



An update on the development of NARA

by Jim Edmunds

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 **Background to the NARA story**

 **A quick look at the methodology**

 **Recent news**

Why is NARA of interest?

- ◆ **We are all interested in PSAs**
- ◆ **PSAs need to be populated by quantified events – including human errors**
- ◆ **NARA (Nuclear Action Reliability Assessment) provides a technique for Quantifying Human Errors**

NARA Origins

- ◆ **Based on HEART - Human Error Assessment & Reduction Technique**
- ◆ **Builds on over 20 years of PSA experience**
- ◆ **Uses the CORE-DATA human error database**
- ◆ **Makes use of earlier IMC work (DORRET)**

Short History of HEART

- 1986 - J Williams publishes HEART at the SaRS 9th ARTs symposium**
- 1988 - J Williams publishes data sources for HEART**
- 1992 - J Williams produces a HEART manual for Nuclear Electric that include 5 new GTTs**
- 1992 - HEART being used for all 'Continuing Operation PSAs' for Magnox and AGR plants**
- 1992 - CORE-DATA human error database project commences**
- 1996 - HEART, THERP and JHEDI validated**

Short History of NARA

- 2002 - HEART 2 project starts – later re-named NARA**
- 2003 - First issue of NARA documentation – User Manual and Technical Basis Report**
- 2005 - The NII organises an international peer review which identifies some areas for improvement**
- 2008 - Second issue of NARA documentation**
- 2009 - Second NII organised peer review identifies some final issues to be addressed**
- 2011 - Most recent NARA documentation issued for consideration by the ONR**

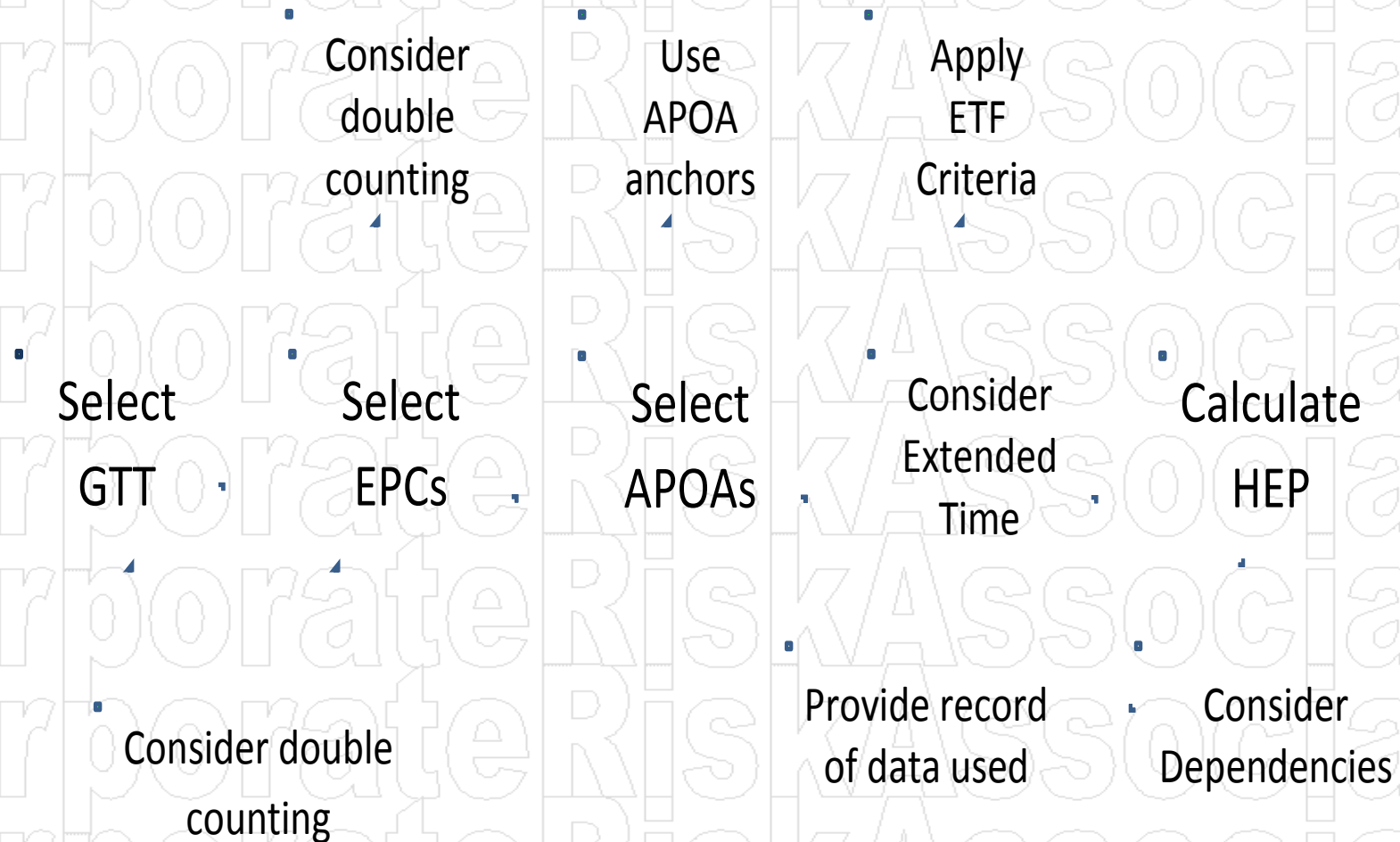
The HEART Methodology

- ◆ **Select a Generic Task Type (GTT) to represent the action being quantified**
- ◆ **Select one or more Error Producing Conditions (EPCs) to represent differences between 'ideal' and real conditions**
- ◆ **Judge the strength of the affect of each chosen EPC on successful task performance and apply an Assessed Proportion of Affect (APOA)**
- ◆ **Calculate the Human Error Probability (HEP)**

Elements of HEART



Elements of NARA



- ◆ **The regulators view of NARA**
- ◆ **Roll-out of NARA within EDF Energy**
- ◆ **Wider interest in NARA**
- ◆ **Similar methodologies for other industries**

The regulators view

- ◆ **ONR confirmed that outstanding issues were resolved early in 2012**
- ◆ **HEP quantifications should be supported by completion of detailed assessment sheets**
- ◆ **This might be relaxed when deriving 'screening' values**

Roll-out of NARA within EDF Energy

 **Program of courses being run by EDF Energy**

 **NARA being used for new HEP quantifications for EDF**

- Existing Fleet
- New Build

 **Use beyond EDF**

Wider interest in NARA (1)


- ◆ **NASA 2006** - 14 HRA methods evaluated, NARA recommended along with CREAM, SPAR-H and THERP
- ◆ **NUREG-1842 2006** – Evaluation of HRA against good practice, NARA not reviewed but developers contributed to workshop
- ◆ **Yucca Mountain 2008** - NARA used for HEQ along with HEART, CREAM and THERP

Wider interest in NARA (2)

- ◆ **HADEN Exercise 2008** – Predictions of human reliability compared to simulator observations, HEART represented but conclusions relevant to NARA
- ◆ **OECD NEA HRA Evaluation 2012** – Ten methods, including NARA , are being evaluated for use in nuclear risk assessment

Development of similar HRA methods

 **Controller Action Reliability Assessment (CARA) 2009** – quantifies HEPs for air traffic control activities

 **Railway Action Reliability Assessment (RARA) 2012** – quantifies HEPs to be used QRA for existing and proposed railway systems



NARA PROGRESS UPDATE

That brings us up-to-date-
any questions?



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Final NARA HEP Calculation

$$\text{HEP} = \text{GTT} \times [(\text{EPC}^1 - 1) \times \text{APOA}^1] \times \dots [(\text{EPC}^n - 1) \times \text{APOA}^n] \times \text{ETF}$$

Task Description: Operator fails to start pump

Generic Task Type selected:

A1 (Carry out simple manual action with feedback).

$$\text{HEP} = 0.006$$

Error Producing Conditions

3 - Time Pressure (x 11)

9 - Operator inexperience (x 8)

Assessed Effect

$$((11 - 1) \times 0.1) + 1 = 2$$

$$((8 - 1) \times 0.3) + 1 = 3.1$$

Extended Time Factor

$$\text{ETF}_3 = 0.03$$

$$\text{Final HEP} = 0.006 \times 2 \times 3.1 \times 0.03 = \underline{0.0011}$$

Final HEART HEP Calculation

$$\text{HEP} = \text{GTT} \times [(\text{EPC}^1 - 1) \times \text{APOA}^1] \times \dots [(\text{EPC}^n - 1) \times \text{APOA}^n]$$

Task Description: Operator fails to start pump

Generic Task Type selected:

F (change plant state using procedures)

$$\text{HEP} = 0.003$$

Error Producing Conditions

Assessed Effect

2 - Time Pressure (x 11)

$$((11 - 1) \times 0.1) + 1 = 2$$

15 - Operator inexperience (x 3)

$$((3 - 1) \times 0.3) + 1 = 1.6$$

$$\text{Final HEP} = 0.003 \times 2 \times 1.6 = \underline{0.0096}$$