITIONS AND FAILURES

INITIAL CONDITIONS

- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors
1. Offsite ac circuit
2. SG tube leakage < T.S. limits; pin-hole leak detected via sampling; at time of shift turnover, combined effect of RCS activity concentration and primary-to-secondary leakage rate insufficient to cause secondary plant rad-alarms.
3. PZR PORV

Non-Precursors
4. PZR level instrmnt/chnl
5. NIS instrmnt/chnl (PR, IR, SR)
6. ESW pump
7. AFW pump
8. CCP

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

Plausible Presursors
1. SG pressure instrmnt/chnl
2. Steam flow instrmnt/chnl
3. Feed flow instrmnt/chnl
4. SG PORV pressure instrmnt controller fails; causing PORV to open; then SG PORV mechanically sticks open

Non-Precursors
5. RCS temperature instrmnt/chnl

COMPONENT FAILURE MENU

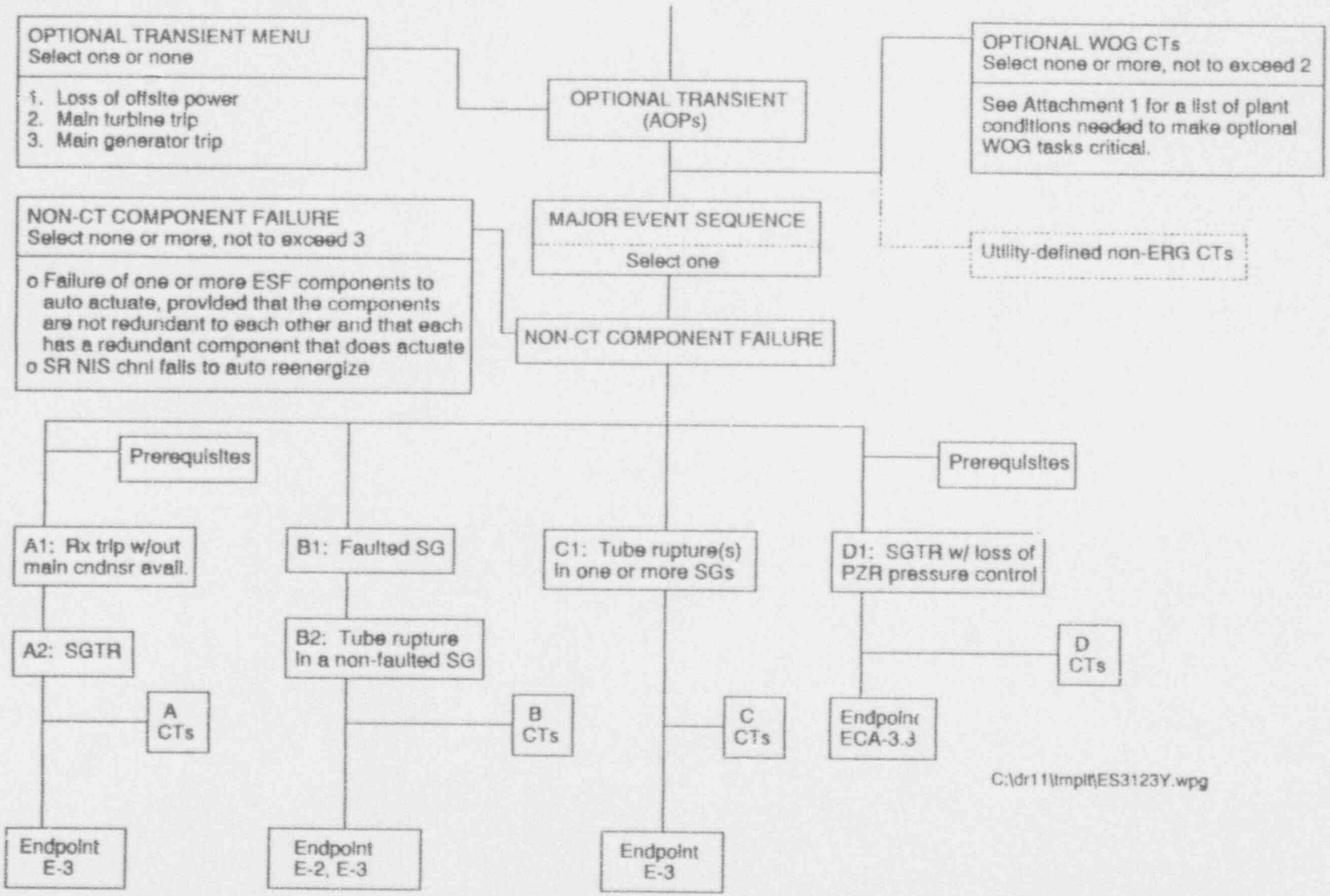
Plausible Precursors
1. Isolable steam/feed leak
2. Unisolable steam/feed leak on SG that will remain unruptured
3. SG tube leak that is within the capacity of the available charging pumps

Non-Precursors
4. Loss of a circulating water pump
5. Turbine intercept valve trip

Continued on Next Page

TEMPLATE E3ECA33: SGTR (PAGE 2) MAJOR EVENT SEQUENCES

Continued from page 1



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SEQUENCING REQUIREMENTS

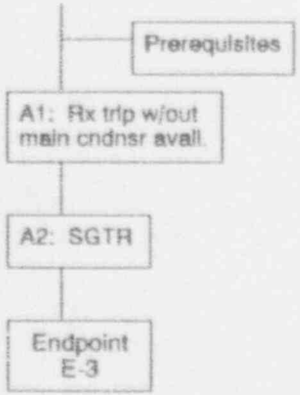
Events must be sequenced in the order specified. For this event sequence, it is intended that the main condenser be isolated from the SGs when the SGTR occurs.

PREREQUISITES

The main condenser must be isolated from the SGs when the SGTR occurs. This can be accomplished by inserting the appropriate malfunctions/failures, such as the following:

- o Loss of condenser vacuum
- o Loss of offsite power

Continued from Optional Transient



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CRITICAL TASKS

The following WOG CTs are critical for this event sequence:

E-3--A E-3--B E-3--C E-3--D

OPTIONAL CRITICAL TASKS:

The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1):

E-0--A E-0--C E-0--D E-0--F E-0--I
E-0--J E-0--K E-0--L E-0--M
ES-3.1--A

MAJOR EVENT SEQUENCE A
Continued on Next Page

Options:

- At the scenario writer's discretion, any anticipated transient requiring reactor trip can be used as the cause of the reactor trip in this event sequence, except for the following, which are proscribed: an unisolable LOCA and a SGTR. The reactor trip may be related to the loss of the main condenser. For example, loss of condenser vacuum could lead to turbine and reactor trip, or loss of offsite power could cause reactor trip and loss of the condenser. However, the reactor trip may be due to some malfunction/failure entirely unrelated to the loss of condenser availability. In such a case, additional malfunction(s)/failure(s) would have to be inserted in order to render the condenser unavailable.

- Tube leakage into the affected SG can be reported (based on sample results), either as part of the initial conditions or as part of the scenario sequence. However, for this event sequence, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

Procedure Transitions:

E-0 → ES-0.1 → E-0 → E-3

SEQUENCING REQUIREMENTS
Events need not be sequenced in the order shown.

PREREQUISITES
None

CRITICAL TASKS
The following WOG CTs are critical for this event sequence:
E-2--A E-3--A E-3--B E-3--C E-3--D

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1):
E-0--A E-0--C E-0--D E-0--E E-0--F
E-0--I E-0--J E-0--K E-0--L E-0--M
ES-3.1--A

Procedure Transitions:

E-0 → E-2 → E-1 → E-3

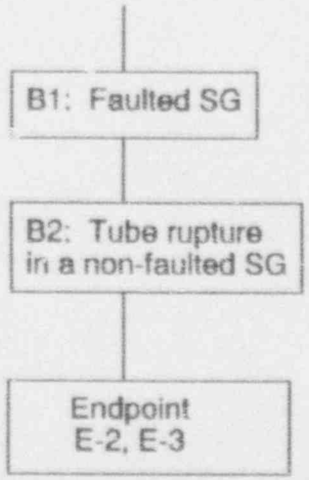
OR

E-0 → E-3 → E-2 → E-3

Options:

- o The SG fault can be on a steamline or a feedline.
- o More than one but not all SGs can be faulted.
- o The SG fault can be inserted after the SGTR (provided that it is not inserted in the included ruptured SG).

Continued from Optional Transient



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SEQUENCING REQUIREMENTS

None

PREREQUISITES

None

CRITICAL TASKS

The following WOG CTs are critical for this event sequence:

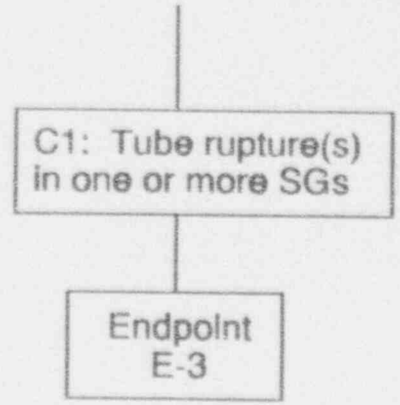
E-3--A E-3--B E-3--C E-3--D

OPTIONAL CRITICAL TASKS:

The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1):

E-0--A E-0--C E-0--D E-0--F E-0--I
E-0--J E-0--K E-0--L E-0--M
ES-3.1--A

Continued from Optional Transient



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Options: None

Procedure Transitions:

E-0 → E-3

SEQUENCING REQUIREMENTS

None

CRITICAL TASKS

The following WOG CTs are critical for this event sequence:

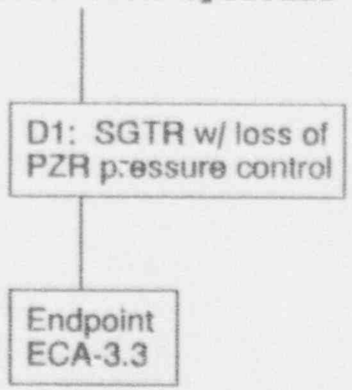
E-3--A E-3--B ECA-3.3--A

OPTIONAL CRITICAL TASKS:

The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1):

E-0--A E-0--C E-0--D E-0--I E-0--J
E-0--K E-0--L E-0--M

Continued from Optional Transient



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PREREQUISITES

- o Normal PZR spray must be unavailable when the crew reaches step 17 of E-3
  - -- This can be accomplished by making unavailable the RCPs that provide normal spray
  - -- Which, in turn, can be accomplished by loss of offsite power
- o Both PZR PORVs must be unavailable when the crew reaches step 18 of E-3
- o Auxiliary spray must be unavailable when the crew reaches step 18 of E-3

Options: None

Procedure Transitions:
E-0 → E-3 → ECA-3.3

If event sequence D is selected, then the scenario writer must bear in mind that the crew might have to transition to ECA-3.1, if the following conditions so warrant:

- o Insufficient RCS subcooling
- o Inadequate secondary heat sink
- o Insufficient RCS inventory (RVLIS)

From ECA-3.1, the crew might have to transition to ECA-3.2. However, the <u>intended</u> procedure flow path for this event sequence is that the crew remain in ECA-3.3.

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG CTs critical within the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

- o Reactor fails to trip automatically but is manually trippable (Refer to WOG CT E-0--A.)
- o No ac emergency bus energized but at least one EDG can be connected to an ac emergency bus (Refer to WOG CT E-0--C.)
- o SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D.)
- o Containment cooling is required but the minimum required complement of containment cooling equipment is not entirely automatically actuated; the minimum required complement of containment cooling equipment can be manually actuated (Refer to WOG CT E-0--E.)
- o Secondary heat sink required but AFW flow is insufficient; the minimum required AFW flow rate can be established, provided that manual action is taken as necessary (Refer to WOG CT E-0--F.)
- o Small-break LOCA with RCS pressure below high-head ECCS pump shutoff head; both high-head ECCS pumps fail to start automatically; at least one high-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--I.)
- o Small-break LOCA with RCS pressure below intermediate-head ECCS pump shutoff head; both intermediate-head ECCS pumps fail to start automatically; at least one intermediate-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--J.)
- o Minimum required number of CCW pumps is not running; at least the minimum required number of CCW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--K.)
- o Minimum required number of ESW pumps is not running; at least the minimum required number of ESW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--L.)
- o Any combination of failures or events that results in a PZR PORV being stuck open; RCS pressure below the setpoint at which the PZR PORV should reclose automatically; the block MOV upstream of the stuck-open PZR PORV can be manually closed (Refer to WOG CT E-0--M.)
- o SGTR after cooldown with all feedwater stopped to the ruptured SG and with narrow range level greater than minimum required but less than feed required (Refer to WOG CT ES-3.1--A)

ECA3132

INITIAL CONDITIONS

- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors

1. SG tube leakage < T.S. limits; pin-hole leak detected via sampling; at time of shift turnover, combined effect of RCS activity concentration and primary-to-secondary leakage rate insufficient to cause secondary plant rad-alarms.

Non-Precursors

2. PZR PORV
3. PZR level instrmnt/chnl
4. NIS instrmnt/chnl (PR, IR, SR)
5. ESW pump
6. AFW pump
7. CCP
8. SG pressure instrmnt/chnl

INSTRUMENT FAILURE MENU

Plausible Precursors

1. SG level instrmnt/chnl
2. SG PORV pressure instrmnt/ controller fails; causing PORV to open; then SG PORV mechanically sticks open
3. PZR level instrmnt/chnl
4. RCS temperature instrmnt/chnl

Non-Precursors

5. PR NIS instrmnt/chnl

COMPONENT FAILURE MENU

Plausible Precursors

1. Unisolable steam/feed leak on SG to be ruptured
2. SG tube leak that is within the capacity of the available charging pumps
3. Primary leak that is within the capacity of the available charging pumps

Non-Precursors

4. Loss of a circulating water pump
5. Turbine intercept valve trip

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

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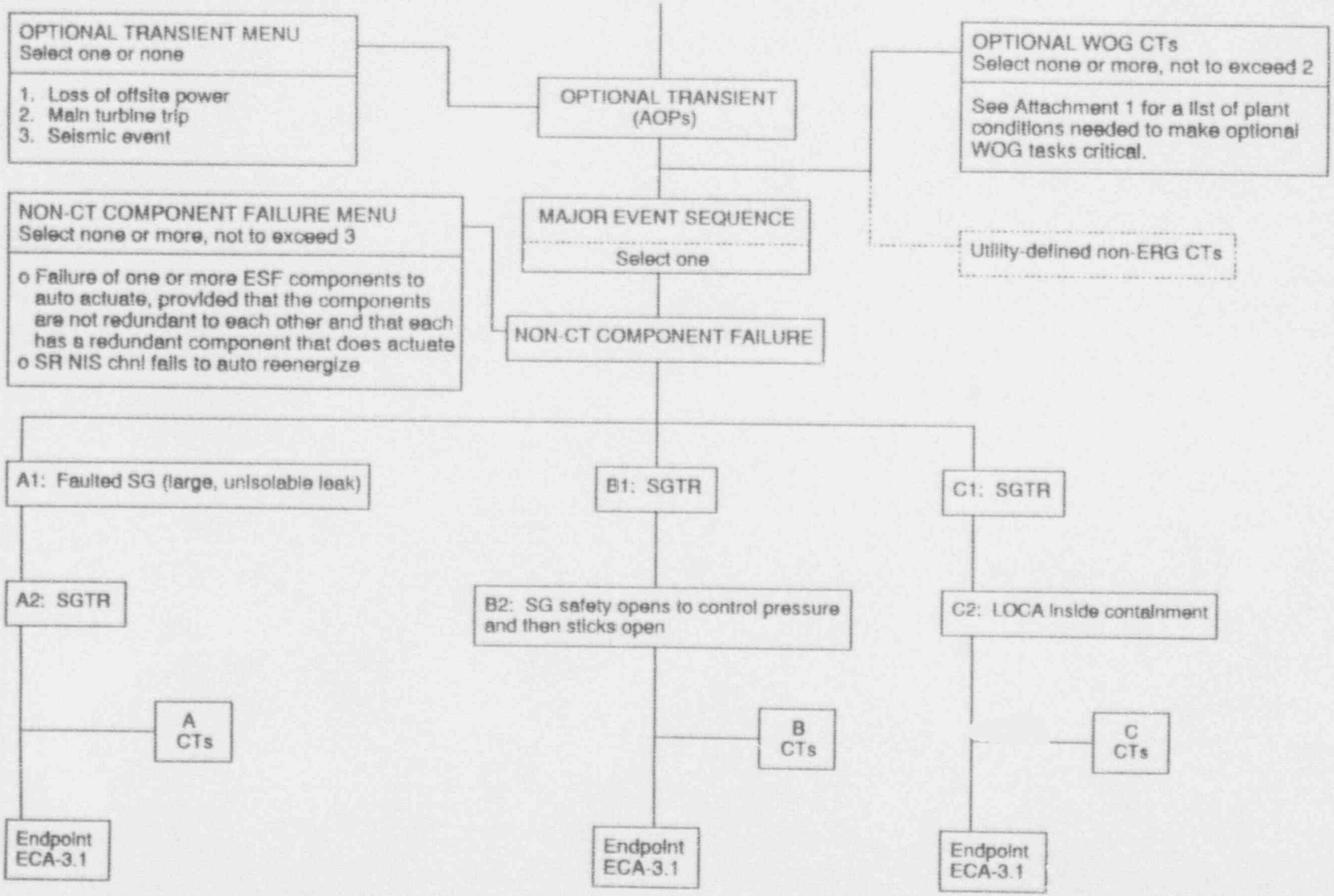
Continued from page 1



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SEQUENCING REQUIREMENTS

Events must be sequenced in the order specified. For this event sequence, it is intended that the SG be faulted before it is ruptured so that the rupture can be attributable to the primary-to-secondary differential pressure across the U-tubes.

PREREQUISITES

None

CRITICAL TASKS

The following WOG CTs are critical for this event sequence: (E-2--A, E-3--A)*

OPTIONAL CRITICAL TASKS:

The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1):

E-0--A	E-0--C	E-0--D	E-0--E	E-0--F
E-0--I	E-0--J	E-0--K	E-0--L	E-0--M

Provided that the secondary-system break (large and unisolable) is located outside of containment, ECA-3.1--B can also critical for this event sequence.

Option:

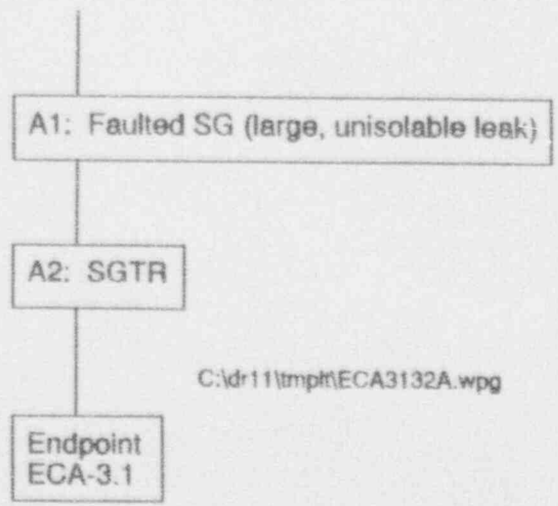
Tube leakage into the affected SG can be reported (based on sample results), either as part of the initial conditions or as part of the scenario sequence. However, for this event sequence, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

* Because E-2--A and E-3--A are nearly identical, only one of these CTs should be critical for this sequence.

Procedure Transitions:

E-0 → E-2 → E-3 → ECA-3.1/2
E-2 ↓ → E-1 → ↑ E-3

Continued from Optional Transient



SEQUENCING REQUIREMENTS

Events must be sequenced in the order specified. For this event sequence, it is intended that the secondary-side pressure transient be induced by the turbine trip that occurs as a result of the SGTR. It is also intended that a high-pressure transient on the SG secondary side cause the SG safety valve(s) to open.

PREREQUISITES

The condenser steam dumps must be made unavailable, so that a safety valve on the ruptured SG must act to control any high-pressure condition in the ruptured SG. The condenser steam dumps can be made unavailable by entering malfunctions/ failures that result in either of the following:

o Loss of offsite power
o Loss of condenser vacuum

CRITICAL TASKS

The following WOG CTs are critical for this event sequence: (E-3--A, E-2--A)* and ECA-3.1--B

OPTIONAL CRITICAL TASKS:

The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1):

E-0--A	E-0--C	E-0--D	E-0--F	
E-0--I	E-0--J	E-0--K	E-0--L	E-0--M

Options: The PORV on the ruptured SG can be made unavailable, to ensure that a safety valve on the ruptured SG will act to control any high-pressure condition in the ruptured SG. The PORV on the ruptured SG can be made unavailable in the following ways:

o Prior to the SGTR, a malfunction can be inserted to prevent the SG PORV from opening (mechanically stuck shut).

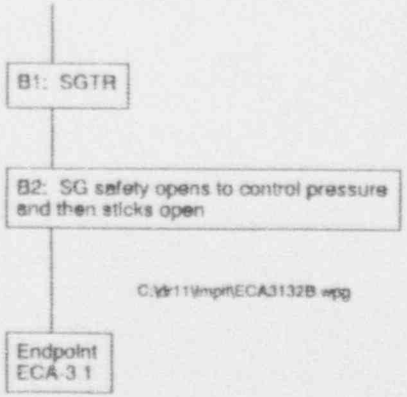
o Prior to the SGTR, the crew can be forced into manually isolating the SG PORV. This can be accomplished by inserting a malfunction or a transient that causes the SG PORV to open, and then mechanically sticking the SG PORV open.

* Because E-2--A and E-3--A are nearly identical, only one of these CTs should be critical for this sequence.

Procedure Transitions:

E-0 → E-2 → E-3 → ECA-3.1/2

Continued from Optional Transient

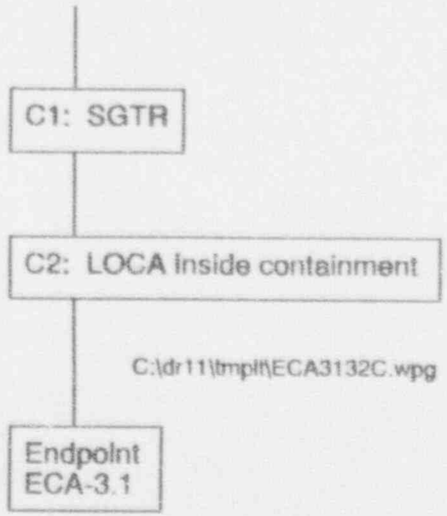


SEQUENCING REQUIREMENTS
None

CRITICAL TASKS
The following WOG CTs are critical for this event sequence: E-3--A

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A E-0--C E-0--D E-0--E E-0--F E-0--I E-0--J E-0--K E-0--L E-3--B (Depending on transition from E-3)

Continued from Optional Transient



PREREQUISITES
None

Option:

1. The LOCA inside containment can be caused by the PZR PORV failing open during RCS depressurization.

   If this option is exercised, then the following prerequisites must be met:

   - o Normal PZR spray must be unavailable when the crew reaches step 17 of E-3
     - -- This can be accomplished by making unavailable the RCPs that provide normal spray
     - -- Which in turn, can be accomplished by loss of offsite power
   - o At least one PZR PORV must be available, with its associated block MOV open
   - o Whichever PZR PORV the crew elects to use for RCS depressurization, the following must apply
     - -- The PZR PORV will not re-close after the crew opens it to depressurize the RCS
     - -- The associated block MOV will not close either

2. Any SBLOCA

Procedure Transitions: E-0 → E-3 → ECA-3.1/2

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG CTs critical in the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

- o Reactor fails to trip automatically but is manually trippable (Refer to WOG CT E-0--A.)
- o No ac emergency bus energized but at least one EDG can be connected to an ac emergency bus (Refer to WOG CT E-0--C.)
- o SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D.)
- o Containment cooling is required but the minimum required complement of containment cooling equipment is not entirely automatically actuated; the minimum required complement of containment cooling equipment can be manually actuated (Refer to WOG CT E-0--E.)
- o Secondary heat sink required but AFW flow is insufficient; the minimum required AFW flow rate can be established, provided that manual action is taken as necessary (Refer to WOG CT E-0--F.)
- o Small-break LOCA with RCS pressure below intermediate-head ECCS pump shutoff head; both intermediate-head ECCS pumps fail to start automatically; at least one intermediate-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--J.)
- o Minimum required number of CCW pumps is not running; at least the minimum required number of CCW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--K.)
- o Minimum required number of ESW pumps is not running; at least the minimum required number of ESW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--L.)
- o Any combination of failures or events that results in a PZR PORV being stuck open; RCS pressure below the setpoint at which the PZR PORV should reclose automatically; the block MOV upstream of the stuck-open PZR PORV can be manually closed (Refer to WOG CT E-0--M.)
- o SGTR with Ruptured SG identified and isolated and its pressure greater than pressure that would force transition from E-3 (Refer to WOG CT E-3--B)
- o RCS cooldown required for any of the following: LOCA with loss of ECR, SGTR in a faulted SG, SGTR in SG that cannot be isolated from intact SGs (Refer to WOG CT ECA-3.1--B)

ECA00

TEMPLATE ECA00: Loss of All AC Power (PAGE 1) CONDITIONS AND FAILURES

INITIAL CONDITIONS

- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors
1. Offsite ac circuit
2. Emerg diesel generator
3. Onsite ac distribution bus

Non-Precursors

4. PZR pressure instrmnt/chnl
5. SG level instrmnt/chnl
6. CCP
7. MD AFW pump
8. SG tube leakage < T.S. limits; pin-hole leak detected via sampling of the SGs. For this template, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

Plausible Precursors None

Non-Precursors
1. SG pressure instrmnt/chnl
2. SG level instrmnt/chnl
3. Steam flow instrmnt/chnl
4. Feed flow instrmnt/chnl
5. PZR level instrmnt/chnl

COMPONENT FAILURE MENU

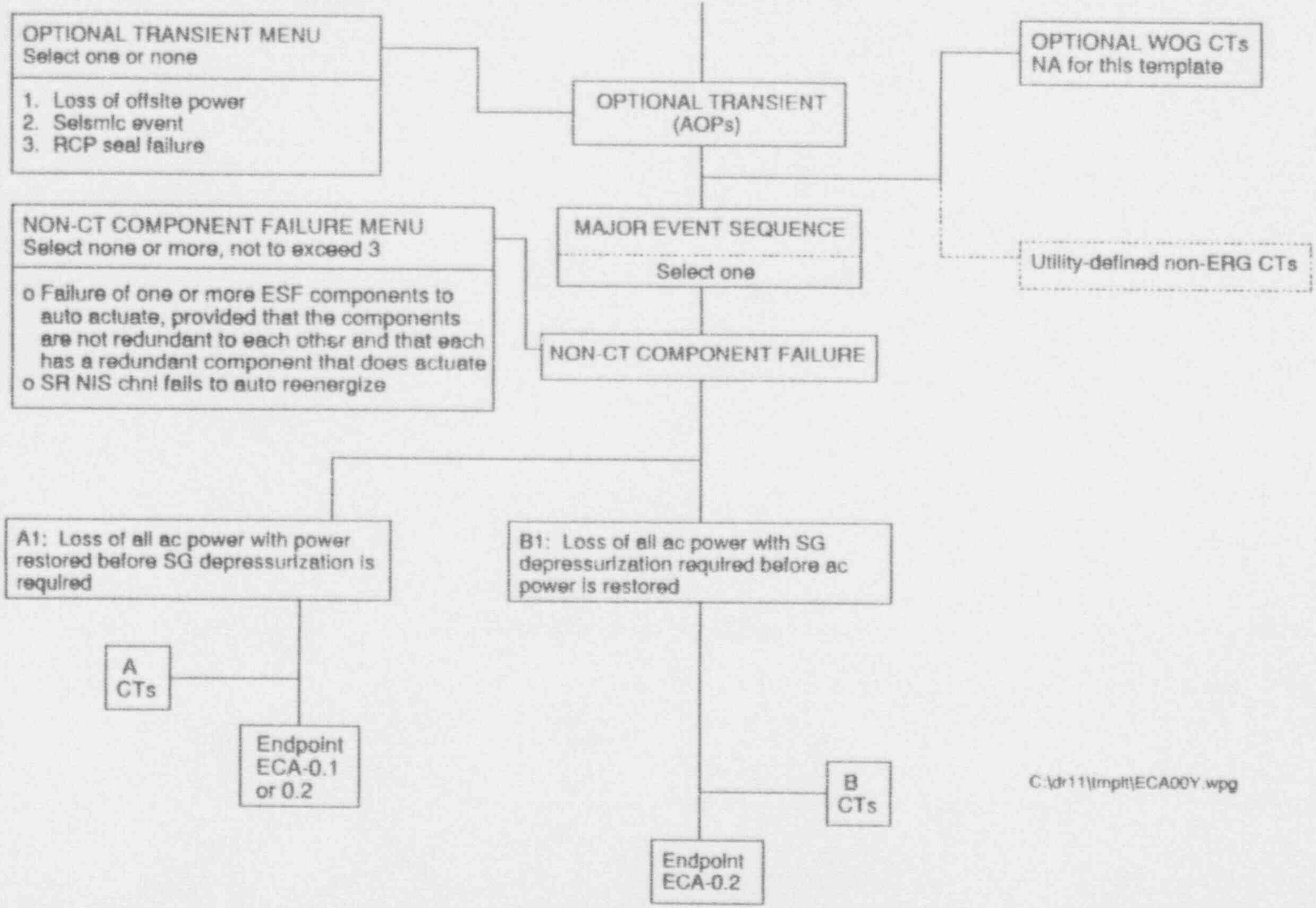
Plausible Precursors
1. Loss of offsite circuit
2. Loss of ac emergency bus

Non-Precursors

3. Movable control assembly
4. Letdown leak
5. Loss of main feed pump

Continued on Next Page

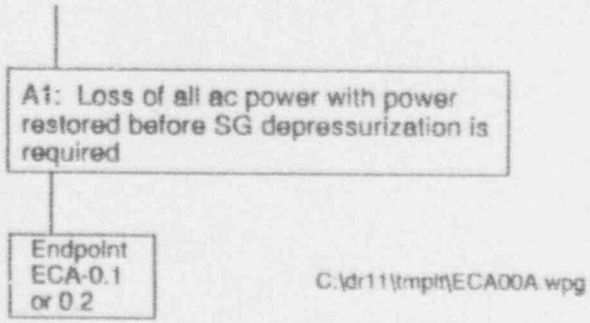
Continued from page 1



SEQUENCING REQUIREMENTS
NA

PREREQUISITES
The crew must be given the opportunity to restore power to at least one ac emergency bus before step 16 of ECA-0.0 is reached. Otherwise, WOG CT ECA-0.0--G will become critical and raise the complexity of scenarios derived from this Major Event Sequence (A) to an inappropriate level.

Continued from Optional Transient



CRITICAL TASKS
The following WOG CT is critical for this event sequence: ECA-0.0--H

OPTIONAL CRITICAL TASKS
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/failures as appropriate (refer to Attachment 1): ECA-0.0--A, ECA-0.0--B, ECA-0.0--F

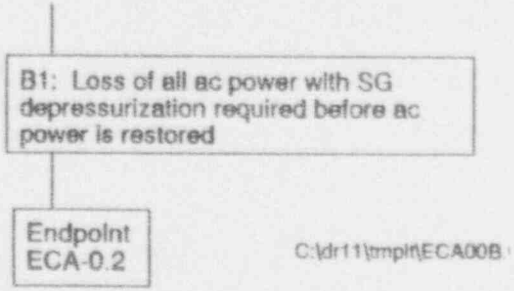
Options: None

Procedure Transitions:

ECA-0.0 → ECA-0.1
↓
→ ECA-0.2

SEQUENCING REQUIREMENTS
NA

Continued from Optional Transient



CRITICAL TASKS
The following WOG CTs are critical for this event sequence: ECA-0.0--G and ECA-0.0--H

OPTIONAL CRITICAL TASKS
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/failures as appropriate (refer to Attachment 1): ECA-0.0--A, ECA-0.0--B, ECA-0.0--F

PREREQUISITES
o All attempts to restore ac power fail such that, by the time the crew reaches step 16 of ECA-0.0, no ac emergency bus is energized (i.e., secondary depressurization is required) o At least one SG is intact with operable SG PORV o Turbine-driven AFW is available for the intact SG(s)

Options: None

Procedure Transitions:

ECA-0.0 → ECA-0.2

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

- PZR PORV fails open but can be closed, provided that manual action is taken as necessary (Refer to WOG CT ECA-0.0--A.)

- Insufficient AFW flow; the minimum required AFW flow rate can be established, provided that manual action is taken as necessary (Refer to WOG CT ECA-0.0--B.)

- Restoration of power to a single ac emergency bus from a single operable EDG with failure of the ESW pump associated with the operating EDG to auto start; the ESW pump can be started, provided that manual action is taken as necessary (Refer to WOG CT ECA-0.0--F.)

FRS1

TEMPLATE FRS1: ATWT (PAGE 1) CONDITIONS AND FAILURES

INITIAL CONDITIONS

- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

<u>Plausible Precursors</u>

1. MD/TD AFW pump
2. Movable control assembly

<u>Non-Precursors</u>

3. PZR pressure instrmnt/chnl
4. CCP/ SIP/ RHR pump
5. Steam/feed flow instrmnt/chnl
6. CCW/ESW pump
7. EDG/ offsite ac circuit/ onsite ac distribution bus
8. SG tube leakage < T.S. limits; pin-hole leak detected via sampling of the SGs. For this template, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

<u>Plausible Precursors</u>

1. Rod position instrmnt/chnl

<u>Non-Precursors</u>

2. PZR press/level instrmnt/chnl
3. RCS flow/temp instrmnt/chnl
4. SG press/level instrmnt/chnl
5. Steam/feed flow instrmnt/chnl

COMPONENT FAILURE MENU

<u>Plausible Precursors</u>

1. SSPS failure
2. Rod motion failure

<u>Non-Precursors</u>

3. RCP seal failure
4. RCP thermal barrier HX leak

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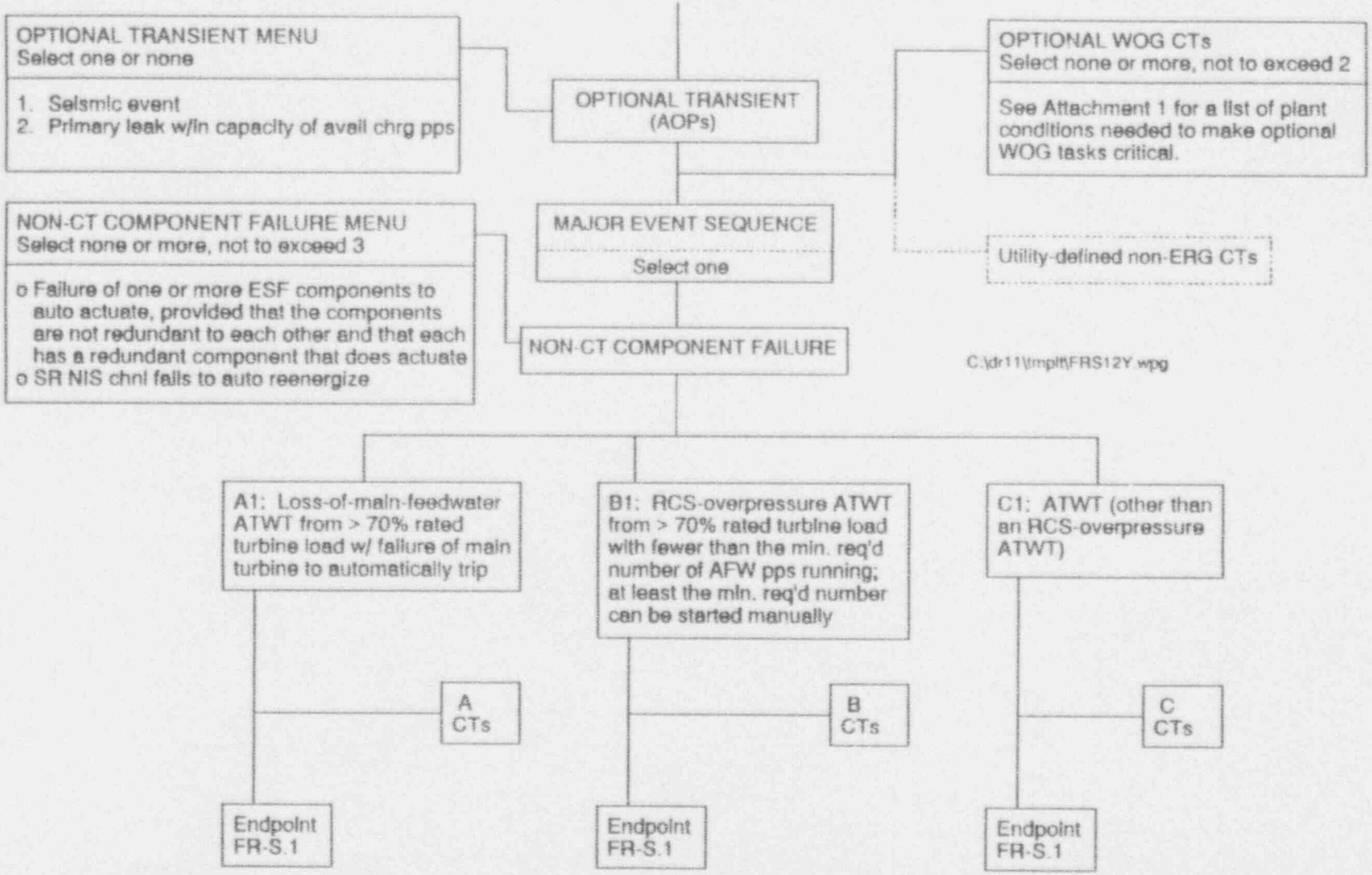
TEMPLATE FRS1: ATWT (PAGE 2) MAJOR EVENT SEQUENCES

Continued from page 1



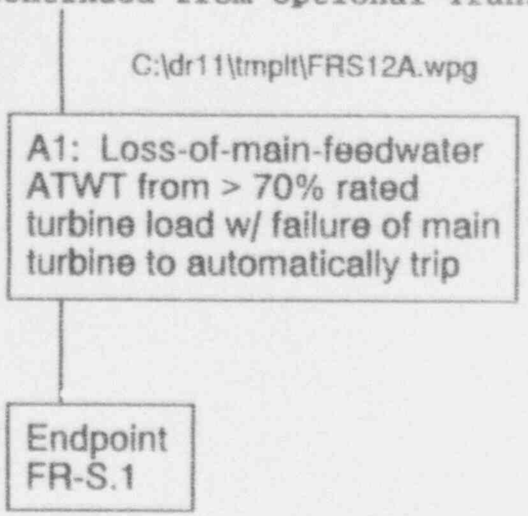
SEQUENCING REQUIREMENTS

NA

PREREQUISITES

The loss of main feedwater must occur at greater than 70% of rated turbine load, in order for WOG CT FR-S.1--A to be critical.

Continued from Optional Transient



Options: None

Procedure Transitions:

E-0 → FR-S.1

CRITICAL TASKS

The following WOG CTs are critical for this event sequence: FR-S.1--A and --C

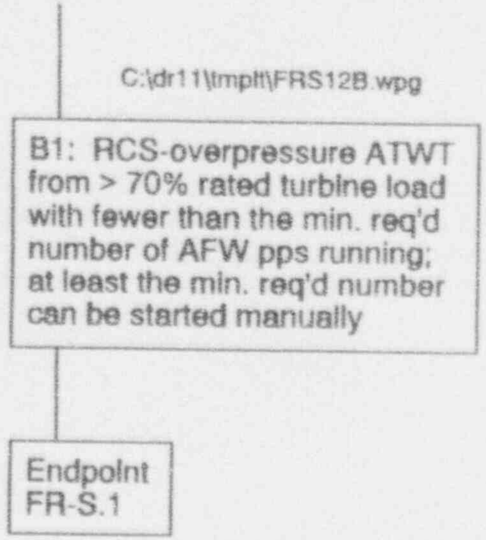
OPTIONAL CRITICAL TASKS

None

SEQUENCING REQUIREMENTS
NA

PREREQUISITES
The RCS-overpressure ATWT must occur at greater than 70% of rated turbine load, in order for WOG CT FR-S.1--B to be critical.

Continued from Optional Transient



Options: None

Procedure Transitions:

E-0 → FR-S.1

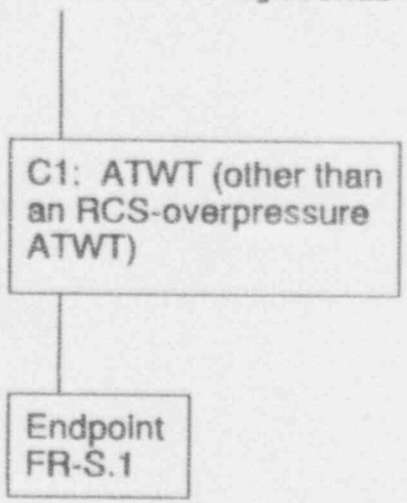
CRITICAL TASKS
The following WOG CTs are critical for this event sequence: FR-S.1--B and --C

OPTIONAL CRITICAL TASKS:
None

SEQUENCING REQUIREMENTS
NA

PREREQUISITES
None

Continued from Optional Transient



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Options: None

Procedure Transitions:

E-0 → FR-S.1

CRITICAL TASKS
The following WOG CT is critical for this event sequence: FR-S.1--C

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--C, --D, --E, --F, --H, --I, --J, --K, --L, --O, --R

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG CTs critical within the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

- o No ac emergency bus energized but at least one EDG can be connected to an ac emergency bus (Refer to WOG CT E-0--C.)
- o SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D.)
- o Containment cooling is required but the minimum required complement of containment cooling equipment is not entirely automatically actuated; the minimum required complement of containment cooling equipment can be manually actuated (Refer to WOG CT E-0--E.)
- o Secondary heat sink required but AFW flow is insufficient; the minimum required AFW flow rate can be established, provided that manual action is taken as necessary (Refer to WOG CT E-0--F.)
- o Large-break LOCA with RCS pressure below low-head ECCS pump shutoff head; both low-head ECCS pumps fail to start automatically; at least one low-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--H.)
- o Small-break LOCA with RCS pressure below high-head ECCS pump shutoff head; both high-head ECCS pumps fail to start automatically; at least one high-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--I.)
- o Small-break LOCA with RCS pressure below intermediate-head ECCS pump shutoff head; both intermediate-head ECCS pumps fail to start automatically; at least one intermediate-head ECCS pump can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--J.)
- o Minimum required number of CCW pumps is not running; at least the minimum required number of CCW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--K.)
- o Minimum required number of ESW pumps is not running; at least the minimum required number of ESW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--L.)
- o LOCA with phase-A containment isolation failure; the plant conditions required in order for the task of closing containment isolation valves to be critical are so detailed and specific that it is best to refer directly to the associated CT worksheet (Refer to WOG CT E-0--O.)

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

o LOCA with containment mini-purge in operation at accident initiation; purge isolation fails such that containment atmosphere remains <u>unisolated</u> via mini-purge penetrations; mini-purge can be isolated, provided that manual action is taken as necessary (Refer to WOG CT E-0--R.)

FRC12

TEMPLATE FRC12: Inadequate/Degraded Core Cooling (PAGE 1) CONDITIONS AND FAILURES

INITIAL CONDITIONS
- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors
1. CCP/ SIP/ positive displacement charging pump
2. Offsite circuit
3. MD/TD AFW pump

Non-Precursors
4. Movable control assembly
5. RHR pump
6. Steam/feed flow instrmnt/chnl
7. EDG/ onsite ac distribution bus
8. SG tube leakage < T.S. limits; pin-hole leak detected via sampling of the SGs. For this template, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

Plausible Precursors None

Non-Precursors
1. Rod position instrmnt/chnl
2. PZR press/level instrmnt/chnl
3. RCS flow/temp instrmnt/chnl
4. SG press/level instrmnt/chnl
5. Steam/feed flow instrmnt/chnl

COMPONENT FAILURE MENU

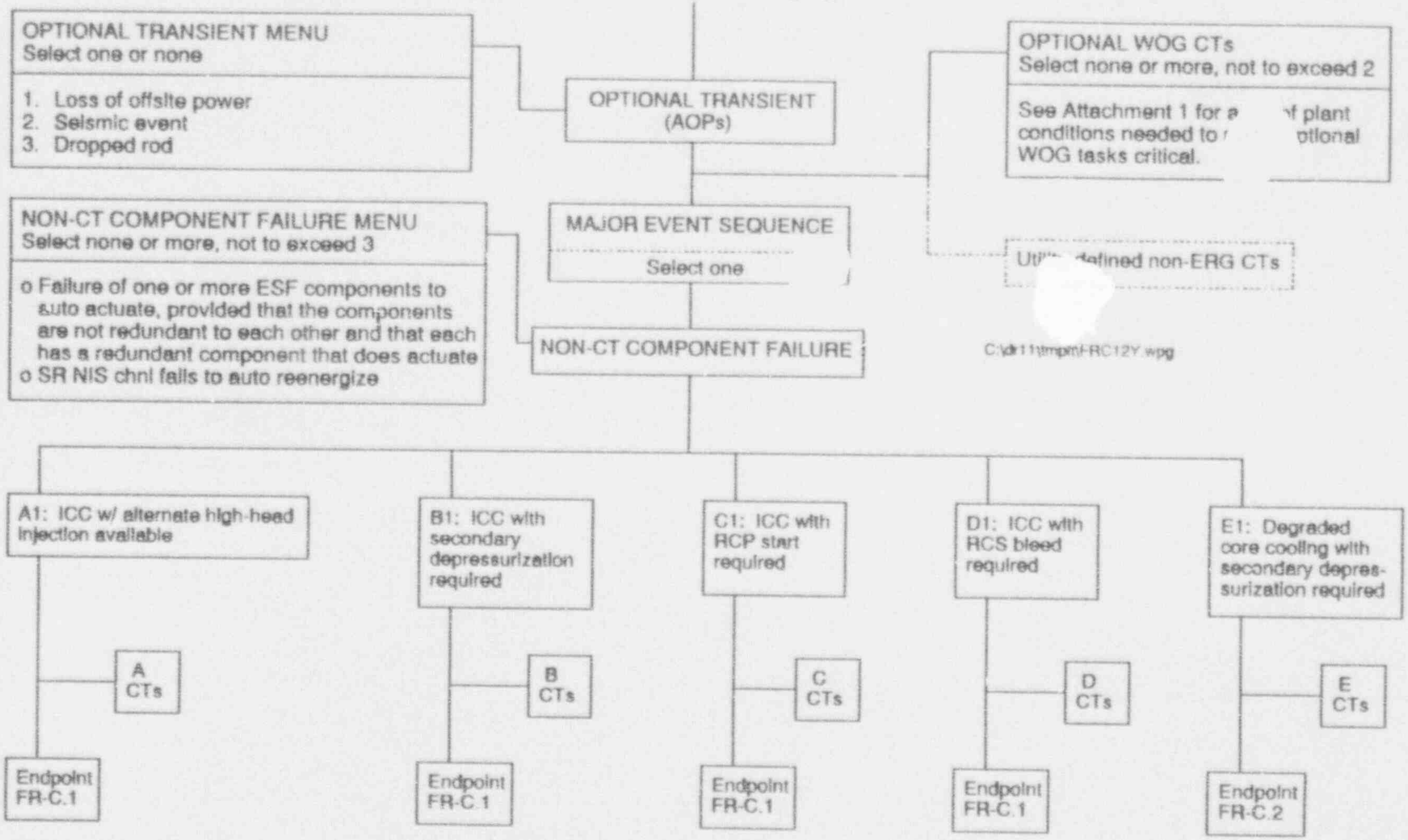
Plausible Precursors
1. Loss of condensate pump
2. Loss of main feed pump
3. Loss of offsite circuit

Non-Precursors
4. RCP seal failure
5. RCP thermal barrier HX leak

Continued on Next Page

TEMPLATE FRC12: Inadequate/Degraded Core Cooling (PAGE 2) MAJOR EVENT SEQUENCES

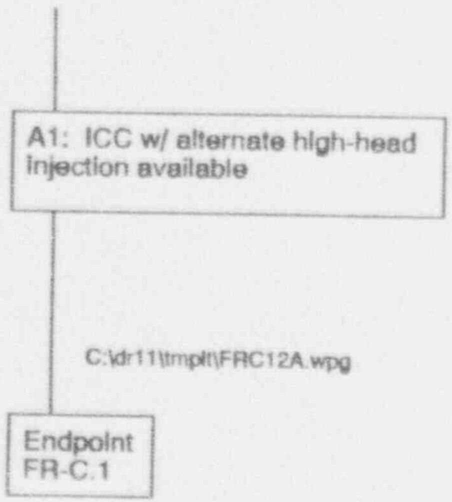
Continued from page 1



SEQUENCING REQUIREMENTS
NA

PREREQUISITES
The scenario writer must specify plant conditions that lead to and result in ICC.

Continued from Optional Transient



OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --F, --K, --L, --M, --O, --R E-0--I can be provided that a CCP is subsequently restored to operable status E-0--J can be provided that an SIP is subsequently restored to operable status Regarding WOG CTs E-0--I and --J, the performance standard related to transition out of E-0 should not be applied in this case.

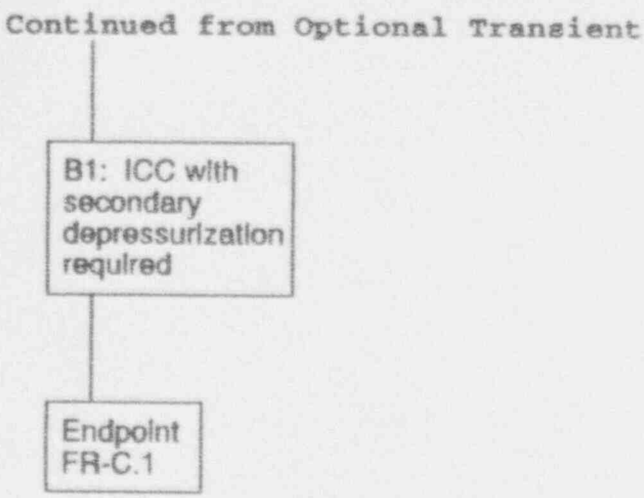
CRITICAL TASKS
The following WOG CT is critical for this event sequence: FR-C.1--A

Options: None

Procedure Transitions:

E-0 → core cooling CSF status tree → FR-C.1
↓ ↑
→ → FR-C.2

SEQUENCING REQUIREMENTS
NA



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PREREQUISITES

- o The scenario writer must specify plant conditions that lead to and result in ICC.
- o Withhold heat sink from the crew until transition to FR-C.1 occurs, ensuring that SG depressurization in FR-C.2 (Sequence E) does not interfere with this sequence.
- o If crew depressurizes SG in FR-C.2 (Sequence E), it will invalidate the critical nature of FR-C.1--B.
- o RCS pressure must be greater than the pressure at which the ECCS accumulators begin to inject.
- o No form of high-head injection (ECCS or alternate) is available.

CRITICAL TASKS
The following WOG CT is critical for this event sequence: FR-C.1--B

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --F, --K, --L, --M, --O, --R

Options:

Due to simulator modeling and/or scenario complexities, this sequence may be better evaluated by alternate methods (e.g. JPM).

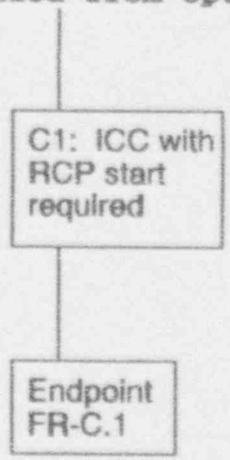
Procedure Transitions:

E-0 → core cooling CSF status tree → FR-C.1
↓ ↑
→ → FR-C.2

SEQUENCING REQUIREMENTS
NA

PREREQUISITES
o The scenario writer must specify plant conditions that lead to and result in ICC. o RCS pressure must be greater than the pressure at which the ECCS accumulators begin to inject. o No form of high-head injection (ECCS or alternate) is available. o Rapid depressurization of the SGs is not possible because of a loss of secondary heat sink.

Continued from Optional Transient



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CRITICAL TASKS
The following WOG CT is critical for this event sequence: FR-C.1--C

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L, --M, --O, --R

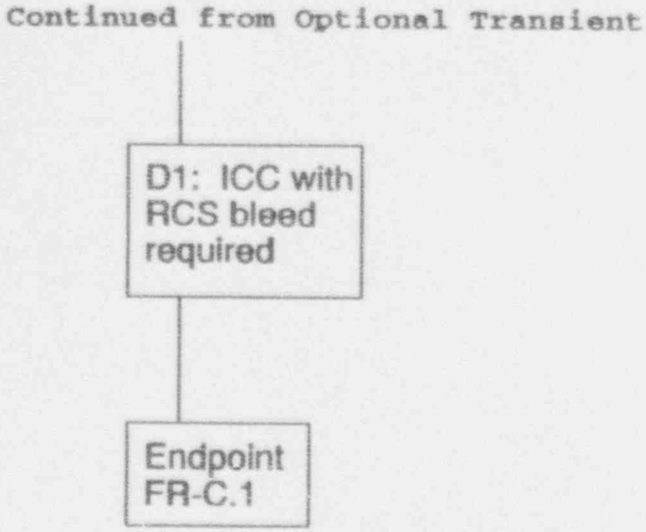
Options:

Due to simulator modeling and/or the scenario complexities, this sequence may be better evaluated by alternate methods (e.g. JPM).

Procedure Transitions:

E-0 → CSF status tree → FR-C.1

SEQUENCING REQUIREMENTS
NA



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CRITICAL TASKS
The following WOG CT is critical for this event sequence: FR-C.1--D

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L, --M, --O, --R, FR-S.1--A, FR-S.1--C

PREREQUISITES
o The scenario writer must specify plant conditions that lead to and result in ICC. o RCS pressure must be greater than the pressure at which the ECCS accumulators begin to inject. o No form of high-head injection (ECCS or alternate) is available. o Rapid depressurization of the SGs is not possible because of a loss of secondary heat sink. o No RCP is available.

Options:

1. Due to simulator modeling and/or scenario complexities, this sequence may be better evaluated by alternate methods (e.g. JPM).

2. Due to scenario time, the CT FR-C.1--D may be considered successful when the crew has an RCS depressurization in progress. This precludes achievement of the CT's actual performance standard of accumulator and low-head ECCS injection flow.

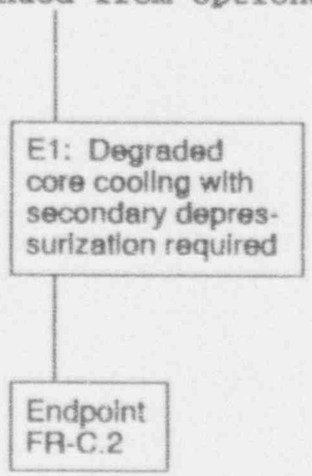
Procedure Transitions:

E-0 → CSF status tree → FR-C.1

TEMPLATE FRC12: Inadequate/Degraded Core Cooling (PAGE 7) **MAJOR EVENT SEQUENCE E**

SEQUENCING REQUIREMENTS
NA

Continued from Optional Transient



C:\dr11\tmplt\FRC12E.wpg

CRITICAL TASKS
The following WOG CT is critical for this event sequence: FR-C.2--A

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L, --M, --O, --R

PREREQUISITES

- o The scenario writer must specify plant conditions that lead to and result in a severe -- but not yet extreme -- challenge to the core cooling CSF.
- o RCS pressure must be greater than the pressure at which the ECCS accumulators begin to inject.
- o No form of high-head injection (ECCS or alternate) is available.
- o No RCP is available.
- o Sufficient time must be available for the crew to depressurize the SGs and provoke accumulator injection before core cooling becomes inadequate.
- o If the crew fails to perform the critical task (WOG CT FR-C.2--A), core cooling will become inadequate.

Options: None

Procedure Transitions:

E-0 → CSF status tree → FR-C.2

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG CTs critical within the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

- o Reactor fails to trip automatically but is manually trippable (Refer to WOG CT E-0--A.)
- o No ac emergency bus energized but at least one EDG can be connected to an ac emergency bus (Refer to WOG CT E-0--C.)
- o SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D.)
- o Containment cooling is required but the minimum required complement of containment cooling equipment is not entirely automatically actuated; the minimum required complement of containment cooling equipment can be manually actuated (Refer to WOG CT E-0--E.)
- o Secondary heat sink required but AFW flow is insufficient; the minimum required AFW flow rate can be established, provided that manual action is taken as necessary (Refer to WOG CT E-0--F.)
- o Minimum required number of CCW pumps is not running; at least the minimum required number of CCW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--K.)
- o Minimum required number of ESW pumps is not running; at least the minimum required number of ESW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--L.)
- o Any combination of failures or events that results in a PZR PORV being stuck open; RCS pressure below the setpoint at which the PZR PORV should reclose automatically; the block MOV upstream of the stuck-open PZR PORV can be manually closed (Refer to WOG CT E-0--M.)
- o LOCA with phase-A containment isolation failure; the plant conditions required in order for the task of closing containment isolation valves to be critical are so detailed and specific that it is best to refer directly to the associated CT worksheet (Refer to WOG CT E-0--O.)
- o LOCA with containment mini-purge in operation at accident initiation; purge isolation fails such that containment atmosphere remains <u>unisolated</u> via mini-purge penetrations; mini-purge can be isolated, provided that manual action is taken as necessary (Refer to WOG CT E-0--R.)
- o Reactor power greater than 70% with loss-of-main-feedwater ATWT and no turbine trip with failure of MSIV automatic closure (Refer to WOG CT FR-S.1--A)
- o ATWT (Refer to WOG CT FR-S.1--C)

FRH1

INITIAL CONDITIONS

- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors

1. CCP/ SIP/ positive displacement charging pump
2. Offsite circuit
3. MD/TD AFW pump
4. PZR PORV and/or associated block MOV

Non-Precursors

5. RHR pump
6. Steam/feed flow instrmnt/chnl
7. EDG/ onsite ac distribution bus
8. SG tube leakage < T.S. limits; pin-hole leak detected via sampling of the SGs. For this template, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

Plausible Precursors None

Non-Precursors

1. Rod position instrmnt/chnl
2. PZR press/level instrmnt/chnl
3. RCS flow/temp instrmnt/chnl
4. SG press/level instrmnt/chnl
5. Steam/feed flow instrmnt/chnl

COMPONENT FAILURE MENU

Plausible Precursors

1. Loss of condensate/ heater drain/ main feed pump
2. Loss of onsite ac emerg. bus
3. Loss of offsite circuit

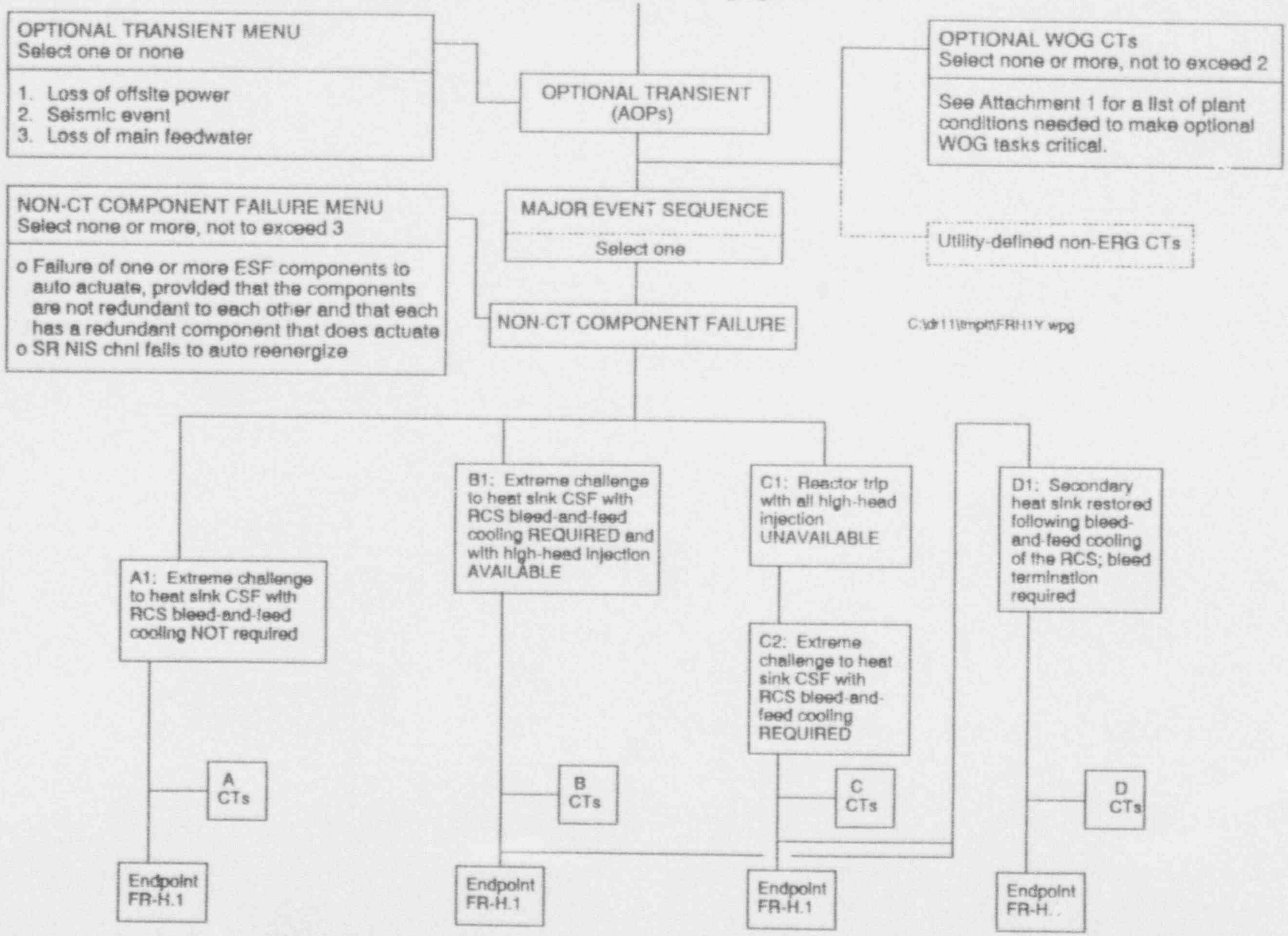
Non-Precursors

4. RCP seal failure
5. RCP thermal barrier HX leak

Continued on Next Page

TEMPLATE FRH1: Loss of Secondary Heat Sink (PAGE 2) MAJOR EVENT SEQUENCES

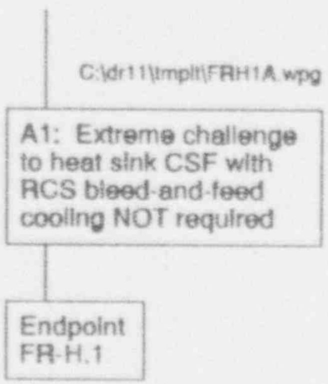
Continued from page 1



TEMPLATE FRH1: Loss of Secondary Heat Sink (PAGE 3) MAJOR EVENT SEQUENCE A

SEQUENCING REQUIREMENTS
NA

Continued from Optional Transient



PREREQUISITES
o Reactor trip o Extreme challenge to heat sink CSF o Secondary heat sink is required o AFW/feedwater flow is insufficient o Sufficient AFW/feedwater flow can be established provided manual actions are taken o Indication that RCS bleed-and-feed cooling is not required

CRITICAL TASKS
One of the following WOG CTs is critical for this event sequence: FR-H.1--A **or** E-0--F **or** FR-H.1--E Regarding WOG CT E-0--F, the performance standard related to transition out of E-0 should not be applied in this case.

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L, --O, --R

Options: None

Procedure Transitions:

E-0 → CSF status tree → FR-H.1

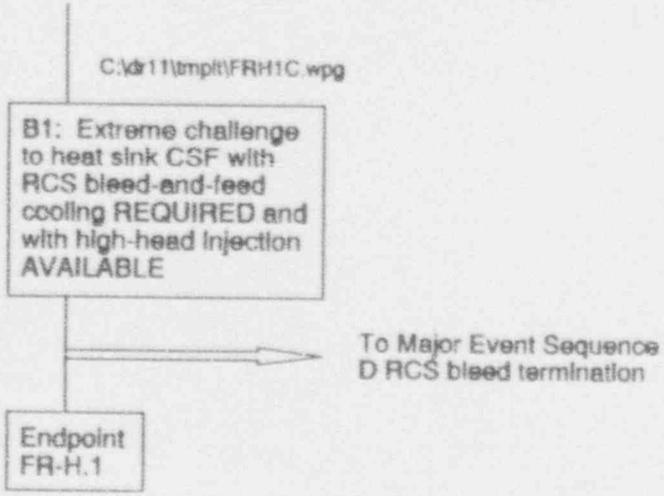
SEQUENCING REQUIREMENTS

NA

PREREQUISITES

- o Extreme challenge to heat sink CSF
- o Secondary heat sink is required
- o No source of feedwater (main or auxiliary) available
- o Indication that RCS bleed-and-feed cooling is required
- o RCS pressure below the setpoint of the PZR PORVs
- o Both PZR PORVs are operable from the control room
- o Both PZR PORV block MOVs are operable from the control room

Continued from Optional Transient



CRITICAL TASKS

The following WOG CT is critical for this event sequence: FR-H.1--B

OPTIONAL CRITICAL TASKS:

The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L, --O, --R

Options: None

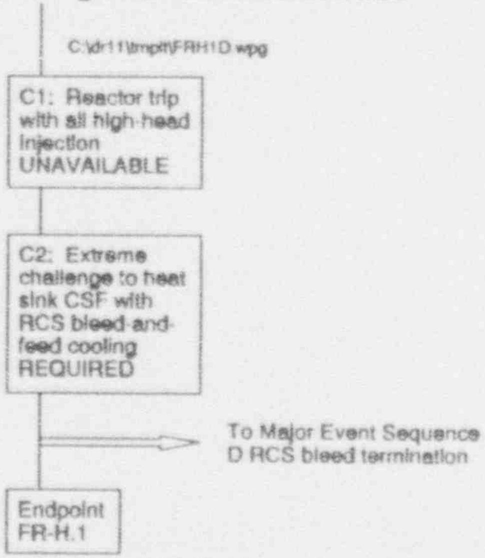
Procedure Transitions:

E-0 → CSF status tree → FR-H.1

SEQUENCING REQUIREMENTS
NA

PREREQUISITES
o Reactor trip o No AFW available o No high-head ECCS pump available -- PDP and one CCP known to be inoperable -- AC emergency bus supplying the operable CCP is lost at the time of reactor trip o Secondary heat sink is required o RCS pressure below the setpoint of the PZR PORVs

Continued from Optional Transient



CRITICAL TASKS
The following WOG CT is critical for this event sequence: FR-H.1--F

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L, --O, --R

Options: None

Procedure Transitions:

E-0 → CSF status tree → FR-H.1

TEMPLATE FRH1: Loss of Secondary Heat Sink (PAGE 6) **MAJOR EVENT SEQUENCE D**

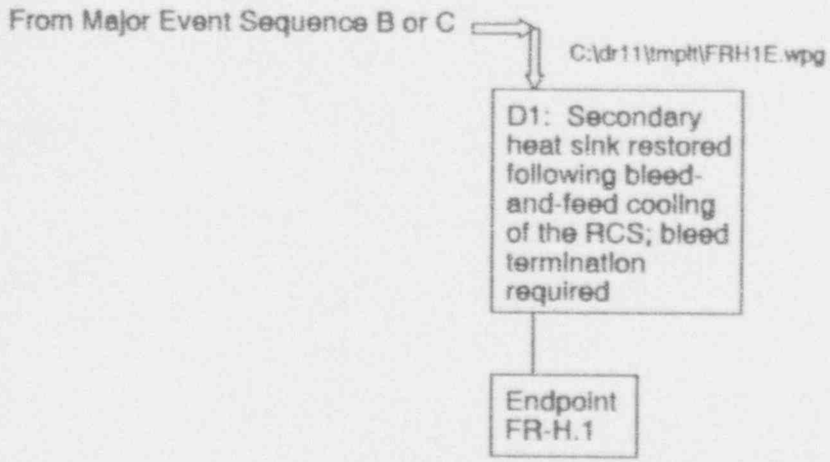
SEQUENCING REQUIREMENTS
NA

PREREQUISITES
o Restoration of secondary heat sink subsequent to establishment of RCS bleed-an-feed heat removal

Options: None

Procedure Transitions:

E-0 → CSF status tree → FR-H.1



CRITICAL TASKS
The following WOG CT is critical for this event sequence: FR-H.1--G FR-H.1--G requires that a reactor vessel head vent valve be open.

OPTIONAL CRITICAL TASKS:
The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L, --M, --O, --R E-0--M can be used in parallel with FR-H.1--G if the PZR PORV fails open during bleed-and-feed

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG CTs critical within the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

- o Reactor fails to trip automatically but is manually trippable (Refer to WOG CT E-0--A.)
- o No ac emergency bus energized but at least one EDG can be connected to an ac emergency bus (Refer to WOG CT E-0--C.)
- o SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D.)
- o Containment cooling is required but the minimum required complement of containment cooling equipment is not entirely automatically actuated; the minimum required complement of containment cooling equipment can be manually actuated (Refer to WOG CT E-0--E.)
- o Minimum required number of CCW pumps is not running; at least the minimum required number of CCW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--K.)
- o Minimum required number of ESW pumps is not running; at least the minimum required number of ESW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--L.)
- o LOCA with phase-A containment isolation failure; the plant conditions required in order for the task of closing containment isolation valves to be critical are so detailed and specific that it is best to refer directly to the associated CT worksheet (Refer to WOG CT E-0--O.)
- o PORV stuck open with pressure below PORV setpoint and with block valve available (Refer to WOG CT E-0--M.)
- o LOCA with containment mini-purge in operation at accident initiation; purge isolation fails such that containment atmosphere remains <u>unisolated</u> via mini-purge penetrations; mini-purge can be isolated, provided that manual action is taken as necessary (Refer to WOG CT E-0--R.)

FRP1

TEMPLATE FRP1: Imminent PTS (PAGE 1) CONDITIONS AND FAILURES

INITIAL CONDITIONS

- IC SET
- O.O.S. COMPONENTS
- SHIFT TURNOVER

IC SET: Enter menu of plant-specific simulator IC sets for initial power levels between 5 and 100%.

SHIFT TURNOVER: Enter any evolution, maintenance, or testing that is scheduled or in progress. Enter any T.S. action(s) in effect, including any related to O.O.S. components.

O.O.S./DEGRADED COMPONENTS MENU: Instrument(s)/ component(s) inoperable/degraded at shift turnover. Select none or more, not to exceed 4.

Plausible Precursors
1. Offsite circuit

Non-Precursors
2. PZR press/level instrmnt/chnl
3. PZR PORV and/or associated block MOV
4. NIS instrmnt/chnl (PR, IR, SR)
5. SG press/level instrmnt/chnl
6. Steam/feed flow instrmnt/chnl
7. EDG/ onsite ac distribution bus
8. SG tube leakage < T.S. limits; pin-hole leak detected via sampling of the SGs. For this template, it is intended that the combined effect of the RCS activity concentration and of the primary-to-secondary leakage rate be insufficient to cause secondary plant radiation alarms. (Leakage need not be inserted into the simulation.)

FAILURES

INSTRUMENT/ COMPONENT: Select none or more, not to exceed 2.

INSTRUMENT FAILURE MENU

Plausible Precursors
1. PZR press/level instrmnt/chnl
2. RCS flow/temp instrmnt/chnl
3. SG press/level instrmnt/chnl
4. Steam/feed flow instrmnt/chnl

Non-Precursors
5. NIS/ RPI instrmnt/chnl

COMPONENT FAILURE MENU

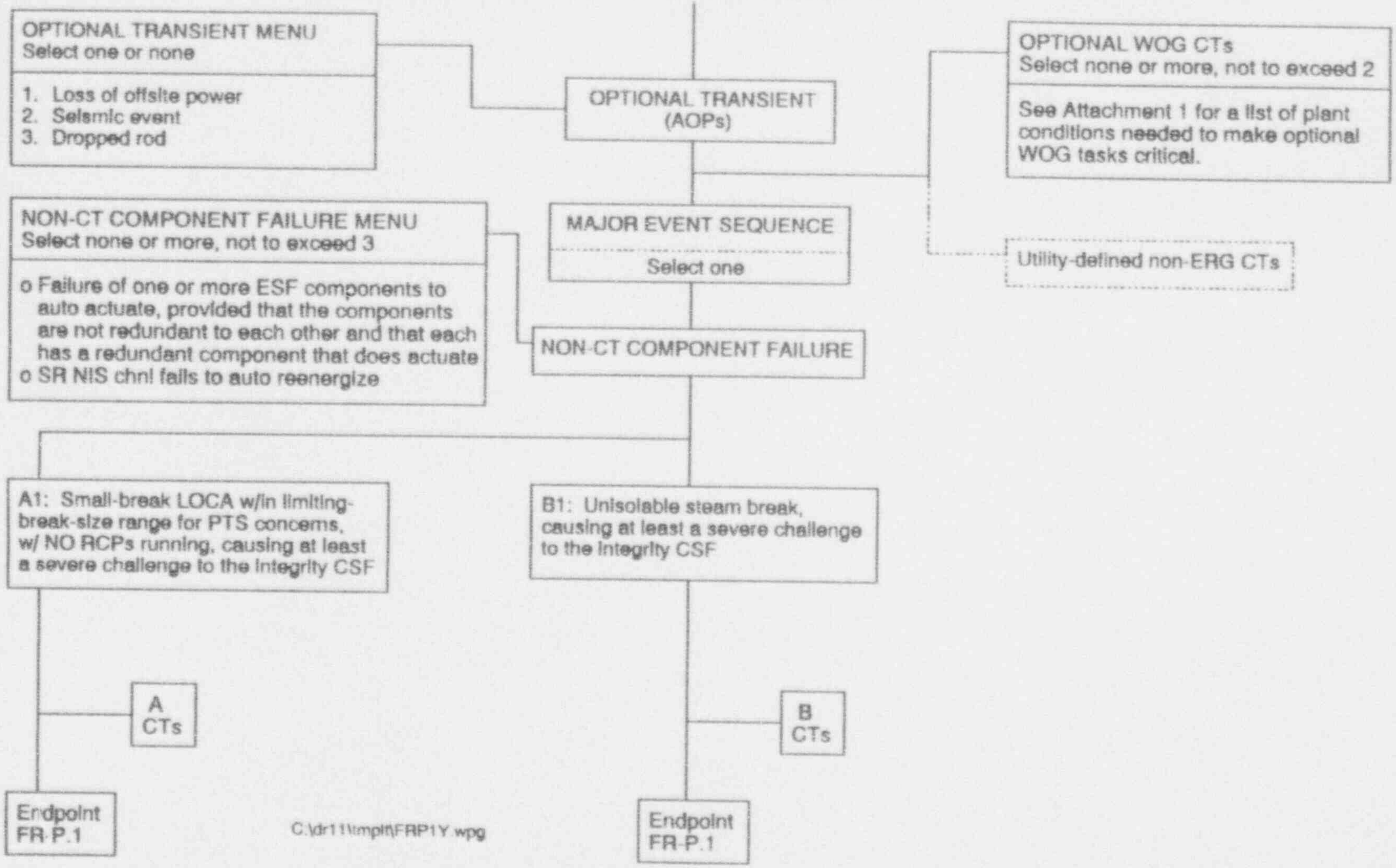
Plausible Precursors
1. Loss of offsite circuit
2. Loss of ac emergency bus

Non-Precursors
3. Feedwater heater tube leak
4. Movable control assembly
5. Loss of circulating water pump

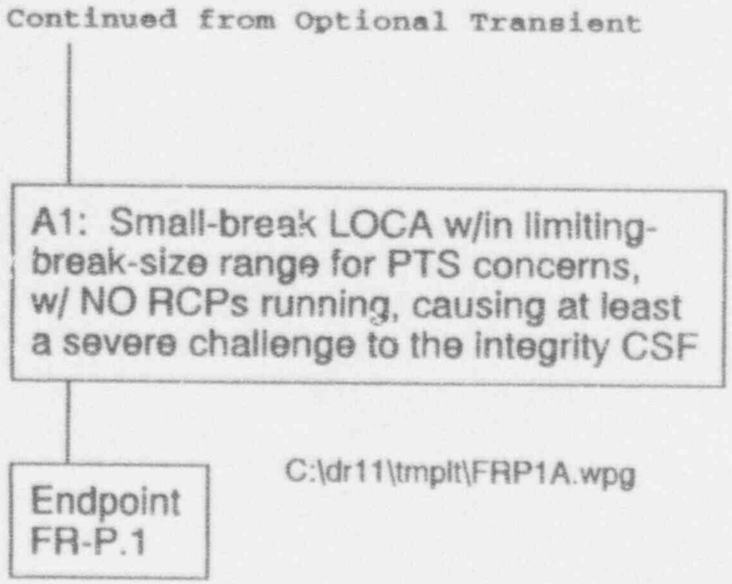
Continued on Next Page

TEMPLATE FRP1: Imminent PTS (PAGE 2) MAJOR EVENT SEQUENCES

Continued from page 1



SEQUENCING REQUIREMENTS
NA



PREREQUISITES

- o Small-break LOCA within the limiting break-size range for PTS concerns: generic analyses based on a typical 4-loop plant show this range to be a hot-leg break between 2 and 4 inches in diameter

- o Termination of forced RCS circulation is required in order to maximize the SI-induced cooldown rate in the RPV downcomer. Forced circulation can be terminated by loss of offsite power or by operator action based on the RCP trip criteria.

- o Depending upon plant-specific design features, one or more (or no) additional conditions may be required in order for a severe challenge to develop on the integrity CSF. The following is an example of an additional condition that might be needed on a plant-specific basis in order to reach a severe integrity challenge:

  -- Minimum safeguards actuation, such that SI flow is less than break flow (The resulting net loss of RCS inventory causes the highest elevations in the RCS to drain, leading eventually to flow stagnation.)

MAJOR EVENT SEQUENCE A
Continued on Next Page

CRITICAL TASKS

The following WOG CTs are critical for this event sequence: FR-P.1--A, --B

- o WOG CT FR-P.1--A is critical for this event sequence, provided that the SI termination criteria of function restoration guideline FR-P.1 are met.
- o WOG CT FR-P.1--B is critical for this event sequence, provided that the following additional conditions are met:
  - -- Temperature in any RCS cold leg has decreased by 100°F or more within the last 60 minutes
  - -- Any cold leg temperature less than T1, but temperatures in all cold legs to the right of Limit A
  - -- AFW continues to be delivered to any SG
  - -- RCS pressure is greater than the pressure in any intact SG

OPTIONAL CRITICAL TASKS:

The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L, --O, --R, ES-1.3--A

WOG CT ES-1.3--A is critical for this event sequence, provided that RWST level decreases to the criterion for transfer to cold leg recirculation

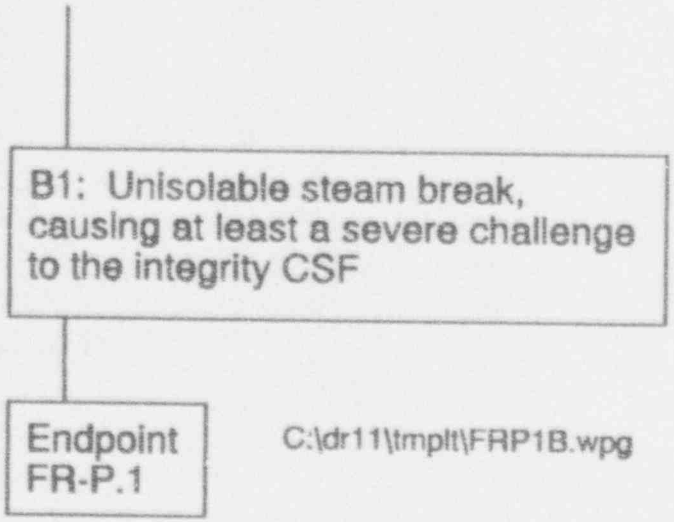
Options: None

Procedure Transitions:

E-0 → integrity CSF status tree → FR-P.1

SEQUENCING REQUIREMENTS
NA

Continued from Optional Transient



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PREREQUISITES
Depending upon plant-specific design features, one or more (or none) of the following conditions may be required in order for a severe challenge to arise on the integrity CSF: o Large steam break (i.e., larger than the equivalent break size of a SG PORV, SG safety valve, or steam dump valve) o Uncontrolled depressurization of multiple (or all) SGs o Loss of forced RCS circulation (e.g., loss of offsite power) o Normal SI (i.e., two trains of ECCS, both operating nominally)

MAJOR EVENT SEQUENCE B
Continued on Next Page

CRITICAL TASKS

The following WOG CTs are critical for this event sequence: FR-P.1--A, --B

- WOG CT FR-P.1--A is critical for this event sequence, provided that the SI termination criteria of function restoration guideline FR-P.1 are met.
- WOG CT FR-P.1--B is critical for this event sequence, provided that the following additional conditions are met:
  - Temperature in any RCS cold leg has decreased by 100°F or more within the last 60 minutes
  - Any cold leg temperature less than T1, but temperatures in all cold legs to the right of Limit A
  - AFW continues to be delivered to any SG
  - RCS pressure is greater than the pressure in any intact SG

OPTIONAL CRITICAL TASKS:

The following WOG CTs can be made critical for this event sequence by entering optional malfunctions/ failures as appropriate (refer to Attachment 1): E-0--A, --C, --D, --E, --K, --L

Options: None

Procedure Transitions:

E-0 → CSF status tree → FR-P.1

PLANT CONDITIONS FOR OPTIONAL CRITICAL TASKS

Enter malfunctions/failures as needed to create the plant conditions that must exist in order to make the desired optional WOG CTs critical within the selected Major Event Sequence. Ensure that plant conditions exist as required in order to make the desired task(s) critical.

- Reactor fails to trip automatically but is manually trippable (Refer to WOG CT E-0--A.)
- No ac emergency bus energized but at least one EDG can be connected to an ac emergency bus (Refer to WOG CT E-0--C.)
- SI fails to actuate automatically but can be manually actuated (Refer to WOG CT E-0--D.)
- Containment cooling is required but the minimum required complement of containment cooling equipment is not entirely automatically actuated; the minimum required complement of containment cooling equipment can be manually actuated (Refer to WOG CT E-0--E.)
- Minimum required number of CCW pumps is not running; at least the minimum required number of CCW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--K.)
- Minimum required number of ESW pumps is not running; at least the minimum required number of ESW pumps can be started, provided that manual action is taken as necessary (Refer to WOG CT E-0--L.)
- LOCA with phase-A containment isolation failure; the plant conditions required in order for the task of closing containment isolation valves to be critical are so detailed and specific that it is best to refer directly to the associated CT worksheet (Refer to WOG CT E-0--O.)
- LOCA with containment mini-purge in operation at accident initiation; purge isolation fails such that containment atmosphere remains <u>unisolated</u> via mini-purge penetrations; mini-purge can be isolated, provided that manual action is taken as necessary (Refer to WOG CT E-0--R.)
- LOCA inside containment with RWST level below level for cold leg recirculation switchover and with containment sump level above minimum requirements (Refer to WOG CT ES-1.3--A)