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THE SANDIA TRANSPORTATION TECHNICAL ENVIRONMENTAL INFORMATION CENTER AND ITS APPLICATION TO TRANSPORTATION RISK ANALYSES*

J. T. Foley, C. A. Davidson, & J. D. McClure

SANDIA LABORATORIES

INTRODUCTION

The purpose of this paper is to describe an applied research activity which is fundamental to the conduct of transportation analyses: the collection, analysis, storage, and retrieval of information on the intensities of technical environments. This paper describes the collection system which provides such a service to official researchers in transportation analysis and the applications of this information in the area of risk analysis.

HISTORY

The Transportation Technical Environmental Information Center, operated by Sandia Laboratories under the auspices of the DOE Division of Environmental Control Technology was organized and developed in 1974, and began operations in 1975.[1] Although new in terms of purpose and scope, the concept of such a center and the methods developed for providing the requisite services are not new. The concept and techniques of operation are derived from an analysis activity which began in 1960,[2] and which has been under continual development to the present day.[3,4]

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1 *Superscript numbers refer to similarly numbered references* at the end of paper.

Although formal operation of the Transportation Technical Environmental Information Center began in 1975, specific consulting and technical environmental study projects in the field of transporting radioactive materials were performed at Sandia on a cooperative, "non-interference with on-going Sandia programs," basis for AEC/ERDA/DOE/NRC/DOT/DOD beginning in 1965. Such cooperative activities have continued to the present time.[5,6,7,8,9] The results of these analyses have been incorporated in the center's transportation technical information file.

Since 1977, the scope of the Transportation Technical Environmental Information Center has been expanded to encompass transportation environments that may be experienced by other energy materials such as gasoline, LNG, hydrogen, etc., in keeping with projected needs of the Department of Energy.

STORAGE/RETRIEVAL SYSTEM

For purposes of storage and retrieval, technical intensity information is cataloged under two major headings: Normal and Abnormal Environments.

Normal environments are those which will be encountered at some level during every shipment. They have a high frequency of occurrence, but are of a relatively low intensity. The abnormal environments, on the other hand, are those which may be encountered occasionally on some shipments and are characterized by higher intensities but lower frequency of occurrence. The environments with very high intensities occur very infrequently. The abnormal environments, while often called by different names to differentiate them, have actually the same technical parameters as the normal environments. Thus, an acceleration is experienced by cargo as a truck crosses railroad tracks at 50 mph. A greater acceleration may result if it strikes a bridge pier at the same speed. To make the difference clear in a succinct manner, the latter is termed "impact." Other descriptions used in this manner are puncture, fire, immersion, etc.

Twelve categories of environment have been identified as relevant to transportation. These include:

1. Acceleration/Time*
2. Acoustic Noise
3. Atmospheric Contents
4. Fragmentation*
5. Humidity
6. Precipitation
7. Pressure*
8. Radiation*
9. Shock*
10. Temperature*
11. Vibration
12. Wind*

* Environments with both normal and abnormal aspects--information in these categories is often cross-indexed in the process of cataloging.

Two sub-categories are used within each environment category--input and response. Input is defined as the environmental level which exists at a cargo "container"/vehicle interface, while response is considered as the environmental level produced when the contained material reacts to the input environments.

When information is acquired, it is reviewed for technical content. Pertinent information is then extracted and microfilmed. The microfilmed information is assigned a title by environment category and is filed in numerical order without regard to subject. This simple technique is possible because of a computerized, multiple cross-index program which was developed to permit the Center operators to retrieve specific information.[3]

The storage/retrieval system, therefore, is a hybrid system, incorporating computerized indexing, microfilm storage, and experienced personnel available to operate the system.

APPLICATIONS IN RISK ANALYSIS

The primary aim of a risk analysis is to provide to a decision maker, descriptions of alternate courses of action when the outcome of making a choice depends upon events that are not known with certainty.[10] A risk analysis is the presentation to the decision maker of statistical models of the system being analyzed. In this paper this means statistical models of transportation systems for energy materials are developed that permit a decision making body to incorporate their own subjective and experience judgments into the structure of the problem in order that an environmental control decision can be produced.

The Transportation Technical Environmental Information Center has been staffed to acquire technical intensity information on normal transportation, transportation accidents, and related transportation statistics. The need for such information was first recognized for analyses of radioactive materials transportation in 1948, when the first comprehensive regulations governing safety in the transport of radioactive materials were put into effect by the Interstate Commerce Commission[11]. The need for such information has been further enunciated on other occasions,[12] and while the present status is somewhat improved, it appears that a continuous data acquisition effort is necessary if the data needs presently being identified in the course of pursuing current risk analysis studies are to be satisfied.

An example of the potential international use of a technical data acquisition, storage, and retrieval capability for transportation accident data and related statistical information is that of the stated intention of the International Atomic Energy Agency (IAEA) to perform comprehensive review of its transportation regulations at intervals of approximately 10 years.[13] The performance of such reviews relies on the availability of up-to-date transportation accident data files. The IAEA has recently approved, and will implement in the near future, an international data gathering process whereby the Member States will provide to the IAEA Headquarters basic statistical information and severity data about "reportable events" involving the transportation of radioactive materials. Such a system will allow the international sharing and comparison of technical transportation accident data.

The number of future applications that can be made of the information in a Transportation Technical Environmental Information Center are difficult to anticipate, but the potential may be illustrated by some recent applications of this type of information in transportation risk assessments for energy materials.

In 1972, the AEC requested that Sandia Laboratories study accident damage and from this information, develop shipping container test criteria. Upon examination of the then extant accident information, the Sandia staff assigned to this study effort formed the opinion that neither transportation damage information nor analysis techniques were available. The Sandia staff, therefore, offered an alternate proposal, i.e., that a study of aircraft accidents, then underway, could be used to develop technical accident intensity data, and this technique could be expanded to additionally describe the intensity of truck and rail accidents. This alternate proposal was accepted and co-sponsored by the Department of Transportation and the AEC.

The study developed techniques for the collation of available technical transportation accident intensity data in formats which would permit the derivation of test criteria from a risk-oriented basis. A final report on this basic data study was issued as "Severities of Transportation Accidents," SLA-74-0001, in July 1976.[14] This work provided a detailed data base of the statistics and the severity of transportation accidents, i.e., the intensities of the accident environmental categories of impact, fire, crush, puncture, and immersion for small packages (mass less than 500 kg), in terms of energies, temperatures, forces, velocities, and immersion depths in water. A similar data base study on accident severity was later performed for large packages (greater than 1000 kg).[15]

To answer the original request concerning test criteria by the AEC in 1972, a follow-on study was then performed that used Ref. 14 as a data base. The study illustrates how, in using technical intensity information, recommendations can be made with respect to the adequacy of existing licensing regulations on a risk-oriented basis.[16]

The transportation accident intensity data of Refs. 14 & 15 were inserted into the Technical Environmental Information Center as a baseline entry, and since then, they, along with other information stored in the Center, have been used in the following risk assessment studies:

- An Assessment of the Risk of Transporting Gasoline by Truck (Draft) BNWL-2133, Battelle Pacific Northwest Laboratories, November 1976.
- An Assessment of the Risk of Transporting Plutoniumn *Dioxide and Liquid Plutonium Nitrate by Train*, BNWL-1996, Battelle Pacific Northwest Laboratories, February 1977.
- An Assessment of the Risk of Transporting Plutonium Dioxide by Cargo Aircraft, BNWL-2030, Battelle Pacific Northwest Laboratories, June 1977.
- Consequences of Postulated Losses of LWR Spent Fuel and Plutonium Shipping Packages at Sea, PNL-2093, Battelle Pacific Northwest Laboratories, October 1977.
- Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, NUREG-0170, Office of Standards Development, U. S. Nuclear Regulatory Commission, December 1977.

- Interim Report - Generic Environmental Assessment on Transportation of Radioactive Materials Near or Through A Large Densely Populated Area, SAND77-1927, Sandia Laboratories May 1978.

- An Assessment of the Risk of Transporting Spent Nuclear Fuel by Truck (DRAFT), Battelle Pacific Northwest Laboratories, July 1978.

- An Assessment of the Risk of Transporting Uranium Hexafluoride by Truck and Train, PNL-2211, Battelle Pacific Northwest Laboratories, August 1978.

The studies listed above are specific examples of the use of technical transportation accident intensity data in detailed risk assessments. These resulting risk statements can in turn be used to weigh the relative risks of certain energy material transportation operations and can be used in the decision-making process. Further, these studies are a means whereby an interested public can be informed of the relative risks associated with energy materials transportation.

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