Human Performance Event Database

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ABSTRACT

The purpose of this paper is to describe several aspects of a Human Performance Event Database (HPED) that is being developed by the Nuclear Regulatory Commission. These include the background, the database structure and basis for the structure, the process for coding and entering event records, the results of preliminary analyses of information in the database, and plans for the future. In 1992, the Office for Analysis and Evaluation of Operational Data (AEOD) within the NRC decided to develop a database for information on human performance during operating events. The database was needed to help classify and categorize the information to help feedback operating experience information to licensees and others. An NRC interoffice working group prepared a list of human performance information that should be reported for events and the list was based on the Human Performance Investigation Process (HPIP) that had been developed by the NRC as an aid in investigating events. The structure of the HPED was based on that list. The HPED currently includes data on events described in augmented inspection team (AIT) and incident investigation team (IIT) reports from 1990 through 1996, AEOD human performance studies from 1990 through 1993, recent NRR special team inspections, and licensee event reports (LERs) that were prepared for the events.

BACKGROUND

Since the mid-1980s, NRC's Office for Analysis and Evaluation of Operational Data (AEOD) has performed studies of human performance in operating events. In 1990, AEOD began to perform multi-disciplinary team studies of human performance in response to specific operational events. These studies were performed on-site and with the assistance of the Idaho National Engineering and Environmental Laboratory (INEEL). AEOD performed these studies

sometimes as part of assistance to augmented inspection team (AIT) inspections, or other inspections, and sometimes simply to analyze what appeared to be interesting individual and team performance during events. All the studies were performed using a protocol, to help ensure that the same questions were asked during each of the event investigations and so that the investigation results would be comparable. Use of a protocol also helped ensure the same questions were posed to each person interviewed. AEOD completed 20 of these human performance studies over the time period from 1990 to 1993. A summary of the results of the first 16 of those studies was published in NUREG-1275, volume 8, "Operating Experience Feedback Report - Human Performance in Operating Events," dated December 1992.

In 1992, AEOD began to develop a database for information on human performance during operating events. The database was needed to help classify and categorize the information to feedback operating experience information to licensees and others. In addition, the database was needed to perform analyses to determine what information was necessary and sufficient and should be reported for events. 10 CFR 50.73 requires that licensees report certain events and NUREG-1022 describes the information that should be reported including information on human performance. However there are a variety of different opinions on what constitutes complete information on human performance.

To determine user needs regarding the content of the database, AEOD asked the NRC Offices of Nuclear Reactor Regulation (NRR) and Nuclear Regulatory Research (RES) to assist as part of an interoffice working group to determine what human performance information should be included for events. The working group determined that the list of information should be based on the human performance investigation protocol (HPIP) that had been developed by RES as an aid in investigating events. The working group recommended that the list of information be included in a revision to NUREG-1022. However, because changing NUREG-1022 to specify information more precisely might be considered a backfit, AEOD decided to construct a database containing this information and perform studies to determine whether it was reasonable to require the reporting of this information. In 1993, the list was specified as the basis for the structure of the HPED. AEOD had the Idaho National Engineering and Environmental Laboratory (INEEL) construct and develop the HPED.

Current plans are to use the HPED to develop better guidance to licensees on human performance information that should be reported for events, to provide information needed to support development of human reliability analysis (HRA) models, and to improve inspection guidance on the human performance information that is required.

DATABASE DESCRIPTION

The HPED currently includes data on events described in AIT reports from 1990 through 1996 time period, AEOD human performance studies that were performed from 1990 through 1993, and recent NRR special team inspections (STIs). The database also includes data from the licensee event reports (LERs) that were prepared for these events, as there generally should be one-to-one correspondence between events and LERs. Because it is possible to have two or more different types of reports for a given event, the database has a total of 160 reports for 88 events.

ORIGIN OF CODED INFORMATION

	AITs/IITs	HPS	STIs	LERs	Total Events
1990	9/1	7	-	14	31
1991	15/1	6	-	16	38
1992	11	3	-	11	25
1993	17	4	2	20	43
1994	3	0	1	3	7
1995	2	0	4	1	7
1996	5	0	0	4	9
	62/2	20	7	69	160

The HPED contains information on events and on human performance factors/issues that influenced performance by crews and

individuals. The record for each event report includes information on whether the following factors were reported as contributors to the event:

- Human Factors Engineering/Human-System Interface
- Work Environment
- System Design and Configuration
- Procedures
- Training
- Communication and Coordination
- Supervision
- Management and Organization
- Fatigue/Stress/Workload
- Individual Personnel Issues (e.g., situation awareness)

The HPED has 54 other fields for other human performance and general event information, including,

- Event Summary and Classification
- Time and Date
- Operating Mode and Power Level
- Preceding or Subsequent Subevents
- Numbers, Titles, and Types of Personnel
- Whether Licensed and Number of Years
- Personnel Training
- Shift Rotation and Duration
- Activity Type and Time on Shift

The database structure was designed to collect information on the many possible contributors to human performance problems. The database structure was based on the Human Performance Investigation Process (HPIP)[1] which provides for a systematic and thorough examination of possible contributors (and which in turn is based on the Management Oversight and Risk Tree (MORT) approach to accident/incident investigation). It should be clear from examining records in the database that events almost never occur simply because an operator simply erred.

PROCESS FOR CODING AND ENTERING DATA

There is a process for coding event data from reports and entering the information in the data base. Two people code an event independently then meet and reach a consensus on what should be in

the record. Then you have a review by a person with operating experience, who does a reality check on the content of the record.

It has been specified that the database records only include information that is explicitly stated in the report and not read anything into the report. For example, if an LER stated that the root cause was found to be one specific thing, say an operator made a mistake, then the database record for that LER would include only that. Another report of the same event, such as an AIT might have additional information that might permit a better understanding of why the event occurred. For example, the operator made a mistake, but it was cold and noisy and the lighting was bad. In addition, the operator may have had a poorly written procedure and may not have been adequately trained. Because a protocol was always used during the AEOD human performance studies (HPSs), more questions were asked consistently during interviews of operators and other involved personnel, and this resulted in more information.

TESTING OF THE DATABASE

We developed a few sample questions to test the database. The questions were designed to characterize the events that occurred and also to compare the information that was included in different types of reports. Questions included how have events been distributed in time, are there differences in the contributing factors reported in different types of reports, what is the relative frequency for contributing factors reported for AIT events. A sort of the data to answer the first question revealed that events have occurred at all times of the day and more frequently during the day. This might be expected as there are more opportunities for error during the day shift.

Sorts of the HPED data indicate there were relatively high numbers of contributors to events that were the subject of AEOD Human Performance Studies. This is partially because the HPS studies were performed of events in which human performance appeared to be interesting, complex, or unusual. It is also because a protocol was used during the studies. Therefore it is not surprising that the studies seem to identify so many causes and contributing factors.

PLANS FOR THE FUTURE

Work on this project so far has focused on developing and testing the database and we have not attempted to make correlations or perform other types of analyses. We are still trying to determine what data fields are needed. We plan to release the database to groups inside and outside the NRC and solicit their comments and advice, try to resolve the comments and make suggested improvements. We have studies planned for the near future that will involve the database.

During future work with the HPED we plan to examine the role of human performance in events that were significant from a risk standpoint. We plan to compare data from the HPED with data from the Accident Sequence Precursor (ASP) database, which is also maintained by the NRC. The ASP database contains analyses of and conditional core damage probabilities (CCDPs) for selected events. Events with higher CCDPs are considered to have a relatively higher risk. We plan to add to the HPED records for events that have high CCDPs and then attempt to characterize those events in terms of factors that influenced performance during the events.

We also plan to review the ATHEANA (A Technique for Human Error Analysis)[2] human reliability assessment (HRA) framework and other HRA models and try to identify steps that can be taken to make the HPED a more useful source of data for human reliability assessments.

A summary of the work planned for the future includes:

- Distribute Draft HPED and request comments
- Update the HPED with recent event information from AIT and other reports
- Continue to test and develop the database and consider including data from other sources, for example,
  - ASP events with high CCDPs
  - Regional inspections performed using the HPIP, and
  - Foreign event reports (Unconditionally released)
- Perform studies of human performance using the HPED data
- Examine risk significance of events and develop information for use in studies of human reliability/risk assessment
- Assess database adequacy for modeling human reliability assessment techniques
- Distribute HPED at NEA PWG-1 Specialists Workshop October 1997 in Chattanooga, Tennessee
- Convert HPED and ASP databases to MicroSoft ACCESS database format

1. NUREG/CR-5455, *Development of NRC's Human Performance Investigation Process (HPIP)*, M. Paradies, et al., Systems Improvements, Inc.: Knoxville, TN, October 1993.

2. NUREG/CR-6350, *A Technique for Human Error Analysis (ATHEANA)*, S. E. Cooper, et al., Brookhaven National Laboratory: Upton, NY, May 1996.