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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-137
Washington, DC 20555

References:
1. Docket No. 50-285
2. Letter from OPPD (W. G. Gates) to NRC (Document Control Desk) dated December 1, 1993 (LIC-93-0278)
3. Letter from NRC (S. D. Bloom) to OPPD (T. L. Patterson) dated September 12, 1995
4. Letter from OPPD (T. L. Patterson) to NRC (Document Control Desk) dated November 30, 1995 (LIC-95-0223)

SUBJECT: Additional Information to Assist Closure of NRR Staff Review of Fort Calhoun Nuclear Plant Individual Plant Examination (IPE) Submittal (TAC No. M74412)

A telephone conference call was held on April 18, 1996 involving NRC and OPPD staff personnel. The main purpose of the call was for OPPD to provide clarification of the methodology involved in the Human Reliability Analyses (HRA) portion of the Fort Calhoun Station IPE (Reference 2). Although the call resulted in a productive information exchange, it was determined that a more detailed written presentation of two particular issues raised by the NRC would be appropriate. OPPD therefore provides the attached discussion for staff consideration.

Please contact me if you have any questions.

Sincerely,

T. L. Patterson
Division Manager
Nuclear Operations Division

TLP/tcm

Attachment

c: Winston and Strawn
L. J. Callan, NRC Regional Administrator, Region IV
L. R. Wharton, NRC Project Manager
W. C. Walker, NRC Senior Resident Inspector

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Clarification of HRA Issues
Fort Calhoun Station Individual Plant Examination

NRC Issue 1

The contribution of the TX sequence may be overstated, with the potential adverse impact of shadowing other important contributions.

Response 1

OPPD has nearly completed the first major PRA model revision since the IPE submittal. This revision reflects several significant changes in plant configuration. Of particular significance is the capability to replenish the Emergency Feedwater Storage Tank with water from the Blair, Nebraska municipal system. Addition of the second 161KV line has also made a significant impact.

The distribution of core damage sequences, based upon the revised model, is significantly different from the distribution shown in the IPE submittal. In particular, the relative contribution of the TX sequence is expected to be less than 15%. Although this result is subject to change as the final model revisions are made, it is believed to be representative of the final results.

NRC Issue 2

Lack of documentation/rules for the HRA process may limit usefulness of the IPE for future plant configuration or licensing changes, especially if the previous expertise is unavailable.

Response 2

The additional guidance which follows has been provided by OPPD's HRA consultant. This guidance is currently being used for HRA work, and will be incorporated into the PRA procedures which are under development.

Guidance in Identifying, Classifying, Combining, and Quantifying HFEs

(This is a brief description of the guidance under which human failure events (HFEs) are identified and a model is chosen to quantify them.)

Identification

HFEs are identified in the system/event modeling effort or as part of the recovery analysis. Typically they are identified as a natural part of the fault tree/event tree modeling for sequences. Sometimes a special depiction of an event and its contingencies is made in a functional event sequence diagram (FESD). Figure B-1 in the HRA notebook is an example. This figure is included on Page 6.

Specification

The event context is specified by the system and sequence modelers with assistance from the HRA analyst(s) and plant personnel. Information regarding the following is collected:

1. The time line description of the situation including the time when the event is likely to be cued (if post-initiator) and the time required to perform the action successfully (i.e., the available time).

2. The crew/team configuration, i.e, the number of people associated with the action underlying the HFE and their potential for human redundancy.

3. Environmental factors that might influence the HFE, e.g.:

   a. Procedures available to guide the action
   b. Cues (instruments and alarms) that either support successful action or inhibit it
   c. Location and physical features, such as lighting, that support or inhibit the success of the action

Classification

Once the event is identified and its situation is specified, the event is classified as one of eight types (Figure 3.3.3.1 in the submittal):

1. pre-initiator, one train of equipment involved
2. pre-initiator, multiple trains of equipment involved
3. post-initiator, in-control room, verification time-dependent
4. post-initiator, in-control room, rule-based time-dependent
5. post-initiator, in-control room, response time-dependent
6. post-initiator, ex-control room time-dependent
7. post-initiator, slip
8. other

Cognitive failures, post-initiator, or what are sometimes called commission errors, are not identified due to lack of an accepted methodology. Later developments in HRA may make the modeling of these types of mistakes possible. It should be noted that types 3-6 are performance (i.e., time-constrained) failures and are assumed to include and occasionally be dominated by (possibly temporary) diagnosis failures or other mistakes. Otherwise, mistakes are not explicitly identified.

Combination Events

The identification of the failure event is made based on judgment as to which of the kinds of failure would dominate the HFE and (typically) only that type is modeled. When two HFE types might compete for significance, then both types may be modeled in a logical OR gate. If the event functionally includes multiple

events that are not judged to be completely dependent, then distinct HFEs may be identified and modeled in a logical AND gate. These multi-event HFEs are referred to as combination events (e.g., Table B-2 from the HRA notebook).

Table B-2
Combination HFEs

AHFFEFWST	=	AHFFEFWST	*	OPER-4E	except for R/SUX scenarios
AHFFEFWST	=	AHFFEFWST	*	OPER-40E	for R/SUX scenarios
AHFFLEVEL	=	AHFFLEVEL	*	OPER-4E	
OPER-41	=	OPER-41	*	OPER-4E	
XEFWST	=	XEFWST	*	OPER-4E	

Rules

The following are "rules" intended to guide the analyst in classifying, combining and quantifying HFEs. Note that the eight-element typology described above captures many of the rules for identification of HFEs. For example, types 1 and 2 indicate that no time-dependent nor cognitive failures are modeled if the action underlying the event is performed prior to the initiator.

Classification

Rule 1. Normal maintenance, testing, and calibration (MTC) activities are assumed to be subsumed in the component failure data. Hence, a pre-initiator HFE does not need to be identified for all or any components in the system models. However, such events may be identified if the event is of particular operational or risk interest. Events so modeled are type 1 HFEs.

Rule 2. MTC activities that can leave components from different systems unavailable will be modeled unless screening determines that the system interaction from their mutual failure is not risk significant. Such events include those in support of the ISLOCA and internal flood analyses. Such events are type 2 HFEs.

Rule 3. Human-induced initiators are assumed to be subsumed by the initiator data and are not explicitly modeled.

Rule 4. Any action that is performed by operators or technicians outside the control room (i.e., an ex-control room action) is assumed to dominate the HFE. The only exception is a burdened in-control room action that must always be identified (see Rule 5). If the action

is considered to be difficult because it takes a significant time relative to the expected available time, then the HFE is classified as type 6. If the action is complicated or subject to environmental factors that promote distraction or difficulty in seeing the component, then the HFE may be modeled as a slip, type 7.

Rule 5. Any action that presents the operators with a difficult choice *even when proceduralized* may be considered burdened. For example, the decision to deliberately create a small LOCA (i.e., initiate OTC) when there is not one is a burdened action. An HFE associated with such an action is classified as either type 4, burdened, or type 5, burdened, depending on whether the cue set for the action is one of the floating steps or otherwise involves a major safety function. If the cue set is as described, then the related HFE is classified as type 4, burdened; otherwise, it is type 5, burdened. The default is type 4, burdened (which is the classification for burdened OTC).

Rule 6. Any action that involves a branching among the EOP sections, or to an AOP, or otherwise involves rule-based diagnosis may be classified as time-dependent and the resulting HFE be type 4 (unburdened).

Rule 7. Any HFE which has as underlying action the verification of system initiation, particularly equipment called out in EOP-00, may be classified as type 3.

Rule 8. Any other HFE that is judged to involve some time-dependent response is classified as type 5.

Combination

HFEs are identified functionally; hence, some may be best modeled as a disjunction (OR gate) or conjunction (AND gate) of distinct HFEs of different types.

Rule 9. If there is a burdened in-control room action along with an ex-control room action potential to an identified HFE, then these distinct HFEs are separately identified, modeled in a logical OR gate, and quantified as appropriate.

Rule 10. Any time-dependent HFE may be modeled in a logical OR gate with a slip related to the time-performance or diagnosis of the event. Typically, however, one type is judged to dominate the other.

Rule 11. Some functionally identified HFEs will turn out to include multiple HFE potential where the HFEs have a logical chronology to them. This may arise because the function involves two distinct safety functions or floating steps, crosses different sections of the EOPs, includes transfer to an AOP, or otherwise allows the possibility of multiple events that are judged not to be completely dependent.

Quantification

Rule 12 Any HFE may be adjusted upwardly from its assessed value to reflect risk management needs. Both values should be noted.

Rule 13. Dependent events are quantified in chronological sequence, with each event assumed to be conditional on the previous event(s). If the cue for the event is *strong*, e.g., involves a safety function or floating step, a transfer to a major section in an EOP or between EOPs, or transfer to an AOP, the resulting HFE may be assumed to be independent of previous events. Note that the available time for subsequent events is reduced by at least the expected completion time of the previous event(s).

Rule 14. The quantification method is determined by the HFE classification as follows:

a. Type 1 THERP (abbreviated)
b. Type 2 THERP (abbreviated) with dependency model of THERP
c. Type 3 verification in-control room TRC
d. Type 4 rule-based in-control room TRC
   i. non-burdened
   ii. burdened
e. Type 5 response in-control room TRC
   i. non-burdened
   ii. burdened
f. Type 6 ex-control room TRC
g. Type 7 THERP (abbreviated)
h. Type 8 informed judgment.

These rules are not considered as hard-and-fast, but are provided as guidance for performing the HRA.

Typical Functional Event Sequence Diagram (FESD)

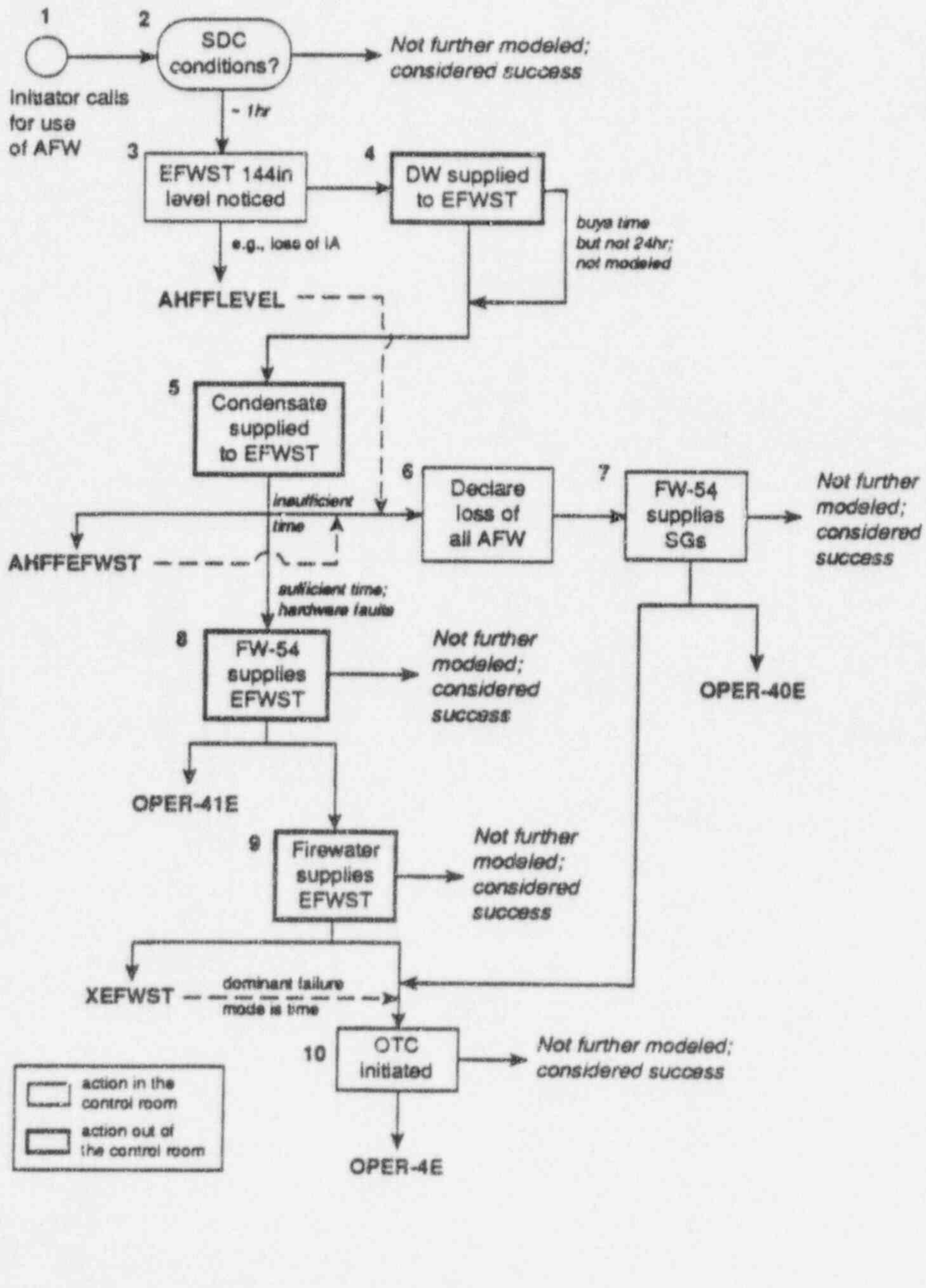

Figure B-1. FESD for long-term recovery action.