RADIATION SOURCE ALTERNATIVES INITIATIVE

Interim Letter Report

Submitted to:

U.S. Environmental Protection Agency
Radiation Protection Division
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Submitted by:

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EPA Work Assignment No.	**: 0-18**
Contract No.	**: 68-D-00-210**
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September 30, 2001

Introduction

Trinity Engineering Associates, Inc., (TEA) was requested by EPA to develop information regarding the use of sealed radiation sources in the United States, and to identify possible alternate technologies that would perform the same functions as the sealed radiation sources without employing ionizing radiation technologies. This summary report describes the TEA work performed in response to each of the requested activities listed in the EPA work assignment. The requested work consisted of four tasks:

Task 1: Develop work plan and cost estimate

Task 2: Conduct research on the use of sealed radiation sources, including identifying source manufacturers, collecting information on the number of sources in use, and a description of the sources. Also included in task 2 was a summary of health risks from these various sources.

Task 3: Identify alternative technologies, their market adoption, and their availability

Task 4: Report on findings

Response to Tasks

Task 1:

TEA developed a work plan and cost estimate based on the work assignment received from EPA. The work plan described an approach to completing the assignment that would entail continuing the work over the end of the contract base fiscal year, and into contract option year 1. The first draft of the work plan was submitted to EPA on August 3, 2001. EPA requested a revision of the work plan, and the revised work plan was submitted on August 10, 2001.

Task 2:

Task 2 was primarily concerned with identifying the types of sources, their manufacturers, their uses, and potential health risks associated with the various types of sources. Task 2 identified five specific topics for inquiry:

1. Identify the manufacturers of sealed radiation sources used in the United States,

2. Identify by name, and approximate number, the radioactive sealed source devices currently being used in the United States,

3. Prepare a summary of current uses of these radioactive sealed source devices, and a concise summary of how they work and in what environments they are used,

4. Prepare a summary of health risks associated with each use,

5. Provide data on the length of use of these radioactive sources, and identify the final destination of these devices after useful life or when damaged.

Database Development

As a response to this task, TEA began developing a Microsoft Access® database containing updated information on all sources and source manufacturers listed on the US Nuclear Regulatory Commission (NRC) license forms. The database tables contain records that identify the vendors, vendor contact information and their vendor codes, the registry numbers for the sources, the isotopic activities in the source, and the intended use for the product. The first draft of the database is contained on the CD-ROM accompanying this report. The database, when completed, will include the information requested for Task 2 with the exception of the health risk assessment.

Review of NRC Risk Analysis Study

The short time remaining in the fiscal year excluded developing a comprehensive risk assessment for all the source types that are identified in the NRC license information. As an interim measure, TEA reviewed the risk assessment performed by the NRC and published in February 2000 as NUREG/CR-6642, "Risk Analysis And Evaluation Of Regulatory Options For Nuclear Byproduct Material Systems", to determine if the NRC study is useful as a risk analysis for this work assignment. The relevant points resulting from the review are listed below:

- In NUREG/CR-6642, the NRC has performed a risk assessment for many of the source categories for both worker and public exposures. The study groups sources into 40 various 'systems' by function, and then evaluates the likelihood of exposure to a highly exposed individual from each of the systems. The study includes estimates of risk from both normal operation and accident conditions.
- TEA did not have the appendices to the report, so the quality of the specific algorithms used for determining dose consequences could not be evaluated.
- The methodology of the study follows that of a probabilistic risk assessment such as those performed for nuclear power stations. Risk is reported in dose units (mrem/yr) , and is determined by the product of [(consequence) x (frequency)] for each given path in the event tree. The determination of frequency does not appear to normalize the frequency of occurrence to 1, but this may be described in the appendices. The discussion regarding determination of consequence does not include any provision for the isotope-dependent dose conversion factors, so it is unclear how the final dose unit is achieved. Again, this may be discussed in the appendices.
- The report mentions that the overall uncertainty is high, even into orders of magnitude, but the uncertainty is not quantified in the results. This is unusual in a

probabilistic assessment, since the underlying event tree uncertainties are usually defined when the trees are constructed. However, this report appears intended for defining relative risk values as a regulatory aid, rather than for developing specific risk values for a compliance effort.

- The individual dose values (in mrem/yr) reported in section 4 of the report for normal operation are higher than expected. For example, the worker risk reported for system 32, manufacturer and distributor unsealed solid sources, is approximately 10 rem per year. The public risk summary reported for system 40, field radiography, is approximately 1500 millirem per year. The report notes in section 2 that these doses may be distributed over a number of personnel, but the report's definition of risk is **"...the "normal" risk is the exposure the receptor is expected to receive**
- **over the year for activities and/or conditions that are expected during the year. It would be the accumulated exposure indicated by personal dosimetry devices (plus any internal exposure not measured by the dosimetry)...".** Following the definition supplied in the report, these dose results are in some cases beyond the regulatory limits and are much higher than could be reasonable expected in these scenarios. A review of the appendices may reveal the actual conservative assumptions contained in the analysis that are creating the higher than expected dose values.
- The analysis includes dose from inhalation, ingestion, external, and immersion exposure.
- The dose values generated in the report are not necessarily, for accident conditions, the dose that would be received by a member of the public or a worker. The reported dose values are frequency times consequence results, with consequence in units of dose and frequency being a unitless value. A reported public risk of 100 millirem/yr for a given system may represent a consequence dose of 1000 rem/yr with an estimated frequency of occurrence of 1 per 10000 years, per system that is available. Since the report does not contain uncertainty estimates it is difficult to bound the actual range of likely doses that could be received by the public.

The review concluded that the risk analysis contained in NUREG/CR-6642 is useful as a risk ranking study. As such, it can be used to assign priorities to the source types studied in any more detailed risk assessments. Absent the appendices and a quantified

estimate of uncertainty, TEA could not make a judgement on the usefulness of the study as a basis for judging the risk to the public in a more standard unit of risk, such as the likelihood of fatal cancer induction per year. The study methodology does appear to form a useful basis for an estimate of risk from the source systems examined. A more detailed examination of the methods and models used in the study to calculate dose may determine that NUREG/CR-6642 could be used as a basis for generating the health risk information desired by EPA.

Remaining Work

- **The database is still in a draft state; the final table relationships, queries, and forms are yet to be completed. This work should require about 40 more man-hours.**
- **The final compilation of the source information for the database is yet to be completed, and has recently become much more difficult since the NRC has removed the source registry information from their website. About 250 man hours are required to complete filling of the database records with the source data.**
- **The health risk assessment is not complete, but the initial review of NUREG/CR-6642 indicates that if the appendices are made available, then this report may serve as a useful basis for estimating the risks posed by sources to the general public.**

Task 3:

Task 3, identifying alternatives to ionizing radiation sources and their market position, was not yet significantly begun when the contract year ended. Two candidate technologies had been identified; first, laser optical systems have largely replaced radiation sources in leveling measurements, and second, photoelectric cells are becoming widely used in smoke detectors as a replacement for the Am-241 sources used in the ionization type detectors. Specific information on cost, market share, benefits, etc., of these technologies relative to the ionizing radiation systems was just

beginning to be compiled when the contract year ended.

Remaining Work

Task 3 has essentially all the proposed work remaining.

Enclosures

1. CD-ROM with Draft Database Rev 2, Excel file of Vendors, Excel file of Partial Registry Data