# Mind the Gap

## The Role of Liability and Insurance Regimes in Strengthening Radiological Security

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*August 2014*

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CNS
James Martin Center for Nonproliferation Studies

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Previous studies have indicated that the threat of radiological terrorism could be reduced by the substitution of non-isotopic alternatives for high-risk radiological sources, where technically and economically feasible.[1] Users of these sources have yet to widely or expeditiously implement this recommendation, however, in large part because the price of isotopic sources is often lower than that of non-isotopic alternatives. One reason for this differential is that the price a user pays does not accurately incorporate the economic risks of damage to incomes and property should a terrorist radiological attack occur. This failure, in turn, stems from the nature of liability and associated insurance regimes covering radiological sources, which lack transparency and clarity. To reduce the threat of a terrorist attack, therefore, it would be helpful to establish legal and insurance mechanisms in order to bring the market costs of high-risk sources closer to actual social cost in order to provide more accurate information to radiological source users about the risks they carry in employing such sources, i.e. the likelihood of an attack or accident and their potential costs.

Similarly, measures to improve the security of radiological sources by implementing best practices in security procedures and physical protection measures would also serve to reduce the risk from radiological terrorism, as would more rapid disposal of disused sources. However, in the absence of clearer legal requirements, such rules and efforts can impose clear costs upon users, while the benefits to society of decreased risks do not make it onto users' bottom lines. That has meant that, in responding to greater public concerns about radiological terrorism after the 9/11 attacks, governments, including the United States, have taken it upon themselves to institute emergency measures to improve source security, often using public funds. However, these measures are less than optimal, have been far from universally implemented, and upgrades could impose costs on taxpayers for many decades to come. Moreover, even the United States, the lead country in spending on these efforts, routinely sacrifices radiological security to other budget priorities.[2]

It would therefore be useful for governments to consider measures that would shift more of the economic risks of maintaining such sources onto users in order to incentivize them to either step up security, dispose of disused sources, or switch to non-isotopic alternatives. New liability and insurance rules and laws and related measures could be a step in that direction. To investigate appropriate steps, the James Martin Center for Nonproliferation Studies (CNS), with the support of King's College London, held a June 2014 workshop in London under Chatham House rules with technical experts involved in insurance, liability law, nuclear and radiological science, and policy makers. This report is based on that workshop as well as additional research.

## The Potential Economic Costs of a Radiological Terrorist Attack

Estimating the potential cost of a radiological terrorist attack is a complex and uncertain enterprise. Nonetheless, these costs are likely to be substantial, running into the tens of billions of dollars in urban areas.

[1] See for example, National Research Council, *Radiation Source Use and Replacement*, (Washington, DC: The National

[2] For details of how budget cuts and spending on nuclear weapons are hurting radiological security and nuclear security work, see Matthew Bunn, Nickolas Roth, and William H. Tobey, *Cutting Too Deep: The Obama Administration's Proposals for Nuclear Security Spending Reductions*, Belfer Center for Science and International Affairs, July 30, 2014, <http://belfercenter.ksg.harvard.edu/project/3/managing_the_atom.html>.

Given that in a radiological attack the loss of life or injury will be far lower than in a nuclear attack, the major costs of an attack are expected to result from its effect in reducing or denying public access to and interest in contaminated areas and enterprises, particularly commercial enterprises. Such costs are commonly described as *event recovery costs*, *business impact costs*, and *perception-based costs. Event recovery costs* include the costs of decontaminating and otherwise restoring areas affected by an attack, and expenses related to relocation, compensation, and health care. *Business impact costs* include the costs of economic activity displaced by the attack (both within and outside the affected area) and diminished spending by affected employees. *Perception-based costs,* which can persist for many years, include a diminished willingness to purchase goods or services from, or invest in, the affected area. Potential costs, therefore, will be significantly affected by a number of factors:

1) **The level at which decontamination is determined to have been completed and employees and residents can return to the affected area**. At a higher threshold of remaining contamination, for example, non-destructive cleanup methods might be employed and a smaller area would have to be cleaned up: at a lower threshold, more expensive demolition or abandonment may be required and more land would be involved.[3]

2) **The value of the area and affected enterprises closed off by the attack**. Government studies indicate that an attack in downtown Manhattan or London would incur event recovery costs alone estimated at $25 billion per square kilometer; those in a far less dense and mixed use urban area like Albuquerque, New Mexico, might have event recovery costs fifty times less, or about $500 million per square kilometer. A 2012 study by the University of Southern California (USC) for the Department of Homeland Security of an attack in downtown Los Angeles did not calculate event recovery costs but did estimate roughly $2 billion a year in business impact and perception costs per year.[4]

3) **Long-term perception costs will likely overshadow other costs.** That USC study indicated, for example, that in the decade after the attack in downtown Los Angeles, perception-based costs of about $20 billion might be anticipated, with business impact costs running roughly one-tenth of that.[5]

4) **An adversary's capabilities to contaminate an area.** The technical skill with which a terrorist developed a weapon or the environments they choose to contaminate (land, water, etc.) will impact the damage they can cause.

5) **The nature of the high-risk source used**. Terrorists that used cesium chloride, for example, might cause particularly large economic losses given its power to contaminate large areas for many years and the difficulty of cleaning it up.

**Who Pays? The Contrast of Liability for Radiation from Radiological Sources and from Nuclear Plants**

To understand the gaps in liability and insurance for radiation sources, it is instructive to look at the legal regime governing nuclear power plants and related materials. Liability for dangerous nuclear radiation (the

[3] The appropriate decontamination level is far from settled. For a sampling of the debate on the issue, see Douglas Guarino, "Federal Panel: Dirty Bomb Cleanup Need Not Follow US Cancer Rules," November 26, 2012, <www.nti.org/gsn/article/federal-panel-dirty-bomb-cleanup-need-not-follow-us-cancer-rules/>.
[4] J. A. Giesecke, W. J. Burns, A. Barrett, E. Bayrak, A. Rose, P. Slovic, and M. Suher, "Assessment of the Regional Economic Impacts of Catastrophic Events: CGE Analysis of Resource Loss and Behavioral Effects of an RDD Attack Scenario," *Risk Analysis* 32 (2012), pp. 583–600.
[5] Ibid.

conventions do not distinguish between accidents or terrorist attacks) is clear for those countries that have ratified international conventions, such as the Convention on Supplementary Compensation for Nuclear Damage (CSC). The CSC, for example, provides that states party to the convention must "provide for strict liability in the event of a nuclear incident where there is substantial nuclear damage off the site of the nuclear installation where the incident occurs" and "require the indemnification of any person other than the operator liable for nuclear damage to the extent that person is legally liable to provide compensation."[6]

Therefore, in states party to these treaties, operators bear the full legal responsibility for ensuring the security (and safety) of their facilities. Victims of any untoward radiation releases from the facility will have a straightforward path to claim compensation, providing an incentive to the nuclear operators to safely operate the facility in order to avoid such payouts. Under such a strict liability standard, a plant operator would be liable even though he did not intend to cause the harm and did not bring it about through recklessness or negligence.

In many countries, such as the United States, governments have established mechanisms to share the economic risks associated with this potentially enormous liability in order to facilitate the operation of nuclear power plants. The United States, for example, has the Price-Anderson Act, which permits operators to buy into a pool (American Nuclear Insurers) for no-fault insurance and which ensures that payouts above pooled resources will be borne by the federal government.

However, the nuclear conventions explicitly exclude radiological sources from their scope. For instance, article 1 (e) of the annex to the CSC states:

"Radioactive products or waste" means any radioactive material produced in, or any material made radioactive by exposure to the radiation incidental to, the production or utilization of nuclear fuel, *but does not include radioisotopes which have reached the final stage of fabrication so as to be usable for any scientific, medical, agricultural, commercial or industrial purpose.* (Emphasis added.)

The CSC builds on two earlier nuclear liability conventions, the Vienna Convention on Civil Liability for Nuclear Damage and the Paris Convention on Nuclear Third Party Liability. According to the *Expose des Motifs* of the Paris Convention, its drafters, who were more cognizant of the nuclear power industry than the radiological source industry, intentionally excluded radiological sources from their scope. As Laurent Kueny, a French delegate to the International Atomic Energy Agency, wrote: "The radiation damage caused by the use of radioactive sources has been excluded from the nuclear liability instruments under the rationale that the use of radioisotopes, as with the use of x-ray equipment, does not present risks comparable to those arising from Nuclear Power Plant or from Nuclear Transport, for which the conventions were designed."[7] As a result, a major recent international conference on radiological sources noted "Financial and other liabilities have not yet been widely established for dealing with disused and orphan sources, and also with incidents and accidents involving radioactive sources."[8]

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[6] Convention on Supplementary Compensation for Nuclear Damage, July 22, 1998, Annex, Article 2, <www.iaea.org/Publications/Documents/Infcircs/1998/infcirc567.pdf>.

[7] Laurent Kueny, "Meeting the Technical, Medical, and Financial Challenges of Damages Caused by Radioactive Sources," paper delivered at the International Conference on the Safety and Security of Radioactive Sources, Abu Dhabi, Oct 27-31, 2013, pp. 7-8.

[8] "Findings of the President of the Conference," International Conference on the Safety and Security of Radioactive Sources: Maintaining Continuous Control of Sources Throughout Their Life Cycle, Abu Dhabi, Oct 27-31, 2013, p. 6.,

However, in the absence of clear national and international rules, many in the insurance and radiological sources industries are convinced that a radiological source possessor bears less liability for a radiation release than would a nuclear operator who discharged the same radiation. For instance, one insurance industry participant in the recent London workshop argued that rather than holding a source licensee to a strict liability standard, the victims of an attack using a stolen source would have to prove that the licensee was negligent in protecting the source. Indeed, there appears to be a widespread assumption in the insurance industry and among some regulators that national governments will foot the bill for any radiological terrorist attack.

According to experts, this legal interpretation is highly questionable. In the absence of clear international or national rules on liability, attempts to seek compensation for economic losses are likely to be handled by civil courts using existing precedents of tort law.[9] Interpretations and relevant laws vary between countries and even among US states. Nonetheless, some general principles do apply. First, in the United States, courts have tended to use a standard of strict liability for users of ultrahazardous materials.[10] Secondly, compliance with rules, national standards, and regulations is not a bar to liability, particularly in the case of strict liability. However, in some cases, intervening criminal activity, such as terrorism, may cut off liability.

Legal source possessors (that is, manufacturers, licensees, or those with legal title to a source) and ultimate consumers would therefore benefit from clarifying which standard should be applied. Given the danger of radiological terrorism, it would appear to make sense to have legal possessors of radiological sources subject to similar liability standards as nuclear operators (and associated regimes) for similar releases and risks. Moreover, given the lack of binding international rules, or even strong national rules and best practices when it comes to radiological security, it is not clear what implementation actions would constitute an effective defense against negligence should this standard be applied.[11]

Such a clear legal standard could be coupled with an approach proposed by Kueny. He has suggested that licensees be required to purchase insurance or a bond to cover potential third-party damages (including the health costs of victims), related to the misuse of sources. He notes that:

> Several countries requires licensees to lodge a bond to cover the end-of-life management of a source; when licensees are required to make a financial commitment to end-of-life

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<http://gnssn.iaea.org/CSN/Abu%20Dhabi%20Conference/Shared%20Documents/Closing%20session/Presidents_findings.pdf>.

[9] Torts are civil wrongs that can be redressed by awarding damages. See <www.law.cornell.edu/wex/tort>.

[10] See, for example, Crawford v. National Lead Co., 784 F. Supp. 439 (S.D. Ohio 1989).

[11] There is no binding international convention on radiological sources, only the voluntary Code of Conduct on the Safety and Security of Radioactive Sources and supplementary International Atomic Energy Agency (IAEA) guidance. The October 2013 Conference in Abu Dhabi on the Safety and Security of Radioactive Sources recommended that the IAEA convene a working group to assess the merits of developing a binding Convention on radioactive sources. The 2014 Nuclear Security Summit included a gift basket from a subset of members, led by the United States, in which they pledged to carry out IAEA recommendations for the physical protection of the most dangerous (Category I) sources. Regulations and implementation at the national level also have many holes. For example, the Government Accountability Office has issued several reports noting lapses by US licensees in handling radiological sources used in medicine and industry and failures in regulating licensees. See Government Accountability Office*, Nuclear Nonproliferation: Additional Actions Needed to Increase the Security of U.S. Industrial Radiological* Sources, GAO-14-293: June 2014 and Government Accountability Office, *Nuclear Nonproliferation: Additional Actions Needed to Improve Security of Radiological Sources at U.S. Medical Facilities*, GAO-12-925, September 2012.

> management, it would be logical to require them [to make a similar commitment to address] improper end-of-life management resulting in injury or economic loss.[12]

The absence of coverage of radiological sources in the nuclear conventions also creates problems at the international level. Should an attack occur with what is alleged to be an illegally imported source, disputes could arise over jurisdiction and in which forum a civil case might be tried. Other disputes could involve which laws to apply and the difficulties of providing records and enforcing judgments across borders.

**The Lack of Insurance Protection for Victims—and Governments**

The lack of clarity when it comes to the liability of legal possessors whose material is used in a radiological attack is matched by a similar lack of clarity when it comes to commercial property insurance policies concerning the victims of such attacks. Insurance companies do not provide commercial property insurance policies to cover damages from nuclear accidents or terrorism attacks because they are protected under Price-Anderson. But Price-Anderson does not apply to radiological terrorism attacks or accidents.

Meanwhile, as noted above, in economic terms, the greatest costs from a radiological terrorist attack over the long term are likely to be those to property and to businesses affected by an attack. These are also the damages least likely to be covered by private insurance.[13]

Economic damages from such an attack may not be covered since commercial insurers generally exclude losses from radiological (or chemical, biological, or nuclear) attacks even from terrorism insurance policies. The 2007 US Terrorism Reinsurance Authorization Act (TRIA) does not endorse such exclusions but does not explicitly block them either.[14] Experts caution, therefore, that many of these exclusions could be challenged legally—given the ambiguity of existing law—which leaves the property insurers ultimately liable. They warn

[12] Kueny, "Meeting the Technical, Medical, and Financial Challenges of Damages Caused by Radioactive Sources," pp. 7-8. Kueny raises questions about the desirability of extending the nuclear conventions and strict liability to some sectors such as industrial radiography, where operators generally operate on the industrial sites of their clients with "very little control of their work environment," and may need technical help to ensure that the device is operating properly. This and other elements may make it infeasible to extend the conventions per se to radiological sources, but a basic legal assumption of strict liability could be coupled with an ability of the licensee to negotiate contracts sharing that liability.

[13] If such an attack were to occur in the United States, individual workers are likely to be covered under worker compensation, health, and life insurance policies, because states generally do not allow these policies to exclude chemical, biological, radiological, or nuclear (CBRN) risks. Reinsurance restrictions on CBRN coverage, however, may limit the ability of insurance companies to actually pay claims. See comment to the President's Working Group on Financial Markets, *The Longterm Availability and Affordability of Insurance for Terrorism Risk,* April 2014, as noted on p. 19 and footnote 111 of the 2014 report.

[14] TRIA was initially authorized in the wake of the 9/11 terrorist attacks, when commercial insurers suffered $43 billion (in 2013) dollars in commercial losses and threatened to exclude coverage involving terrorism attacks. TRIA requires insurance companies to offer such coverage as part of standard commercial insurance and several other lines. See Government Accountability Office, *Terrorism Insurance: Status of Coverage Availability for Attacks Involving Nuclear, Biological, Chemical or Radiological Weapons*, GAO-09-39, December 2008; Government Accountability Office, *Terrorism Insurance: Treasury Needs to Collect and Analyze Data to Better Understand Fiscal Exposure and Clarify Guidance*, GA0-14-445, May 2014.

that the likelihood of such a judgment is likely to increase if the federal government has formally certified an attack as a terrorist attack. [15]

Many US insurance companies which provide terrorism insurance, for example, have told the Government Accountability Office (GAO) that they do not underwrite chemical, biological, radiological, or nuclear (CBRN) risks because the lack of available data to assess the frequency and severity of attacks makes it difficult to construct appropriate models, leading insurers to focus on worst case scenarios. They also have resisted including this coverage because the scale of potential losses and the deliberate nature of the acts and the lack of available reinsurance makes such coverage difficult to price or too expensive.[16] Industry experts also complain that a shortage of communication between government and industry makes it difficult to build models for estimating risks of a radiological terrorist attack and appropriate insurance policies to cover them. For example, they cite a lack of information about near misses and failed attacks. Acknowledging this can be difficult to do, they nonetheless point out that such information sharing is carried out in other sensitive industries. In fact, the Congressional Budgetary Office has managed to construct such models in order to determine the likely payout of claims for such an attack and the federal government's potential share in these expenses before they are recouped.[17]

Indeed, where such insurance is available today, it is generally perceived as too expensive given the estimated risk of an accident. For instance, there is a limited, stand-alone insurance market for CBRN insurance today but low demand and high prices—as much as five to ten times higher than general property insurance, according to the 2014 White House report—have prevented most businesses from purchasing coverage.[18] One nearly ten-year-old study estimated that only 35 percent of insurers offered CBRN coverage in TRIA-eligible lines, and less than 3 percent of policy holders opted for it.[19] The capacity of this market is also limited, for instance, with limits of as little as $750 million in some high-risk locations.[20] This contrasts with

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[15] The Treasury Department released an interpretative letter in 2004 stating that the program covers loss from a Treasury-certified act of terrorism, if the coverage for those perils is provided in the policy issued by the insurer. (Interestingly, no such certification was made after the 2013 Boston Marathon attack.)

[16] Government Accountability Office, *Terrorism Insurance: Treasury Needs to Collect and Analyze Data to Better Understand Fiscal Exposure and Clarify Guidance*, GA0-14-445, May 2014, p. 51. See also The President's Working Group on Financial Markets, *The Longterm Availability and Affordability of Insurance for Terrorism Risk,* April 2014, p. 16 (see footnote 91 in particular), <www.treasury.gov/initiatives/fio/reports-and-notices/Documents/PWG_TerrorismRiskInsuranceReport_2014.pdf>.

[17] It is interesting to note that insurance industry experts consulted by the Congressional Budget Office (CBO) apparently believe that annualized, projected, TRIA-backed CBRN losses to the federal government under a recently introduced House reauthorization bill (described below) are now estimated as lower than they were when the law was last reauthorized in 2007, although the reasons for this differences are not explained by CBO. The expected annual losses under the 2014 legislation were $650 million in the current study versus $800 million in 2007, but would only apply in any cases to where policy holders had TRIA-based coverage. Congressional Budget Office, *Cost Estimate: HR4871-TRIA Reform Act of 2014*, July 15, 2014, <www.cbo.gov/sites/default/files/cbofiles/attachments/hr4871.pdf>.

[18] This figure is for "standalone" coverage, which differs from the typical embedded coverage available for standard terrorism insurance. The President's Working Group on Financial Services, 2014. A similar multiple of five for CBRN coverage was cited by a Washington DC real estate developer in the 2008 GAO report.

[19] US Department of the Treasury, *Assessment: The Terrorism Risk Insurance Act of 2002,* Report to Congress, Washington, DC: June 30, 2005, <www.treasury.gov/resource-center/fin-mkts/Documents/tria_studyby_treas.pdf>. Similar conclusions were reached by the interagency President's Working Group on Financial Markets in its *September 2006 Terrorism Risk Insurance* report.

[20] President's Working Group on Financial Markets, April 2014, p. 24.

the broader terrorism insurance market, where more than 60 percent of commercial property holders purchase such coverage.[21]

**Covering the Gap**

It would therefore be useful for the United States and other countries where CBRN coverage is not routine to devise mechanisms for greater sales of such insurance. Given the potentially larger losses from a CBRN attack than from a conventional terrorist one, it is clear that this is not a burden that national governments will be able to shed entirely. Nonetheless, a market that shifted some of the expenses of smaller incidents to private insurance would be to the benefit of taxpayers even if the federal government still needed to backstop major attacks.[22] As importantly, when it comes to radiological sources, the involvement of insurance companies would provide an additional set of actors with an incentive to pressure users to upgrade security or pursue non-isotopic alternatives.

In the United States, the House of Representatives is considering one approach that might provide some greater incentive for CBRN coverage as it prepares to reauthorize TRIA. Draft House legislation would sharply raise the cap at which insurance companies could turn to the federal government for help in paying off commercial claims stemming from conventional attacks; the legislation, however, keeps the current, more generous cap and other terms for federal involvement in CBRN incidents if covered.[23] The principle of the federal government paying a greater share of the costs associated with CBRN attacks than conventional terrorist attacks makes sense, although where caps, deductibles, and other terms should be set to insure minimal federal involvement (both in terms of broad uptake of private policies and eventual catastrophic losses) is open to debate. [24]

However, the House bill would not block insurers from excluding CBRN coverage or from selling it separately; therefore, much of the price differential is likely to remain. A 2007 RAND Corporation study concluded that policies that bundled CBRN coverage with conventional terrorist coverage is likely to lead to higher take-up rates for private insurance and a better deal for the government.[25] Similarly, commercial property insurance policy holders have argued that, under TRIA, insurers should be required to offer CBRN coverage akin to that which they offer for conventional terrorism.[26]

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[21] As the title of the 2014 GAO report makes clear, data in this area is spotty but industry reports indicate that more than 60 percent of business have purchased terrorism insurance as part of their commercial property policy. Government Accountability Office*, Nuclear Nonproliferation,* pp. 30-31.

[22] Lloyd Dixon, Robert J. Lempert, Tom LaTourrette, and Robert T. Reville, *The Federal Role in Terrorism Insurance: Evaluating Alternatives in an Uncertain World,* RAND Corporation, 2007, <www.rand.org/pubs/monographs/MG679.html>.

[23] Current law requires insurers to pay the first $100 million in claims—for losses beyond that and up to $100 billion, industry and the federal government would share the losses: insurers would pay a 20 percent deductible of their premiums for TRIA-covered lines and 15 percent of the remaining charges. However, the federal government is mandated to recoup any losses that amount to less than $27.5 billion through a tax on policy holders and has the option of further surcharges above that.

[24] Dixon et al, "The Federal Role in Terrorism Insurance" provides a good overview of these tradeoffs.

[25] Ibid.

[26] Nathan Bacchus, "TRIA's importance to Risk Managers," Risk Management, March 1, 2014; Comments to the President's Working Group notice, September 2013.

In determining how to provide greater CBRN coverage, one model lies in Europe. Some European governments have made it possible for insurers to include CBRN coverage by permitting the companies to obtain reinsurance from government-backed terrorism insurance pools like the UK's Pool Re and France's *Gestion de l'Assurance et de la Réassurance des risques Attentats et actes de Terrorisme,* or GAREAT.[27] Under Pool RE, insurers pay into a common pool. Should an attack occur, an insurer will cover the first £20 million (about $34 million) in property damage or business interruption costs. After that, the pool will provide additional resources until it is exhausted (current resources are about £5 billion pounds) with the government providing the ultimate backstop.

GAREAT contains an interesting provision requiring all commercial policy holders to purchase antiterrorism insurance (including CBRN coverage) as part of their property insurance.[28] This approach may have some benefits in spreading risk among a larger pool, but—at least in the United States—might fail to gain political traction, given the heated debate about somewhat similar requirements in the Affordable Care Act (a.k.a. Obamacare). Moreover, even basic terrorism insurance is far from universal in Europe or other developed countries, and CBRN coverage even more so. [29]

**Practical Challenges in Holding a Licensee Liable**

Should laws assign strict liability to a licensee, compelling those licensees to pay compensation to victims could face practical challenge that should be addressed.

*Forensics*

Given the homogeneity, portability, and failure to implement potential tracking and identification technologies for radiological sources, it would likely be difficult to track an attack to a particular source and its licensee. Forensics could be further complicated if the material is used in a dirty bomb attack, with an explosion destroying much of the evidence.

To be sure, there are some practices and technologies that might be helpful. For instance, most modern sealed sources have a serial number engraved in the stainless steel encapsulation that might allow a source to be tracked back to the licensee and manufacturers of the relevant device. Unfortunately, record keeping is often poor, sources are sometimes resold, licensees can disappear, and such serial numbers are much harder to detect after an attack. One possibility might be for isotope producers or device manufacturers to add an additional unique isotope to their products, which would not affect the use of the source but would allow identification even after an accident.[30] To be effective, such a step would require international agreement. In addition, better

[27] *Catastrophe Risk: U.S. and European Approaches to Insure Natural Catastrophe and Terrorism Risks* GAO-05-199: February 2005.

[28] Spain and Australia have similar requirements, according to John Cooke, "Terrorism Risk Insurance in Selected Countries," *Policy Issues in Insurance,* OECD, 2005, pp. 241-275.

[29] Ibid.

[30] This possibility has yet to be explored rigorously, but CNS Scientists-in-Residence George Moore and Ferenc Dalnoki-Veress postulate that a small amount of a unique combination and ratio of isotopes could be produced and work as an identifier. One possibility might be for a manufacturer to add Cesium (Cs)-137 and Cs-134 to all of its sources at the end of the production process. Another, more complicated, approach would be adding different isotopes of the same type to each type of source. After a detonation, the traces of the material could be analyzed for the unique isotopic ratio, which should persist no matter how little material remained.

training is needed so that investigators would feel confident carrying out normal forensic operations such as DNA or fingerprint identification in a contaminated environment.

*Perception-Based Costs*

Calculating the appropriate compensation for the most expensive part of an attack—the perception-based costs—would be tremendously difficult, given its dependence on a subjective variable: the perceived psychological impact on potential employers and employees, as well as consumers and investors. Further study in this area would be worthwhile.

**Recommendations**

There are several options that countries, in particular the United States, could take, both domestically and in conjunction with the international community, that could address these issues of liability and risk.

*Options for Liability and Insurance Regimes*

National and international law and corresponding insurance regimes need to be adjusted to provide better market-based information to users about the risks they carry with high-risk radiological sources.

The clearest and most effective option would be for national authorities, particularly in the United States, to establish that those in legal control of a radiological source are liable for paying damages to victims if there is any untoward radiation release from the source (theft or accident). Such legislation should not prevent lawsuits seeking recompense from others to cover these costs, such as licensees suing manufacturers that produce a defective source that accidentally releases such material, or a consumer such as an oil company that does not provide adequate security or conditions for a mobile source operated by a licensed oil service firm.

Such national legislation would ideally be complimented or brought about by a similar international regime, through, for example, a convention for radiological sources. Such a convention would also clarify other relevant questions about jurisdiction, legal forum, and other relevant aspects of international law. It might also require source manufacturers to include a trace isotope for forensic purposes, and countries to notify the international community if a source fell out of regulatory control. It could also address international repatriation and disposal issues.

Should such an international regime be brought into existence, victims would be in a similar situation to that involving nuclear materials, and, as with Price-Anderson, would have little need for insurance policies to compensate for their losses.

In the absence of such a regime, countries—in particular on a coordinated, multilateral level—should establish better and clearer rules for radiological security and monitoring provisions (including tracking and tracing technologies) that would allow courts to make a fair judgment about the negligence and liability of those in legal control of sources. Ideally, some kind of international certification program under International Atomic Energy Agency auspices might be developed for this purpose, so that those who met the certification standard or switched to non-isotopic alternatives could profit from lower insurance rates.[31]

[31] Recent US Senate legislation from Senator Dianne Feinstein would establish US standards in this regard.

In such a scenario, potential victims would still benefit from having coverage against radiological terrorism. In the United States, for example, it would make sense to amend TRIA to prohibit excluding radiological terrorism from terrorism insurance policies and bundle the two together in order to assure a greater pool. It would also make sense for the federal government to accept a greater share of the costs of such incidents than those of equivalent conventional terrorist attacks.

In both cases, it would make sense, as Kueny has suggested, to use the financial assurance tool as a means of insuring against lost or theft of material. That is, in addition to purchasing a bond to pay for disposal, manufacturers, licensees, and shippers should be required to purchase a bond or insurance policy against the risk of loss or control of material before end of life, whenever and wherever it is under their legal control. Charges should also be scaled according to relative risks to people, businesses, and property (i.e. cesium chloride should have the highest cost).

*Further Studies and Models*

1. The Organization for Economic Cooperation and Development (OECD) should be tasked with carrying out a study looking at coverage of CBRN terrorism risk insurance across all its members and Russia. In the United States, the Treasury Department (perhaps in coordination with the Department for Homeland Security) needs to do a better job of assembling information about all terrorism risk insurance, including CBRN coverage. Both Treasury and the OECD should conduct studies considering the economic and effects of codifying a strict liability standard for radiological sources. Related studies should be carried out by relevant institutions looking at the effects on the applications of such sources in medicine, industry, hydrocarbons, etc.
2. As suggested by the 2013 International Conference on the Safety and Security of Radioactive Sources, the International Expert Group on Nuclear Liability should take up issues related to liability associated with radiological sources in both national and international law.[32]
3. The National Nuclear Security Administration should support efforts to examine the feasibility of using trace isotopes as a means of aiding forensic investigations of nuclear terrorism. Assuming this is shown to be technically feasible, international agreement should be sought on including such isotopes.
4. The GAO should initiate a study on the ability of insurance companies to cover mandatory lines of insurance—such as workmen's compensation and health insurance—in light of problems with commercial reinsurance in these areas, and consider whether reinsurance companies should be prohibited from such exclusions.
5. Governments should provide better information to the insurance industry on radiological terrorist threats, including failed attacks, and work with the industry to develop better models in order to enhance cost estimates of radiological terrorist attacks.

[32] "Findings of the President of the Conference," 2013, p. 13.

**About the Author**

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