



HEALTH PHYSICS SOCIETY

Specialists in Radiation Safety

JOHN R. FRAZIER, PhD, CHP
President

Auxier & Associates, Inc.
Suite 1
9821 Cogdill Road
Knoxville, TN 37932
865-675-3669
jrfrazier@auxier.com

December 19, 2002

Mr. Peter E. Ruedel
Natural Resources and Environment Team
General Accounting Office
441 G Street NW
Washington, DC 20548

Dear Mr. Ruedel:

I am pleased to provide you with the attached response to your request for input on control of radioactive material in light of its potential use in a radiological dispersion device. I have attempted to address the three specific questions you posed but have also taken the opportunity to provide you with some general considerations regarding the topic of controlling radioactive sources. These general considerations reflect key points the Society continues to make as it provides its expertise to Congress and to the Federal Agencies regarding the challenges brought on by the events of September 11, 2001.

If you have any questions regarding the enclosed materials, please do not hesitate to contact me, or the Society's Congressional and Federal Agency Liaison, Keith Dinger.

Sincerely,

John R. Frazier
President

Enclosure



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**HEALTH PHYSICS SOCIETY
RESPONSE TO THE
GENERAL ACCOUNTING OFFICE
REQUEST FOR INPUT ON CONTROL OF RADIOACTIVE MATERIAL
IN LIGHT OF ITS POTENTIAL USE IN A
RADIOLOGICAL DISPERSION DEVICE**

December 19, 2002



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INTRODUCTION

Senator Akaka, Chair of the Senate Governmental Affairs Subcommittee on International Security, Proliferation, and Federal Services, has requested the General Accounting Office (GAO) prepare a report addressing control of radioactive material in light of its potential use by terrorists in a dispersal device, such as a conventional bomb. The GAO has requested the Health Physics Society provide input on the subject in general, and on specific questions posed by the Senator.

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The Health Physics Society, formed in 1956, is a scientific organization of professionals who specialize in radiation safety. The Society's mission is excellence in the science and practice of radiation safety. Society activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. Society members are the leaders in understanding, evaluating, and controlling the potential health risks from radiation sources. The expertise of Society members in these areas qualifies them to assess potential radiological hazards from use of radioactive materials in a terrorist event and to identify appropriate actions in response to such an event. Society members represent stakeholders related to the use and control of radioactive materials, including radioactive source manufacturers, users, and regulators.

GENERAL CONSIDERATIONS

Radiological dispersion devices (RDDs), informally known as "dirty bombs", are conventional explosive devices incorporating radioactive materials. RDDs are distinctly different from nuclear weapons of mass destruction (WMD). Nuclear WMDs have the ability to kill large numbers of people and produce widespread destruction from the force of the detonation, and to a much lesser degree, cause radiation-induced deaths and injuries from the radiation emitted during the nuclear explosion. In contrast, it is extremely unlikely that an RDD could result in any clinically observable injuries or deaths from radiation exposures produced during or following detonation of the device. Any injuries and deaths from RDDs would be caused by the blast from the conventional explosive. RDDs, however,



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are designed to instill panic in the population, relying on fear of radiation to induce irrational and dangerous reactions in the general public, resulting in adverse psychosocial effects.

The ability of a detonated RDD to accomplish a terrorist's primary goal depends on the knowledge and perceptions of the general public, first responders, and decision-makers regarding radiation and its potential for inducing adverse health effects. Therefore, any actions to combat and mitigate the potential psychosocial effects from the use of radioactive materials in a terrorist event must address the underlying issue of adequate education on the scientific facts about radiation, primarily for people managing and responding to the event, but also for members of the general public who may be in the vicinity of the event.

Detonation of an RDD might disperse sufficient radioactive material into relatively large areas that would be rendered unavailable for use by the general public until such areas are decontaminated. Although detonation of an RDD would not likely produce any human health effects from the radioactive material, the resulting adverse economic effects of widely dispersed radioactive contamination could be significant.

Potential sources of radioactive materials for use in an RDD include orphan sources - radioactive sources that have been lost, stolen, or abandoned by their owners. Members of the Health Physics Society have been addressing the matter of orphan sources for many years and the Society has issued the attached Position Statement, "STATE AND FEDERAL CONTROL IS REQUIRED FOR BETTER CONTROL OF ORPHAN SOURCES," and the attached background information on this Position Statement.

Radioactive sources subject to the Health Physics Society concerns and recommendations in its position statement are *categorized* in the background information paper as those having characteristics that justify the need for the sources to be "licensed" and, thus, controlled and regulated to ensure public and environmental safety. Such characteristics include, for example, the amount of radioactive material, the "radiotoxicity" of the material, and the potential for use of certain materials in a nuclear weapon. Of course, there are numerous radioactive sources with characteristics that do not pose a threat to public safety;



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hence, expenditure of resources to increase control and regulation of these sources is not justified. The Society's concern has previously centered on the possibility that high-activity sources may cause inadvertent injury through ignorance or mishandling, such as those events that have happened in Brazil, Mexico, Spain, Thailand, the former Soviet Republic of Georgia, and other locations. However, to these earlier concerns has been added the speculation that orphan sources can be used to construct RDDs.

The ability of an RDD to result in sufficient radioactive contamination to disrupt the daily lives of a large number of members of the general public with a resulting economic impact depends on the characteristics and amounts of radioactive material used in the device.

Therefore, any actions to combat and mitigate the potential economic effects from the use of radioactive materials in a terrorist event must be based on the characteristics of the radioactive material. Just as the Health Physics Society has recommended appropriate categorization of sources for increased orphan source controls, the most logical approach for assessing potential hazards from, and to control requirements for, radioactive sources that could be used by terrorists is to establish a system of categorization that considers the characteristics of radioactive sources. This categorization system must include the accessibility to the sources by terrorist agents and other non-radiological attributes (e.g., physical properties) that effect their potential use in a terrorist event.

The Society recognizes the importance of assuring the security of sources that pose the greatest potential threat, but applying stringent precautions to radioactive sources that present no potential for use in an RDD can place an undue burden on the businesses, hospitals, and research institutions that possess such innocuous sources. These institutions will ultimately be called upon to implement source control requirements with the potentially adverse consequence of losing the benefit achieved through the intended use of these innocuous sources. The Health Physics Society feels there must be extensive informed discussion on this issue, and we urge that any classification scheme be developed with the assistance of qualified radiation safety personnel.



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The Health Physics Society position statement also includes a recommendation that alternative technologies be examined as part of implementing recommendations from national and international scientific committees known as the “Principle of Justification.” Recent legislation developed to address “dirty bombs” have included provisions related to alternative technologies, such as expert committees examining alternative technologies or offering tax incentives for the development of alternative technologies.

Just as in the case of increasing controls and requirements on radioactive sources, the Health Physics Society feels the legislative and regulatory pursuit of alternative technologies must involve extensive informed discussion on the issue and must be based on the potential hazard as identified in a classification system. The Society urges that the evaluation of alternative technologies and any application of those technologies be done with the assistance of qualified radiation safety personnel.

QUESTION 1: WHAT IS THE KNOWN NUMBER OF RADIOLOGICAL SOURCES IN THE U.S., AND HOW MANY HAVE BEEN LOST, STOLEN, OR ABANDONED?

Estimates of the number of devices in the U.S. containing radioactive sources, estimates of the number of those that are no longer used or needed, and estimates of the number of sources reported lost, stolen, or abandoned are given in the attached “Background Information” paper from the Health Physics Society, along with references for the source of the information.

The Health Physics Society urges caution when compiling and reporting numbers of radioactive sources when such numbers are to be considered in the context of their potential for use by terrorists. For example, the 2,000,000 devices with radioactive sources cited in our paper include large numbers of small, innocuous sources, such as household fire detectors, that present no viable use in an RDD. The most informative statistic for the purpose of the GAO report would be the number of sources *likely to be used in a terrorist event*. Therefore, the Society encourages the GAO to attempt to categorize or describe the nature of the sources reported as lost, stolen, or abandoned in order to maintain perspective on their potential use in a radiological dispersal device.



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QUESTION 2: HOW EFFECTIVE ARE NRC AND STATE CONTROLS OVER RADIOLOGICAL SOURCES?

Answers to this question should be developed in the context of this report. That is, the real concern is what is the effectiveness of controlling radioactive sources that could be of use to a terrorist?

This question is very general and results in an oversimplification of a complex issue, viz., controls over radioactive sources. Regulatory bodies, such as the NRC and State Radiation Control Programs, establish requirements for how radioactive sources are to be controlled by their owners and users. However, the owners and users perform the actual control of the sources. Two factors that determine the “effectiveness of controls” of radioactive sources are: (1) the effectiveness of the regulatory requirements; and (2) the effectiveness of owners and users to implement the requirements. The latter factor is a function of the effectiveness of the owners’ and users’ procedures and practices and of the effectiveness of the enforcement of the regulatory requirements and their implementation. Therefore, the effectiveness of controls over radioactive sources is not entirely attributable to the regulatory organization responsible for the source. Furthermore, the Department of Energy has regulatory responsibilities for some radioactive sources not covered by the NRC and States.

In our position statement, the Health Physics Society proposes improvements in licensing requirements, infrastructure support, licensee responsibilities, enforcement actions, and philosophical approach to licensed source controls. Clearly, the Society believes that the effectiveness of controlling sources categorized as an orphan source is in need of improvement, without attempting to quantify the effectiveness, or ineffectiveness of current controls.

QUESTION 3: WHAT EFFORTS HAVE BEEN INITIATED SINCE SEPT. 11 TO BETTER SAFEGUARD RADIOLOGICAL SOURCES?

The Health Physics Society has offered the expertise of its members to national and international governmental bodies in response to events of September 11, 2001. These have included the formation of a Society’s Committee on Homeland



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Security, assistance to Congressional members and committees, and support of programs within the Department of Justice, Department of State, Department of Defense, and the International Atomic Energy Agency.

Specific to safeguarding radiological sources, the Society assisted in an educational forum for congressional staff that was organized by the Senate Environment and Public Works Committee, and assisted in formulation of language for the “Dirty Bomb Prevention Act of 2002” (S. 2684) and the “Radiological Terrorism Prevention Act of 2002” (in draft by Senator Gregg).



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STATE AND FEDERAL ACTION IS NEEDED FOR BETTER CONTROL OF ORPHAN SOURCES

POSITION STATEMENT OF THE HEALTH PHYSICS SOCIETY*

Adopted: April 2002

Contact: Richard J. Burk, Jr.
Executive Secretary
Health Physics Society
Telephone: 703-790-1745
Fax: 703-790-2672
Email: HPS@BurkInc.com
<http://www.hps.org>

Orphan sources are radioactive sources that have escaped institutional control, i.e., sources that have been lost, stolen, or abandoned. The Health Physics Society believes that the orphan source problem is a radiation safety issue of high priority needing national and international attention. The Society makes the following recommendations regarding orphan sources:

1. A restructuring of the present system for the retention, transfer, and disposal of unwanted radioactive sources is needed so that it encourages prompt and proper transfer, storage, or disposal of such sources. So long as disposal options remain limited, there should be provisions for the prompt collection of unwanted sources and their storage at centralized secure facilities pending final decisions on their disposition. We recommend that this be the responsibility of a single federal agency. Federal agencies and the States, together with other radiation safety organizations, should work with safety and trade organizations to disseminate information on source disposition options to licensees. In particular, this educational effort should be directed toward licensees who have had little contact with federal and state regulators and have minimal radiation safety programs.
2. The previous and successive recommendations are prospective and will take several years to implement. We recommend that actions be taken by Federal and State regulatory agencies to prevent existing radioactive sources from becoming orphaned as well as to correct the problem with vulnerable sources.

Such actions should include the following:

- Developing procedures for recovery and safe transport of orphan sources.
- Creating temporary repositories where orphan sources may be stored safely and securely until disposition occurs.
- Developing national transport interception levels for these purposes.
- Developing a confidential national tracking system for licensed sources.
- Requiring financial surety for licensed sources.
- Enforcing license conditions on all licensed sources.
- Overhauling the radioactive materials licensing process for sources that could become orphaned consistent with the paragraphs above and below.
- Working to have these measures adopted internationally.

3. Federal and State regulatory agencies should fully implement the ICRP and NCRP principle of *justification*. They should examine the practicality of adopting as licensing policy the principles of *justification*, whereby: (1) there is documentation of the net benefit from the use of the radiation/radioactivity being licensed; and, (2) potential users examine alternative technologies that are technically and economically feasible and whose alternative use would result in an equal or greater net benefit than from the use of the radiation/radioactivity.

4. Federal funding for these new initiatives as well as for existing ones should be a high priority. Congress should emphasize this through budget resolution statements that specifically support and direct Federal agency programs to address the orphan source problem.

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Background Information on “STATE AND FEDERAL ACTION IS NEEDED FOR BETTER CONTROL OF ORPHAN SOURCES”

Position Statement of the Health Physics Society*

Adopted April 2002

Introduction

The Rules of the Health Physics Society (HPS) assign the responsibility “...for the preparation of impartial scientific and technical statements as it deems necessary” to the Society’s Scientific and Public Issues Committee (S&PIC). In this capacity the S&PIC and the Society’s President carry out the duties as Society spokesman in accordance with the Society By-laws. The S&PIC is composed of the President, President-elect, and the three most recent Past Presidents. The S&PIC has issued their “impartial scientific and technical statements” in various formats, but the most common method has been by means of formal “Position Statements.” Position Statements of the Health Physics Society are intended to address fundamental issues of radiation-safety with the expectation they will be enduring in their nature. To avoid excessive length and detail in position statements the thoughts and discussion that provided the background to the primary recommendations may be captured in a S&PIC approved document to provide amplification and clarification of the position statement for those desiring further background and supporting information.

In April of 2002, the S&PIC issued a position statement titled, “STATE AND FEDERAL ACTION IS NEEDED FOR BETTER CONTROL OF ORPHAN SOURCES.” This document provides background information on that position statement. It should be considered as an adjunct to the position statement and not a stand-alone document.

What is an Orphan Source?

An Orphan Source is taken to be a source of radioactive material that is not, but should be subject to regulatory control; a source subject to regulatory control, but has been abandoned, lost or misplaced; or a source that is subject to regulatory control, but has been stolen or removed without proper authorization (IAEA 2000)

How Many Orphan Sources Are There?

The number of devices in the U.S. containing radioactive sources is estimated to be approximately 2,000,000 (Meserve 2000). As many as 500,000 of these are unused and no longer needed or wanted (Lubenau & Yusko 2000).

Because disposal options are limited or too costly, unused or unneeded sources are often placed into unplanned long-term storage where some become vulnerable to loss, theft or abandonment, becoming orphan sources.

The Nuclear Regulatory Commission (NRC) estimated that approximately 375 sources are reported lost, stolen or abandoned each year, about one a day (Meserve 2000). The actual number is higher because not all such losses of control are reported.

Why are Orphan Sources a Concern?

Worldwide, at least 60 reported orphan source incidents have caused severe radiation doses to 266 unsuspecting members of the public (Yusko 2001). Of these, 39 individuals died as a result of their exposures. These accidents represent failures to meet the goal of the International Commission on Radiological Protection to avoid radiation exposures that lead to deterministic effects, i.e., preventing acute radiation injuries and deaths (ICRP 1990).

Orphan sources frequently become mixed with metal scrap destined for recycling. In the U.S., since 1983, over 500 radioactive sources have been reported found in metal scrap, with over half of these occurring since 1995 (Lubenau & Yusko 2000). If not detected and removed from the metal scrap, they cause contamination of metal products and byproducts and the metal making plants (Yusko 2000). In the U.S., there have been at least 33 incidents of this type. Cleanup, waste disposal, and other costs have been as much as \$ 23 million per event in the U.S. (Lubenau & Yusko 1998). The Atomic Energy Act and NRC regulations, in addition to providing for the common defense and security and protection of health and safety, provide for protection of property (USNRC 1996). U.S. steel makers have called for government action to address the orphan source problem (AISI 1998, SMA 2000).

Because of the threat of orphan sources, all U.S. steel manufacturers have installed radiation detection systems to monitor incoming scrap metal¹, an expensive undertaking. Many manufacturers of other metals have also done so, as have many facilities that accept and process scrap metals. These programs, in addition to detecting orphan sources, have also detected scrap metals contaminated by Naturally Occurring Radioactive Material (NORM) and other radioactive materials.

The events of September 11, 2001, have focused attention on all forms of terrorism, including the threat of using radioactive materials (NCRP 2001, Karam, *et al.* 2002). Addressing the orphan source issue successfully will help limit the availability of radioactive materials for this purpose.

What is Being Done About Orphan Sources?

The International Atomic Energy Agency (IAEA) recognizes orphan sources as a problem requiring special worldwide attention and has undertaken a number of initiatives to strengthen regulatory oversight of radioactive sources by national authorities (Gonzalez 1999, IAEA 1999, IAEA 2001a, Yusko 2001, IAEA 2001b).

U.S. initiatives include rule making and related actions taken by the NRC to improve oversight of selected general licensees (USNRC 2000), a program to conduct a "roundup" of orphan sources that is sponsored by the Council of Radiation Control Program Directors (CRCPD) initially supported by EPA and now supported by NRC and DOE. (CRCPD 2000); a DOE program to recover orphan sources in emergency situations; another DOE program to accept unwanted transuranic sources (USNRC 1999, Tompkins and Pearson 2001); and U.S. Department of State support of IAEA initiatives by sponsoring a position in the IAEA specifically for work on orphan source issue (Lubenau 2001).

It should be noted that although actions are being taken to secure some orphan sources, these do not address the root causes of the problem.

Root Causes of the Problem Are Not Being Addressed

Root causes contributing to the orphan source problem are:

1. Existing U.S. programs do not encourage and facilitate the prompt disposition of unwanted or unneeded radioactive sources for disposal or transfer to environments which provide safe and secure storage, pending final decisions on their disposition. Many licensees possessing radioactive devices have had no contact with regulators and consequently are not familiar with obligations to provide for proper disposal.
2. Licensees in possession of unneeded or unwanted sources often discover that disposition options are severely limited. For example, the return of sources to manufacturers may be dependent upon whether the manufacturing company still exists, its willingness to accept the sources, conditions imposed by it upon such transfers and the cost for the service. Disposal of the source as waste is limited by low-level radioactive waste compact agreements on access to disposal sites, as well as limits on the types and quantities of radioactive material that may be disposed. Even when available, disposal has become so expensive that many licensees resort instead to unplanned, long-term storage. Disposal to the DOE is restricted to transuranics and to emergency situations when requested by the NRC.
3. Some current uses of radioactive sources, as well as U.S. national radiation protection policies, do not meet the International Commission on Radiological Protection (ICRP) principle of *justification* (ICRP 1985, ICRP 1990, ICRP 1997).

Beyond *justification*, *optimization* is not always practiced. In some cases, alternative technologies (to radioactive materials) such as x-ray generators may be both technically and economically feasible, but these are not always utilized by potential users.

Underlying these factors is the lack of a coordinated national commitment to make solving of the orphan source problem a national priority. As a result, funding to support State and federal initiatives has been slow to come and subject to uncertainty. The NRC has amended its regulations to increase oversight of selected categories of general licensees and made changes to its enforcement program. Continued NRC support for these and other necessary changes will be influenced by budgetary constraints coupled with competing program needs within the NRC. In this regard, it should be noted that because of past resource constraints, NRC staff delayed earlier implementation of changes (Lubenau & Yusko 1995). The CRCPD's program to "round up" orphan sources will be limited by availability of State resources to conduct the program and federal funding to support it.

Footnotes

1. Radiation detection systems are installed at steel mill plant entrance points where incoming shipments of metal scrap are inspected and weighed. If multiple shipment entry points are in use at a plant, then a radiation detection system will be needed for each. Despite technical advances, these systems cannot provide 100% assurance of detection of orphan sources. To provide defense-in-depth, some steel plants install costly additional monitoring systems within the plant. Operating costs are also incurred for training and auditing of personnel, for maintaining and upgrading equipment and for management oversight.

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