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Mr. J.W. Stetkar
Chairman
Technical Advisory Committee

Subject: TAC Report titled "IMPLEMENTATION GUIDE ON HUMAN RELIABILITY ANALYSIS (HRA) FOR PRA" dated May 27, 2017.

Dear Chairman Stetkar

NRRC will update the HRA guide continuously by incorporating the experience of the trial case of HRA with the assistance of the utilities.

The NRRC reply to the TAC recommendation as follows.

CONCLUSIONS AND RECOMMENDATIONS (from TAC)

The following recommendations should be addressed before the guidance is issued for trial use:

- To the extent possible, these methods should be used to evaluate personnel actions in the models that quantify PRA initiating event frequencies, in the Level 1 plant response models, and in the Level 2 severe accident mitigation models.

(NRRC Response)

The NRRC will respond to your comment in revision 1 (short term).

- The guidance should describe how to develop a realistic scenario timeline, the types of information that should be documented in the timeline, and how the timeline is used in the qualitative assessment, operational narrative, and human error probability (HEP) quantification.

(NRRC Response)

The NRRC will respond to your comment in revision 1 (short term; see Figure 1).

This figure is consistent with the timeline presented in NEI 16-06 and the timeline analysis in the HRA Calculator.

In our HRA guide example, the results of the time analysis are included in the information of Preliminary CRD (Crew Response Diagram) by using the results of the thermal hydraulic analysis contained in the installation permission application document. Further modifications will be effected by realistic observations of training and information obtained at the site.

- The guidance should describe how to perform a "time uncertainty analysis" and how to account for that analysis during quantification of the scenario-specific HEPs.

(NRRC Response)

NRRC HRA team will consider the quantification method of time uncertainty analysis this fiscal year.

- The guidance should be enhanced to place more emphasis on observations of carefully selected simulator scenarios to supplement the information obtained from the operator interviews. Simulator runs should also be conducted for critical operator actions to confirm realistic scenario time windows (e.g., delay time, time to perform an action, time to get to a location, etc.).

(NRRC Response)

The NRRC will respond to your comment in revision 1 (short term).

As also shown in Appendix C "F&B Evaluation Case (C.2.1.2 Questions about Plant Data, System Data and Training Summary)", actual observations of simulator training was conducted first. An interview was held.

Corresponding to this recommendation, we emphasize the importance of observations of such simulator scenarios by appending it to Section "5.2 Narrative discussion including operator interviews".

- Appendix G of the guide should include one or more instructional examples that show how deviation scenarios are developed and applied in a practical HRA.

(NRRC Response)

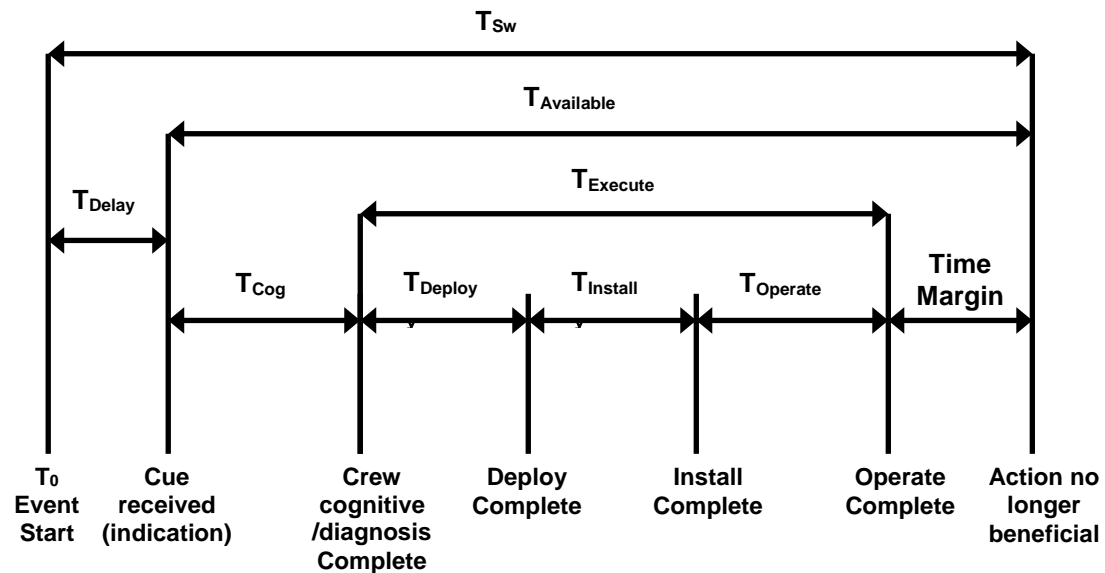
We will consider rational ways of implementation in future HRA research by acquiring detailed knowledge and increasing the number of cases.

THERP's method of decomposing actions of personnel into elemental acts and applying error rates to each one of them led to excessive HEP that did not match the actual condition. For this reason, we will also consider the application of task analyses and quantification methods that do not break human behavior into individual actions like IDHEAS.

Sincerely,



George Apostolakis



T_0 =Event Start

T_{sw} : system time window

T_{delay} : time elapsed before the indication occurs

T_{avail} : Time available for action = $(T_{sw} - T_{delay})$

T_{cog} : Time required for cognitive, diagnosis, decision making

T_{exe} : Time for execution = $(T_{deploy} + T_{install} + T_{operate})$

T_{deploy} : Deployment time

$T_{install}$: Install time

$T_{operate}$: Operation time

T_{reqd} : Minimum time required to achieve operation = $(T_{cog} + T_{exe})$

Fig1. Timeline concept for HRA guide