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MULTIPLE FACETS OF DAMAGE CAUSED BY EXPOSURE TO LOW-DOSE RADIATION AND THE LEGAL REMEDY

Yi-Chen Su* & Peter W.S. Chang**

In addition to the toll in human life, there are at least three facets of damage caused by the protracted exposure to low-dose radiation: bodily injury, mental anguish, and property injury. After examining cases and compensation schemes in the United States and Taiwan, this article concludes that both the Taiwanese administrative compensation scheme and U.S. federal courts' interpretation of the Price-Anderson Act favor finding injury to the claimants' property, but not adverse effects to their health. To redress the injustice caused by the systemic bias, this article argues that the tort system should be adapted to tolerate gray area, such as the adoption of the probability of causation. This article further argues that the probability of causation should be applied in calculating damages in the radiation-exposure context.

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INTRODUCTION

The magnitude 9.0 earthquake,¹ which hit Japan in March 2011 leading to radiation leaking from the Fukushima power plant site,² raised worldwide concern regarding the consequences of radiation exposure. Radiation leaking or contamination usually has long term effects, oftentimes much longer than a human life. For instance, it is estimated that the radioactive materials released in Fukushima could exist at dangerous levels for up to half a million years.³

While high-dose⁴ radiation causes agonizing and often fatal damage to the human body in a matter of days or hours, low-dose radiation may lead to cancer.⁵ Epidemiologists estimated that 6,000 to 7,000 cases of thyroid cancer would not have occurred if it were not for the Chernobyl explosion in Russia in 1986.⁶

Other than the toll in human life, there are at least three facets of damage caused by the protracted exposure to low-dose radiation: bodily injury, mental anguish, and property injury. The legal remedy for each facet should be considered separately.

After examining cases and compensation schemes in the United States and Taiwan, this article concludes that both the Taiwanese administrative compensation scheme⁷ and U.S. federal

¹ Press Release, U.S. Geological Survey, USGS Updates Magnitude of Japan's 2011 Tohoku Earthquake to 9.0 (Mar. 14, 2011) *available at* http://www.usgs.gov/newsroom/article.asp?ID=2727&from=rss_home.

² David Muir, Jessica Hopper & Dean Schabner, *Japan Earthquake: Radiation Leaking after Fukushima Nuclear Plant Explodes*, ABC NEWS (Mar. 14, 2011) <http://abcnews.go.com/International/japan-earthquake-radiation-leaking-fukushima-nuclear-plant-explodes/story?id=13131123>.

³ Jeffrey Kluger, *Japan's Radiation Exposure: How Serious Is It?*, TIME: ECOCENTRIC BLOG (Mar. 12, 2011) <http://ecocentric.blogs.time.com/2011/03/12/japan-radiation-exposure-how-serious-is-it/>.

⁴ Dose is concentration multiplied by duration. Bernard D. Goldstein, *Toxic Torts: the Devil is in the Dose*, 16 J.L. & POL'Y 551, 566 (2008).

⁵ Eben Harrell, *Japan Nuclear Emergency: How Much Radiation Is Safe*, TIME: ECOCENTRIC BLOG (Mar. 13, 2011) <http://ecocentric.blogs.time.com/2011/03/13/japan-nuclear-emergency-how-much-radiation-is-safe/>.

⁶ Kluger, *supra* note 3.

⁷ Article 10 of the State Compensation Law requires each victim to initiate a

courts' interpretation of the Price-Anderson Act⁸ favor finding injury to the claimants' property, but not adverse effects to their health. Residents without property ownership, such as the lessee or the poor, are virtually remediless. The social injustice caused by systemic bias should be redressed. Part I of this article examines early milestone cases dealing with damage caused by low-dose radiation exposure in the United States and Taiwan respectively, and their effect on later cases or legislation. Part II briefly explores two compensation schemes in the United States, namely the Radiation Exposure Compensation Program⁹ and the Energy Employees Occupational Illness Compensation Program,¹⁰ in contrast to the federal courts' view of causation and the interpretation of bodily injury under the Price-Anderson Act in recent cases. Part III examines a Taiwanese court's reasoning in granting plaintiffs damages for mental anguish, as opposed to U.S. federal courts' reluctance in granting damages even if the defendants had engaged in deception or concealment concerning the danger of the work environment. This Part also highlights the anomaly under the Price-Anderson Act that a plaintiff has to separate her fear of the radioactivity from the non-radioactive part of the same material to which the plaintiff was exposed to be eligible for damages. Part IV examines the Taiwanese compensation scheme redressing property injury and U.S. federal courts' reasoning regarding the interpretation of damage to property and loss of use of property under the Price-Anderson Act.

negotiation process with the government authorities concerned for a possible agreement on compensation before going to court. Law of the People's Republic of China on State Compensation, art. 10 (1980) (Taiwan) [hereinafter State Compensation Law], *available at* <http://en.chinacourt.org/public/detail.php?id=1163> (amended) (original passed in 1980, not amended available at http://www.virtual-asia.com/taiwan/bizpack/legalcodes/state_compensation.htm).

⁸ U.S. Congress passed the Price-Anderson Act, 42 U.S.C. § 2210, in 1957. The Act authorizes the government making "funds available for a portion of the damages suffered by the public from nuclear incidents" and limiting "the liability of those persons liable for such losses" to serve dual purpose of protecting the public and encouraging the development of the atomic energy industry. 42 U.S.C. § 2012(i) (2011); *Duke Power Co. v. Carolina Env'tl. Study Grp., Inc.*, 438 U.S. 59, 65 (1978).

⁹ *Infra* note 124.

¹⁰ *Infra* note 170.

It is not the purpose of this article to argue whether an agency adjudication scheme is superior to the courts, or vice versa, in the radiation-exposure context. Rather, the article argues that the tort system should be adapted to tolerate gray area, such as the adoption of the probability of causation.¹¹ Currently, the probability of causation is employed under certain compensation schemes in inferring causal link. This article further argues that the probability of causation should be applied in calculating damages in the radiation-exposure context as well.

I. THE TORTS

It is difficult, if not impossible, to set a safe dose for radiation exposure.¹² Consequently, the difficulty in setting a threshold leads to the difficulty in establishing the standard of care, as well as negligence, in torts.

Though earlier cases seemingly have agreed that dose limits under federal regulations set the sole standard of care,¹³ recent cases suggest that the issue is far from settled. For instance, in *Dumontier v. Schlumberger Tech. Corp.*,¹⁴ the Court of Appeals for the Ninth Circuit opined that accepting federal dose limits as the standard of care would make a discharge or dispersal exceeding the limits in federal regulations a strict liability offence.¹⁵ It is evident under 10 C.F.R. § 140.81(b)(1) that exceeding such regulations, “although [a] possible cause for concern, is not one which would be expected to cause substantial injury or damage.”¹⁶ Similarly, the court in *Cook v. Rockwell Int’l Corp.*,¹⁷ also an American case, was struggling with

¹¹ *Infra* note 114.

¹² Harrell, *supra* note 5; *see also* 10 C.F.R. § 140.81(b)(1) (2011).

¹³ *See, e.g., In re TMI Litig.*, 193 F.3d 613, 626–27 (3d Cir. 1999), *amended by* 199 F.3d 158 (3d Cir. 2000); *Roberts v. Florida Power & Light Co.*, 146 F.3d 1305, 1308 (11th Cir. 1998); *O’Conner v. Commonwealth Edison Co.*, 13 F.3d 1090, 1105 (7th Cir. 1994).

¹⁴ 543 F.3d 567 (9th Cir. 2008).

¹⁵ *Id.* at 571.

¹⁶ 10 C.F.R. § 140.81(b)(1) (2011).

¹⁷ 618 F.3d 1127 (10th Cir. 2010).

the various regulations and documents proffered by the defendants.¹⁸ Eventually, the court concluded that the defendants failed to establish the minimal level of radiation exposure at which such contamination becomes unreasonable.¹⁹ The court interpreted relevant regulations, state or federal, as akin to zoning statutes – merely indicating special care must be taken, rather than setting a minimal level at which such contamination becomes unreasonable.²⁰

Indeed, studies have suggested that an individual's risk of cancer is increased even by exposure to low-dose radiation.²¹ Before the Second World War, it was believed no demonstrable harm could be measured by exposure to radiation below a tolerance dose.²² After the war, the concept of a threshold was gradually abandoned in light of the effects seen in the atomic bomb survivors in Japan.²³

Radiation contamination is the unpleasant consequence of utilizing radioactive materials in various sectors, such as generating electricity or assisting medical imaging or diagnosis. Litigation for damage caused by the contamination follow suit. Among those cases, *Wang Yu-Lin v. AEC*²⁴ and *In re TMI Litigation*²⁵ are the milestone cases concerning low-dose radiation exposure in Taiwan and the United States respectively.

The Taiwanese case, *Wang Yu-Lin*,²⁶ was chosen to elaborate the issues of establishing duty of care, negligence, and causation in a radiation-contamination context. The Taiwanese court sought

¹⁸ *Id.* at 1147.

¹⁹ *Id.*

²⁰ *Id.*

²¹ Per Hall, *Cancer Risks after Exposure to Low Doses of Ionizing Radiation—Contribution and Lessons Learnt from Epidemiology*, 2001 EUROPEAN COMMUNITY 22, available at http://ec.europa.eu/energy/nuclear/radiation_protection/doc/publication/125.pdf.

²² *Id.*

²³ *Id.* It has been shown that the risk of cancer is increased even at doses below 100 mSv. *Id.* at 30.

²⁴ *Wang Yu-Lin et al. v. AEC*, 2002 87-chong-shang-kuo-tze-1 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

²⁵ *In re TMI Litig.*, 193 F.3d 613 (3d Cir. 1999), amended by 199 F.3d 158 (3d Cir. 2000).

²⁶ 2002 87-chong-shang-kuo-tze-1 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

to answer the unsettled question whether statistics and laboratory data, such as the increased incidences of various cancers and the increased frequencies of chromosomal aberration,²⁷ in the absence of manifestation of physically detectable diseases, were sufficient to establish physical damage in torts.²⁸ If not, the question is whether the statistics and laboratory data suggesting adverse effects from radiation exposure to human bodies, in the absence of manifestation of diseases, were sufficient to establish a causal link from such radiation exposure to individuals' mental anguish.²⁹

By comparison, the American case, *In re TMI Litigation*,³⁰ demonstrates the extent of complexity and difficulty for plaintiffs to establish negligence and causation by estimating the radiation doses to which they were exposed.³¹ More importantly, even if the plaintiffs had developed illnesses, their case still failed because it is difficult, if not impossible, to exclude the possibility that the illnesses may have been induced by causes other than their exposure to radiation.³²

A. *Wang Yu-Lin v. AEC*

Since the issuance of the Taiwanese appellate court's decision in 2002 sustaining state compensation to citizens with prolonged excessive radiation exposure from ⁶⁰Co contaminated steels,³³ the spread of radioactive steel remains a worldwide concern. In recent years, large quantities of ⁶⁰Co contaminated steel were found or intercepted in several countries.³⁴ Some have caused significant

²⁷ Chromosomal aberration, which is a result of DNA damaged by irradiation, can be measured quantitatively as a function of absorbed dose. *In re TMI Litig.*, 193 F.3d at 640.

²⁸ *Wang Yu-Lin et al. v. AEC*, 2002 87-chong-shang-kuo-tze-1 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

²⁹ *Id.*

³⁰ 193 F.3d 613 (3d Cir. 1999).

³¹ *Id.* at 666–716.

³² *Id.* at 643–48.

³³ ⁶⁰Co is a radioactive isotope of Cobalt.

³⁴ See, e.g., Christian Schwägerl, *Finds of Radioactive Steel on the Rise in Germany*, SPIEGEL ONLINE INTERNATIONAL (Feb. 16, 2009) <http://www.spiegel.de/>

damage.³⁵

In March 1985, radiation safety surveillance was conducted for a newly installed X-ray machine at a dental clinic located in a newly-constructed apartment building called Ming-Sheng Villa.³⁶ The inspector was surprised that very high gamma-radioactivity was detected even if the X-ray machine was not plugged in.³⁷

The inspector submitted a report of his findings to the Taiwanese AEC, which is the governmental nuclear regulatory agency in Taiwan.³⁸ After receiving the report, the Taiwanese AEC dispatched two specialists to the dental clinic and the store next to the clinic for extensive investigation.³⁹ Radiation levels ranging from 0.5 to 120 μSv per hour were observed.⁴⁰ The radiation-protection specialists reported the results of their investigation and proposed remedial measures to the then Director of the Department of Radiation Protection of the AEC.⁴¹ For unknown reasons, both the Director and the then Secretary General of AEC decided to classify the reports and took no further action. As a result, neither the residents living in the Ming-Sheng Villa nor the general public was informed of the radioactive contamination.⁴²

international/world/0,1518,607840,00.html; IANS, *Germany Probes Radioactive Steel Exported by India*, SILICONINDIA NEWS (Feb. 15, 2009) http://www.siliconindia.com/shownews/Germany_probes_radioactive_steel_exported_by_India-nid-52533.html; Prabir Purkayastha, *Hot Steel and a Cold Govt: Mayapuri Radioactive Exposure*, INDIA CURRENT AFFAIRS (Aug. 10, 2010) <http://indiacurrentaffairs.org/hot-steel-and-a-cold-govt-mayapuri-radioactive-exposure-prabir-purkayastha/>.

³⁵ Prabir Purkayastha, *Hot Steel and a Cold Govt: Mayapuri Radioactive Exposure*, INDIA CURRENT AFFAIRS (Aug. 10, 2010) <http://indiacurrentaffairs.org/hot-steel-and-a-cold-govt-mayapuri-radioactive-exposure-prabir-purkayastha/>.

³⁶ Jau-Yuan Hwang, Joseph B.H. Chang, & Wushou P. Chang, *Spread of ⁶⁰Co Contaminated Steel and Its Legal Consequences in Taiwan*, 81 HEALTH PHYSICS 655, 655 (2001).

³⁷ *Id.*

³⁸ *Id.*

³⁹ *Id.*

⁴⁰ *Id.* 1 mSv equals 1000 μSv .

⁴¹ *Id.* at 655.

⁴² *Id.* at 655–56.

It was not until approximately seven years after the first official report was sent to the Taiwanese AEC, in August 1992, that the radioactive contamination at the Ming-Sheng Villa building was disclosed to the general public by a local newspaper.⁴³ The residents of the Ming-Sheng Villa learned from the media that, unbeknownst to them, they had stayed for years in apartments with excessive radiation levels.⁴⁴

The residents filed a petition for state compensation against the Taiwanese AEC in May 1994.⁴⁵ The Taiwanese AEC denied the petition a few days later.⁴⁶ As a result, a total of 57 residents of the Ming-Sheng Villa brought a collective civil action against the Taiwanese AEC before the Taipei district court.⁴⁷ The district court handed down a judgment partially in favor of the exposed residents in October 1997, and both the residents and the AEC appealed.⁴⁸

It is worth noting that it was not until May 1994, almost nine years after the first official report regarding the radiation contamination at Ming-Sheng Villa, that the Taiwanese AEC issued the Regulations for Prevention and Handling of Radiation Contaminated Buildings.⁴⁹ The regulations were the first written rule specifically governing radiation contaminated construction materials and buildings in Taiwan.⁵⁰ Therefore, there was no statutory text at the time of the incident prescribing AEC's duty.⁵¹

The appellate court, which is the trial of second instance in Taiwan, handed down its decision in January 2002.⁵² The court based its finding of governmental duty on the Council of Grand

⁴³ *Id.* at 656.

⁴⁴ *See* Wang Yu-Lin et al. v. AEC, 2002 87-chong-shang-kuo-tze-1 at 16–17 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

⁴⁵ Hwang, Chang, & Chang *supra* note 36, at 656.

⁴⁶ Wang Yu-Lin et al. v. AEC, 2002 87-chong-shang-kuo-tze-1 at 41 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

⁴⁷ Hwang, Chang, & Chang *supra* note 36, at 656.

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ *Id.*

⁵¹ *Id.*

⁵² Wang Yu-Lin et al. v. AEC, 2002 87-chong-shang-kuo-tze-1 at 87 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

Justices' prior interpretation of law.⁵³ Specifically, the Council of Grand Justices instructed that "whether a governmental agency has the duty to act is dependent on the purposes of the statute rather than the text of the statute."⁵⁴

The second paragraph of Article 2 of the State Compensation Law⁵⁵ ("SCL") provides that if any national's freedoms or rights are infringed as a result of failure of any civil servant in the fulfillment of his or her duty, such national is entitled to damage compensation against the government department to which the civil servant belongs.⁵⁶

In this case, the Taiwanese appellate court concluded that the AEC owed the residents a duty of care.⁵⁷ Based on the Council of

⁵³ Council of Grand Justices' Opinion No. 469 (Nov. 20, 1998) (Taiwan). The Council of Grand Justices consists of fifteen members nominated by the President. The Council is charged with interpreting the Constitution.

⁵⁴ Council of Grand Justices' Opinion No. 469 (Nov. 20, 1998) (Taiwan). The Council of Grand Justices' interpretation concerning the government's duty under Article 2 of the State Compensation Law stated that if the purposes of an enacted law are not limited to the prescription of government's authority in promoting public affairs, but instead protect the life, human health, property and other interests of the citizen, the victim of public authorities' action may seek compensatory damages. *Id.* In particular, if specific provisions are stipulated therein with respect to matters which are executed by the responsible authorities in the exercise of their public authorities, pursuant to which the public servant of a responsible authority has no discretionary power for inaction with respect to any obligations to identifiable persons, and the failure to discharge his or her duties by reason of deliberateness or negligence has resulted in harm to the liberty or rights of the identifiable persons, the victim of such failure may claim compensatory damages in accordance with Article 2, the latter part of Paragraph 2, of the State Compensation Law. *Id.*

⁵⁵ State Compensation Law, art. 2 (1980) (Taiwan), available at <http://en.chinacourt.org/public/detail.php?id=1163> (amended) (http://www.virtual-asia.com/taiwan/bizpack/legalcodes/state_compensation.htm, not amended: original passed in 1980).

⁵⁶ *Id.*

⁵⁷ Wang Yu-Lin et al. v. AEC, 2002 87-chong-shang-kuo-tze-1 at 49 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002). The Appellate Court opined that the AEC's duty to act included the examination of buildings suspected of using radioactive steel and other related materials from the same or similar sources; informing the residents in the Ming-Sheng Villa of the radioactivity levels detected in the

Grand Justices' interpretation, the appellate court reasoned that the government's duty exists when there is an imminent emergency even if the statute did not clearly specify the government's obligation.⁵⁸ Specifically, even if civil servants have discretion in determining whether to act or how to act, when a national's life, body, or health is facing imminent danger, the administrative agency's discretion should be reduced to zero in the face of emergency.⁵⁹

Moreover, the Taiwanese Control Yuan's⁶⁰ issuance of corrections against the Taiwanese AEC and its officials for the agency's nonfeasance may have paved the way for the Taiwanese court's finding of AEC's negligence,⁶¹ and thereby for the court to hold in favor of the exposed residents on policy grounds. The first correction against AEC officials led to the initiation of the lawsuit at issue,⁶² and the second correction issued approximately half a year before the appellate court's decision specifically pointed out that the AEC's nonfeasance had caused the exposed residents to suffer long-term mental anguish.⁶³

areas they lived; and controlling or the putting up alarms over the areas in which the radioactivity levels detected might have exceeded safety standards. However, the court acknowledged that the Taiwanese AEC did not have the direct duty or legal empowerment to confine and to prevent radioactive steel entering into the market, which is a duty comparable to the governmental agency's obligation to prevent unsafe drugs or food entering into the market. *Id.*

⁵⁸ *Id.*

⁵⁹ *Id.*

⁶⁰ The Control Yuan is one of the branches of the central government in Taiwan. It is an investigatory agency monitoring the other branches of the government. The Republic of China (Taiwan) *The Control Yuan*, GOVERNMENT ENTRY POINT, <http://www.taiwan.gov.tw/ct.asp?xItem=25513&ctNode=1957&mp=999> (last updated Apr 9, 2012).

⁶¹ *See* Wang Yu-Lin et al. v. AEC, 2002 87-chong-shang-kuo-tze-1 at 49 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

⁶² *Id.* In September 1993, the Control Yuan impeached three AEC officials in their personal capacity after investigation for their failure to report their findings to their superiors concerning the unusual radiation inside the wall of the building as well as the source of the contaminated steel. AEC officials impeached include the former Director of the Department of Radiation Protection and the former Secretary General; both had been involved in the decision to conceal the report mentioned in the above and took no actions in 1985. *Id.*

⁶³ *Id.* In May 2001, the Control Yuan issued another correction against the

The appellate court in Taiwan found that the causation between AEC's negligence and the suffering of the exposed residents exists based on an American legal concept, "reasonable medical certainty,"⁶⁴ even though the definition of "reasonable medical certainty" in American case law is far from certain.⁶⁵ The court's

Taiwanese AEC and the Department of Health on several grounds. First, the inconsistency of radiation exposure threshold for residents' mandatory health examination formulated by the AEC between Taipei city and other counties failed to meet international standards and had caused injustice. Second, the AEC's failure to provide residents with radiation safety education and necessary health consultation had caused residents economic losses and long-term mental anguish. Third, more than 150,000 buildings suspected of radiation contamination were yet to be examined, indicating the AEC's failure in the execution of radiation protection. Fourth, the Department of Health failed to follow the results of the residents' health examination for years and did not provide the residents with necessary medical assistances. *Id.*

⁶⁴The phrase "with a reasonable degree of medical certainty" in American case law can be traced to Chicago, Illinois, sometime during the years from 1915 to 1930. Jeff L. Lewin, *The Genesis and Evolution of Legal Uncertainty About "Reasonable Medical Certainty"*, 57 MD. L. REV. 380, 381 (1998). The standard of reasonable medical certainty was adopted "in law to assure that testimony received by the fact finder was not merely conjectural but rather was sufficiently probative to be reliable" because of the observation that "[l]ittle, if anything, is 'certain' in science." *Dallas v. Burlington Northern, Inc.*, 689 P.2d 273, 277 (Mont. 1984). The requirement of reasonable medical certainty is applicable only when an expert is expressing an expert medical opinion about causation or future damages, or other issues related to possibility or probability. *Holmes v. Gamewell*, 712 S.W.2d 34, 37 (Mo. App. E.D. 1986); *Wagner v. Piehler*, 879 S.W.2d 789 (Mo. App. W.D. 1994). In practice, reasonable medical certainty is the standard for medical testimony involving judgment as to causation and future damages. As a general rule, a statement of medical opinion must be one of "reasonable medical certainty" to support a finding of a causal relationship between an accident and an injury. *Carter v. Jones Truck Lines, Inc.*, 943 S.W.2d 821, 826 (Mo. App. S.D.1997).

⁶⁵It has long been criticized that the cases on reasonable medical certainty reflect a lack of clarity. *Wollen v. DePaul Health Center*, 828 S.W.2d 681, 682 (Mo. 1992). Though case law does not provide a definition, the how-to books for medical experts do. "The phrase 'reasonable medical certainty' means 'more likely than not.' In other words, if there is preponderance – [fifty-one percent] or more – of evidence in one direction, then the phrase 'reasonable medical certainty' is applicable." WILLIAM T. TSUHIMA & KENNETH K. NAKANO, *EFFECTIVE MEDICAL TESTIFYING – A HANDBOOK FOR PHYSICIANS* 5 (1998). Nevertheless, since the early 1980s, the requirement of "reasonable medical certainty" has been gradually replaced

finding of causation may be deemed a policy consideration.

The appellate court acknowledged that it is very difficult to establish factual causation by methods developed in natural science, such as the observance of increased rate of cancer occurrence after years of radiation overexposure.⁶⁶ It is impossible to request ordinary people without scientific knowledge or training to proffer evidence on the issue of causation in cases like this.⁶⁷ Therefore, in cases concerning public harm, the burden of proof on the issue of causation required in traditional torts should be relaxed.⁶⁸ The court opined that as long as the probabilities of the residents' contracting diseases increased due to the AEC's conduct, the requirement under the concept of "reasonable medical certainty" has been met.⁶⁹ It is not necessary for the plaintiffs to prove that AEC's conduct caused their actual damage.⁷⁰

with the "probabilities" of causal relationships because of the former's ambiguity and lack of clarity. *See Lane v. State Farm Mut. Auto. Ins. Co.*, 308 N.W.2d 503, 512–13 (Neb. 1981). However, a mere possibility does not qualify for admission into evidence nor does it make the expert testimony substantial evidence supporting a verdict or judgment of the court.

⁶⁶ Wang Yu-Lin et al. v. AEC, 2002 87-chong-shang-kuo-tze-1 at 75 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

⁶⁷ *Id.*

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ *Id.* Indeed, later studies showed that, in the case in Taiwan, the residents' cancer risks were demonstrated. The study conducted by Hwang et al. indicated that cancer occurrences exhibited significant exposure-dependent increased risks in individuals with the initial exposure before the age of thirty, but not beyond this age. S.L. Hwang et al., *Cancer Risks in a Population with Prolonged Low Dose-Rate Gamma-Radiation Exposure in Radiocontaminated Buildings 1983–2002*, 82 INT'L. J. RADIATION BIOLOGY 849, 849–58 (2006). Another study conducted by Hwang et al. further strengthened the association between protracted low-dose radiation and cancer risks, especially for breast cancers and leukemia, in this unique affected population. S.L. Hwang, J.S. Hwang, Y.T. Yang, W.A. Hsieh, T.C. Chang, H.R. Guo, M.H. Tsai, J.L. Tang, I.F. Lin & W.P. Chang, *Estimates of Relative Risks for Cancers in a Population after Prolonged Low-Dose-Rate Exposure: a Follow-Up Assessment from 1983 to 2005*, 170 RADIATION RES. 43, 143–48 (2008).

The court further reasoned that the Taiwanese AEC could have foreseen that the residents' health be affected by their exposure to the radioactive steel, and therefore causation exists.⁷¹ The Taiwanese AEC knew since 1985 both that the building was contaminated with radioactive steel and the source of the steel, but neglected to inform the residents.⁷² AEC's inaction caused the residents exposure to radioactive materials for a prolonged period of time.⁷³ Therefore, the court concluded that this should be sufficient to find causation in this case, and stated that to find otherwise would cause injustice.⁷⁴

The Taiwanese court created an exception, lowering the bar of causation for this particular case, arguably based on policy considerations. On the other hand, unlike the Taiwanese court in *Wang Yu-Lin*, the American court in *In re TMI Litigation* refused to relax the standard of causation in the radiation-exposure context.

B. *In re TMI Litigation*

The radiation leak at Three Mile Island more than thirty years ago was described as “the worst nuclear accident” in the United

⁷¹ Wang Yu-Lin et al. v. AEC, 2002 87-chong-shang-kuo-tze-1 at 76 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

⁷² *Id.*

⁷³ *Id.*

⁷⁴ *Id.* In 2004, a group of residents in Taipei County sued the Taiwanese AEC on the same grounds as the residents in the *Ming-Sheng Villa* case. Yang Feng-Ming v. AEC, 2005 94-chong-shang-kuo-tze-4 at 7 (Civ. Judgment of Taiwan App. Ct., Aug. 31, 2005). On appeal, the Appellate Court concluded that the statute of limitation had elapsed since the residents first knew of the radioactive contamination. *Id.* The court reasoned that, in this case, the Taiwanese AEC learned of the radioactive contamination in October 1996 and promptly informed the residents. *Id.* The residents applied for compensations and the compensations were granted pursuant to the Regulations for Prevention and Handling of Radiation Contaminated Buildings which was issued in 1994 after the Ming-Sheng Villa incident. The residents in this case did not initiate a lawsuit until April 2004. *Id.* It was more than eight years since they learned of the radioactive contamination. *Id.* The statute of limitations is two years from the time the plaintiffs learn of the tortfeasors who committed the tort. *Id.*

States.⁷⁵ Radioactive materials were released into the environment, including a river nearby.⁷⁶ It took operations personnel almost one month to regain control and reestablish stable conditions after the accident.⁷⁷ Litigations claiming personal injury continued for almost twenty years and those cases were eventually consolidated in one federal court.⁷⁸ These cases showcase the tort system's helplessness, rather than unpreparedness, in dealing with new challenges accompanied with the advances of science and technology.

Following the accident, more than 2,000 plaintiffs filed claims alleging that they had developed neoplasms⁷⁹ caused by exposure to the radioactive materials released into the environment as a result of the nuclear reactor accident on March 28, 1979.⁸⁰ The district court granted summary judgment in favor of the defendants, including the owners and operators of the nuclear facility, and held that the plaintiffs⁸¹ were unable to connect their neoplasms, either directly or indirectly, to the accident.⁸² The parties appealed.⁸³

The Third Circuit Court of Appeals previously had held that, for plaintiffs to prevail in claims alleging injuries caused by radiation exposure, they must establish: first, the defendants released radiation into the environment exceeding the doses permitted by the federal

⁷⁵ *In re TMI Litig.*, 193 F.3d 613, 655–56 (3d Cir. 1999), amended by 199 F.3d 158 (3d Cir. 2000).

⁷⁶ *Id.* at 658.

⁷⁷ *Id.* at 657.

⁷⁸ *Id.* at 625.

⁷⁹ *Id.* at 622. Neoplasm is defined as “an abnormal tissue that grows by cellular proliferation more rapidly than normal and continues to grow after the stimuli that initiated the new growth cease.” Neoplasms may be either benign or malignant. *Id.* at 623 n. 2.

⁸⁰ *Id.* at 622–24.

⁸¹ *Id.* at 627. The trial plaintiffs are a group of ten plaintiffs selected by the parties to participate in a “mini trial” of the claims. They are also called “typical” plaintiffs. *Id.* at 622. The neoplasms they suffered including acute lymphocytic leukemia, chronic myelogenous leukemia, thyroid cancer, Hurthle cell carcinoma, thyroid adenoma, osteogenic carcinoma, breast cancer, adenocarcinoma of the ovaries, bladder cancer, and acoustic neuroma. *Id.* at 623, 627 n. 15.

⁸² *Id.* at 623, 628.

⁸³ *Id.* at 628.

regulations in effect at the time of the incident;⁸⁴ second, the plaintiffs were exposed to the radiation, though it is not a requirement that the doses to which they were exposed were in excess of the levels permitted by the federal regulations;⁸⁵ third, the plaintiffs suffered injuries;⁸⁶ and fourth, the radiation was the cause of the injuries.⁸⁷ Here, in *In re TMI Litigation*, the plaintiffs were unable to proffer reliable dose estimates of the radiation to which they were exposed even with the aid of experts.⁸⁸

On appeal, as the court framed it, the critical issue in this case is whether the trial plaintiffs have the ability to “demonstrate that they were exposed to doses of radiation sufficient to cause their neoplasms.”⁸⁹ Indeed, the court of appeals agreed with the district court’s findings in general that, though the majority of the plaintiffs’ expert witnesses were well-qualified, many of the methodologies and data their opinions were based on are those that “a reasonable expert in the field would not rely upon.”⁹⁰ As a consequence, the majority of the expert testimonies proffered by the plaintiffs were excluded, and the remaining were insufficient to create a material issue of fact to survive the summary judgment.⁹¹

However, the court acknowledged that low-dose radiation may cause lethal damage by injuring DNA, even if not all irradiation-caused damage to DNA is harmful.⁹² It is also believed that the probability of causing such lethal damage, rather than the severity, is determined by dose.⁹³ In other words, the probability of radiation exposure leading to cancer is proportional to the dose absorbed.⁹⁴

The court further acknowledged that medical examinations and laboratory tests cannot prove or disprove “that a specific

⁸⁴ *In re TMI Litig.*, 67 F.3d 1103, 1119 (3d Cir. 1995).

⁸⁵ *Id.*

⁸⁶ *Id.*

⁸⁷ *Id.*

⁸⁸ See *In re TMI Litig.*, 193 F.3d at 627.

⁸⁹ *Id.* at 622–23.

⁹⁰ See *id.* at 627, 666–716.

⁹¹ *Id.* at 717.

⁹² *Id.* at 640, 642.

⁹³ *Id.* at 640, 642.

⁹⁴ *Id.* at 642.

malignancy was caused by a specific radiation exposure.”⁹⁵ The inquiry into cause is further complicated by the fact that radiation is not known to leave a marker in cells that later become malignant,⁹⁶ and that mankind has been exposed to natural radiation since our first appearance on the planet.⁹⁷ Therefore, even if the plaintiff can prove that her cancer was caused by radiation,⁹⁸ she may not be able to exclude the possibility that the cancer was induced by other causes, such as the natural radiation or other background radiation.⁹⁹

Seemingly the only way to establish causation, as the court has suggested, though it was not sure, is probably by conducting epidemiological studies of populations exposed to radiation.¹⁰⁰ Consequently, though not presented in *In re TMI Litigation*, another issue arising from the admissibility of evidence in similar cases is under what circumstances epidemiological studies can be used to establish causation between the radiation exposure and the injury.¹⁰¹ As the Fifth Circuit Court of Appeals recently suggested, epidemiological studies can be used only if: first, the studies are scientifically reliable and show a substantially elevated risk; second, the plaintiff is similar to those in the studies; and third, the plaintiff must offer evidence excluding other plausible causes of the injury or condition with reasonable certainty.¹⁰² The instruction, which was originally devised by the Texas Supreme Court,¹⁰³ is not helpful because the plaintiff would eventually fail on the third element for not being able to exclude other possible causes.

As exemplified in *In re TMI Litigation*, plaintiffs in a lawsuit relating to nuclear accidents oftentimes cannot describe how the incident occurred because of the complexity of nuclear science

⁹⁵ *Id.* at 643.

⁹⁶ *Id.*

⁹⁷ *Id.*

⁹⁸ The court suggested that translocations, or stable chromosome aberration, can be reliably used as markers for estimating dose exposure. *Id.* at 690-91.

⁹⁹ *Id.* at 643-44.

¹⁰⁰ *Id.* at 643.

¹⁰¹ *Cotroneo v. Shaw Env't & Infrastructure, Inc.*, 2011 639 F.3d 186, 192-93 (5th Cir. 2011).

¹⁰² *Id.*

¹⁰³ *Id.*

and engineering involved.¹⁰⁴ In some ways, this complexity could affect the establishment of the defendants' duty of care. Even if the parties are able to establish the duty of care, it is difficult to estimate the radiation doses to which the plaintiffs were exposed because of the existence of numerous unsettled competing theories and models in the field.¹⁰⁵ Consequently, epidemiological studies based on the estimates of radiation doses cannot be admitted to prove causation.¹⁰⁶ As the court in *In re TMI Litigation* has stated, it "is somewhat analogous to the last domino in the line that begins to fall when the first domino is toppled."¹⁰⁷

In particular, dose reconstructions¹⁰⁸ are more complex when the claimants experienced more diverse exposures and circumstances of exposure, either on an individual basis or as a group,¹⁰⁹ as seen in some radiation-exposure class litigations.¹¹⁰ It further adds to the complexity and difficulty in estimating radiation doses if there is potential for internal doses, as opposed to external doses,¹¹¹ through the ingestion, inhalation or absorption of radioactive materials.¹¹²

¹⁰⁴ See *In re TMI Litig.*, 193 F.3d at 655. The court's description of the TMI accident was exclusively taken from the defense exhibits. The plaintiffs did not offer any explanation of how the accident occurred. *Id.*

¹⁰⁵ See *id.* at 659–62, 667–95.

¹⁰⁶ See *id.* at 704–06.

¹⁰⁷ *Id.* at 715.

¹⁰⁸ Dose reconstruction refers to research and analysis leading to a quantitative estimate of radiation exposure, particularly when radiation monitoring data are unavailable, incomplete, or unreliable. NAT'L INST. FOR OCCUPATIONAL SAFETY AND HEALTH, USER'S GUIDE FOR THE INTERACTIVE RADIOEPIDEMIOLOGICAL PROGRAM 16 (2009).

¹⁰⁹ See Guidelines for Determining Probability of Causation Under the Energy Employees Occupational Illness Compensation Program Act of 2000, 67 Fed. Reg. 22,296 (May 2, 2002) (to be codified at 42 C.F.R. pt. 81).

¹¹⁰ See e.g., *In re Hanford Nuclear Reservation Litig.*, 292 F.3d 1124 (9th Cir. 2002); *In re TMI Litig.*, 193 F.3d 613 (3d Cir. 1999).

¹¹¹ External dose is referring to the dose from radiation sources located outside the body. NAT'L INST. FOR OCCUPATIONAL SAFETY AND HEALTH, *supra* note 108, at 16.

¹¹² See Methods for Radiation Dose Reconstruction Under the Energy Employees Occupational Illness Compensation Program Act of 2000, 42 USC § 7384 (2010); see also Methods for Radiation Dose Reconstruction Under the Energy Employees Occupational Illness Compensation Program Act of 2000, 67 Fed. Reg. at 22,314 (May 2, 2002) (to be codified at 42 CFR Pt. 82).

The extensive involvement of science and technology in *In re TMI Litigation* can be demonstrated by the court's unusually long opinion, which dedicated approximately thirty pages to explaining the background knowledge of nuclear science and technology.¹¹³ Therefore, the right question to ask in cases like this is, assuming that the plaintiff's illness was actually caused by the radiation, whether a reasonable plaintiff has the capacity to establish the causal link. Alternatively, should public policy allow holding victims to a high burden of proof under which virtually no reasonable plaintiff could prevail?

Perhaps with this question in mind, the court in *In re TMI Litigation* did point out the possibility of moving away from the demand of rigid causation toward a "probability of causation" approach in determining the probability that a particular malignancy may have been caused by the plaintiff's exposure to the particular radiation.¹¹⁴ Later, in *Kennedy v. S. Cal. Edison Co.*,¹¹⁵ the Ninth Circuit Court of Appeals opined that, whether the calculation of the probability of causation is *per se* unreliable is not the point.¹¹⁶ The point, as the court in *In re TMI Litigation* asked but could not resolve, is whether the plaintiff has the ability to demonstrate that the deceased was exposed to doses of radiation sufficient to cause her illness."¹¹⁷

In essence, courts in these cases were conducting circular reasoning. A court suggested that epidemiological studies should be helpful in establishing causation,¹¹⁸ and then another court instructed that epidemiological studies cannot be admitted unless the plaintiffs can exclude other possible causes.¹¹⁹ One court suggested that the

¹¹³ *In re TMI Litig.*, 193 F.3d at 629–58.

¹¹⁴ *Id.* at 727. A "probability of causation" ("PC") approach determines the probability, as opposed to absolute proof, that a particular malignancy may have been caused by exposure to ionizing radiation. "Although the radiation dose to the individual is a variable in the PC equation, there is no specific dose required to make the equation workable." *Id.*

¹¹⁵ 268 F.3d 763 (9th Cir. 2001).

¹¹⁶ *Id.* at 771.

¹¹⁷ *See id.*; *see also In re TMI Litig.*, 193 F.3d at 622–23.

¹¹⁸ *In re TMI Litig.*, 193 F.3d at 643.

¹¹⁹ *Cotroneo v. Shaw Env't & Infrastructure, Inc.*, 2011 F.3d 186, 193 (5th Cir.

probability of causation may help when plaintiffs cannot reliably estimate radiation doses,¹²⁰ and then the other court commented that the probability of causation needs not be considered if the plaintiffs cannot reliably estimate whether the radiation dose is sufficient to cause the illness.¹²¹

Though the Taiwanese court in *Wang Yu-Lin* found that causation exists and acknowledged that the plaintiffs' health was affected, the court was reluctant to grant plaintiffs damages for the injury to their health. In the radiation-exposure context, however, the Sixth Circuit Court of Appeals has asserted the plaintiffs' needs for immediate medical monitoring,¹²² and epidemiological studies might be frustrated by lengthy appeals even if the plaintiffs prevail at trial.¹²³ Because of the difficulty in setting the standard of care, finding negligence, and proving causation, agency adjudication schemes began to develop through legislation.

II. REMEDY FOR BODILY INJURY

Creating an agency adjudication system to remedy the claimants' injury to health caused by low-dose radiation exposure not only reduces the claimants' burden of proof, but allows the government to incorporate its policy considerations into the compensation system. The Radiation Exposure Compensation Program¹²⁴ ("RECP") in the United States is an example.

2011).

¹²⁰ *In re TMI Litig.*, 193 F.3d at 727.

¹²¹ *Kennedy v. S. Cal. Edison Co.*, 268 F.3d at 771.

¹²² The medical monitoring claim seeks to compensate for the costs of periodic testing to detect disease onset. Jamie A. Grodsky, *Genomics and Toxic Torts: Dismantling the Risk-Injury Divide*, 59 STAN. L. REV. 1671, 1679 n. 18 (2007).

¹²³ *Nieman v. NLO, Inc.*, 108 F.3d 1546, 1554 (6th Cir. 1997).

¹²⁴ Dep't of Justice, *Radiation Exposure Compensation Act (RECA)*, <http://www.justice.gov/civil/common/reca.html> (last visited June 28, 2011). U.S. Congress passed the Radiation Exposure Compensation Act (RECA) on October 5, 1990 and later broadened the scope of the Act's coverage on July 10, 2000 42 U.S.C. § 2210 (2006). The RECA provides that the Attorney General be responsible for processing and adjudicating claims under the Act. The Department of Justice established the Radiation Exposure Compensation Program ("RECP"), which is administered by its Civil Division's Torts Branch. *Id.*. See also Letter from Ste-

The RECP is an example of an administrative adjudication scheme triggered by failed class action. Many people filed class action lawsuits alleging exposure to radiation hazards after the cessation of the government's aboveground atomic weapons tests from 1945 to 1962,¹²⁵ as well as underground uranium-mining operations and related activities.¹²⁶ The lawsuits were eventually dismissed by the appellate courts and Congress stepped in to devise a program to make partial restitution to individuals who have developed serious illness after exposure to the radiation.¹²⁷

The program recognizes that the money paid is partial restitution, which does not completely compensate for the burdens placed upon the individuals,¹²⁸ and the program was designed as an expedient, low-cost alternative to litigation.¹²⁹ Unlike litigation, the RECP does not require claimants to establish causation, as do the courts.¹³⁰ Instead, a claimant qualifies for the compensation by establishing the diagnosis of a listed disease after working or residing in a designated location for a specific period of time.¹³¹

phen L. Caldwell Director, Homeland Security and Justice Issues to The Honorable Patrick J. Leahy, Chairman & The Honorable Arlen Specter, Ranking Member, Comm. on the Judiciary, U.S. Senate, The Honorable John Conyers, Jr., Chairman, The Honorable Lamar S. Smith, Ranking Member, Comm. on the Judiciary, House of Representatives (Sept. 7, 2007) [hereinafter Radiation Exposure Letter], available at <http://www.gao.gov/new.items/d071037r.pdf> (relating to Radiation Exposure Compensation Act: Program Status).

¹²⁵ Radiation Exposure Letter, *supra* note 124.

¹²⁶ *Id.*

¹²⁷ Dep't of Justice, *Radiation Exposure Compensation Act (RECA)*, <http://www.justice.gov/civil/common/reca.html> (last visited June 28, 2011).

¹²⁸ Radiation Exposure Letter, *supra* note 124, at 1 n. 1.

¹²⁹ Dep't of Justice, *supra* note 127. As of fiscal year 2006, the average claim-processing time was less than one year. Radiation Exposure Letter, *supra* note 124, at 3. Nevertheless, the expedient low-cost alternative to litigation was not created at the expense of precision and fairness. The program allows claimants being rejected for compensation to re-file their claims with RECP after obtaining new evidence to correct the deficiency that led to the rejection. *Id.* at 8. Specifically, in about forty percent of the claims rejected, claimants re-filed their claims at least once. *Id.* Because the convenience of re-filing their claims, very few claimants would seek judicial review. *Id.*

¹³⁰ Dep't of Justice, *supra* note 127.

¹³¹ *Id.*

The Radiation Exposure Compensation Act¹³² (“RECA”), which is the statutory authority for RECP, has been amended several times.¹³³ The RECA Amendments of 2000, among other things, added compensable diseases and expanded both the time periods and geographic areas covered under the program, allowing more individuals to be eligible for the compensation.¹³⁴ Since the program began processing claims in April 1992,¹³⁵ as of June 2007 approximately two-thirds of claims filed were granted.¹³⁶ Claimants residing downwind of the weapon test sites received almost half of the payments.¹³⁷

The policy consideration behind RECP is evident. The program has expanded its coverage even though the decision was not supported by critical medical evidence.¹³⁸ The RECA Amendments of 2002 eliminated the requirement for uranium workers diagnosed with lung cancer to submit certain medical evidence to redress the unintended effect of excluding many lung cancer claimants from eligibility for compensation under the program.¹³⁹ Before the amendment, the Agency for Toxic Substances & Disease Registry had concluded that lung cancer and some other cancers in many uranium miners are not caused by uranium radiation because the miners smoked cigarettes and were exposed to other substances also known to cause cancer.¹⁴⁰

Unfortunately, the eligibility for restitution under the RECP is limited. Responding to the lawsuits filed in federal and state courts following the nuclear accident at Three Mile Island

¹³² 42 U.S.C. § 2210 (2011).

¹³³ Radiation Exposure Letter, *supra* note 124, at 2.

¹³⁴ *Id.*

¹³⁵ *Id.* at 1.

¹³⁶ *Id.* at 3. The program had received more than 26,000 claims. *Id.* Among them, over 18,000 claims were approved and more than 24,000 claimants were compensated. *Id.* at 7.

¹³⁷ *Id.* at 8.

¹³⁸ *Id.* at 2.

¹³⁹ *Id.*

¹⁴⁰ Agency for Toxic Substances & Disease Registry, *Public Health Statement for Uranium*, CDC (Sept. 2011) <http://www.atsdr.cdc.gov/phs/phs.asp?id=438&tid=77>.

in 1979, Congress added section 2014(hh) to the Price-Anderson Act¹⁴¹ (“PAA”) providing the federal courts with original and removal jurisdiction for any “public liability action”¹⁴² resulting from “a nuclear incident or precautionary evacuation,”¹⁴³ except for certain claims covered by workers’ compensation, claims incurred in wartime, or claims involving the licensed property where the nuclear incident occurs.¹⁴⁴ Under the PAA, “nuclear incident” was defined as any occurrence causing “bodily injury, sickness, disease, or death, or loss of or damage to property, or loss of use of property, arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of source, special nuclear, or byproduct material.”¹⁴⁵ Courts have interpreted “bodily injury” as one of the threshold requirements to be satisfied before seeking damages under the Act.¹⁴⁶

Approximately ten years after *In re TMI Litigation*, and approximately seventeen years after RECP began processing claims, specific causation continued to haunt the courts and bar plaintiffs from seeking damages for their personal injury. In *June v. Union Carbide Corp.*,¹⁴⁷ the Tenth Circuit Court of Appeals suggested that the plaintiffs might have produced evidence sufficient to raise a genuine issue of fact if they timely argued that they had produced evidence of but-for causation,¹⁴⁸ instead of urging the court to adopt a substantial-factor test.¹⁴⁹ However, the court acknowledged that

¹⁴¹ The Price-Anderson Act of 1957, Pub. L. No. 85–256, 71 Stat. 576 (codified as amended in scattered sections of 42 U.S.C.).

¹⁴² “Public liability action” is defined as “any suit asserting public liability.” 42 U.S.C. § 2014(hh) (2011). “Public liability” is defined as “any legal liability arising out of or resulting from a nuclear incident or precautionary evacuation.” 42 U.S.C. § 2104(w) (2011).

¹⁴³ *El Paso Natural Gas Co. v. Neztosie*, 526 U.S. 473, 477 (1999).

¹⁴⁴ 42 U.S.C. § 2104(w) (2011).

¹⁴⁵ 42 U.S.C. § 2014 (q) (2011).

¹⁴⁶ *See, e.g.*, *Phillips v. E.I. DuPont De Nemours & Co.*, 534 F.3d 986, 1010 (9th Cir. 2008); *June v. Union Carbide Corp.*, 577 F.3d 1234, 1248 (10th Cir. 2009).

¹⁴⁷ 577 F.3d at 1234.

¹⁴⁸ *Id.* at 1246–47. The court suggested that the plaintiffs can prevail if they produce evidence that radiation was a necessary component of a causal set that probably would have caused the Plaintiffs’ ailments. *Id.* at 1247.

¹⁴⁹ *Id.* at 1239. The plaintiffs argued that, under the substantial-factor test, an ac-

the plaintiffs' expert witnesses are vulnerable to the defendants' challenge if admitted,¹⁵⁰ and the court acknowledged that it has no expertise in analyzing the data and opinions from the plaintiffs' experts.¹⁵¹

Therefore, even if the plaintiffs were residents of a uranium and vanadium milling town,¹⁵² which had been ranked by the Environmental Protection Agency to prioritize remedial action as the nation's most environmentally hazardous sites,¹⁵³ and at least some of the plaintiffs or decedents had developed diseases,¹⁵⁴ their claims for personal injury could not survive summary judgment.¹⁵⁵ For plaintiffs who had not developed any disease, their claims for medical monitoring were not compensable because they failed to meet the threshold requirement of bodily injury under the PAA.¹⁵⁶ The court reasoned that subclinical injuries, such as DNA damage and cell death, creates only a possibility of clinical disease and does not constitute bodily injury under the PAA, regardless of certain state courts' recognition of medical-monitoring claims absent clinical symptoms.¹⁵⁷

The *June* court raised public policy considerations to justify its denial of relief for plaintiffs who have not developed diseases.¹⁵⁸ As the court has stated, public policy dictates "denying relief to those without symptomatic, diagnosed ailments so that scarce resources can be directed to compensate those who have suffered more serious

tor's conduct can be deemed causal where it is of sufficient significance in producing the harm as to lead reasonable persons to regard it as a cause and to attach responsibility. *Id.*

¹⁵⁰ *Id.* at 1247 n.7.

¹⁵¹ *Id.* at 1246–47.

¹⁵² *Id.* at 1236.

¹⁵³ *Id.* at 1237.

¹⁵⁴ Of the twenty-seven personal-injury plaintiffs, eleven had been diagnosed with non-thyroid cancer and sixteen had been diagnosed with thyroid disease, including one case of thyroid cancer. *Id.*

¹⁵⁵ *Id.* at 1236.

¹⁵⁶ *Id.* at 1248.

¹⁵⁷ *Id.* at 1249.

¹⁵⁸ *Id.* at 1251.

harms.”¹⁵⁹ These public policy considerations are simply misguided because plaintiffs, even those who have suffered serious harms, would eventually fail on causation issues and be left remediless.

Similarly, in *Phillips v. E.I. Dupont De Nemours & Co.*,¹⁶⁰ the Ninth Circuit rejected a more lenient “substantial factor test” and insisted on finding but-for cause.¹⁶¹ As a result, even though the court found that plutonium production at the Hanford Nuclear Weapons Reservation was an abnormally dangerous activity warranting strict liability and thereby limited the issues to causation and damages,¹⁶² the residents living in the surrounding area of Hanford Reservation were unable to prove that the amount of radiation to which each plaintiff was exposed was sufficient to be the factual cause of his or her thyroid disease.¹⁶³

Though the *Phillips* court rejected medical-monitoring claims under the PAA,¹⁶⁴ the jury in the lower court found in favor of two plaintiffs who had developed thyroid cancer.¹⁶⁵ Nevertheless, the *Phillips* court was skeptical about “government bias” in revealing the Hanford Environment Dose Reconstruction Project,¹⁶⁶ which released a report disclosing that a large quantity of radioactive substances had been emitted from the Hanford Reservation into the surrounding area,¹⁶⁷ and the plaintiffs’ stipulation to the accuracy of the document prior to trial.¹⁶⁸

Contrary to the stagnation in court, administrative compensation schemes have developed and adopted probability of causation to estimate the probability or likelihood that the illness of an individual member of a certain group was caused by exposure

¹⁵⁹ *Id.*

¹⁶⁰ 534 F.3d 986 (9th Cir. 2008).

¹⁶¹ *Id.* at 996, 1010–11.

¹⁶² *Id.* at 998, 1005.

¹⁶³ *Id.* at 998–99, 1013–14.

¹⁶⁴ *Id.* at 1010.

¹⁶⁵ *Id.* at 998–99.

¹⁶⁶ *Id.* at 1014.

¹⁶⁷ *Id.* at 997. The U.S. Department of Energy created the project in 1987. In 1990, a report entitled Initial Hanford Radiation Dose Estimates was released. The disclosure sparked a blaze of litigation. *Id.*

¹⁶⁸ *Id.* at 1014.

to a particular hazard.¹⁶⁹ For instance, an energy employee is eligible for compensation for a specified cancer under the Energy Employees Occupational Illness Compensation Program Act of 2000 (“EEOICPA”)¹⁷⁰ if the Department of Labor determines that the cancer was “at least as likely as not,” a fifty percent or greater probability, caused by radiation doses incurred in the performance of duty.¹⁷¹

However, employing the probability of causation to determine whether a claimant should be compensated may lead to an unintended result. As James Robins has pointed out, companies would have the incentive to replace workers just before their cumulative exposure was large enough for the probability of causation to exceed the mandated cutoff point.¹⁷² Nevertheless, the unintended result can be avoided if the compensation awarded is in proportion to the probability of causation regardless of whether the particular claimant’s probability of causation is higher or lower than fifty percent.

In fact, what commentators were really opposed to is arbitrarily setting a cutoff point, or a bright-line, such as a relative risk¹⁷³ exceeding 2.0.¹⁷⁴ Though it might be imprecise or even

¹⁶⁹ Guidelines for Determining the Probability of Causation Under the Energy Employee Occupational Illness Compensation Act of 2000, 67 Fed. Reg. 22,296, 22,297 (May 2, 2002) (to be codified at 42 C.F.R. pt. 81).

¹⁷⁰ 42 U.S.C. § 7384–85 (2011) .

¹⁷¹ Guidelines for Determining the Probability of Causation Under the Energy Employee Occupational Illness Compensation Act of 2000, 67 Fed. Reg. 22,296, 22,296 (May 2, 2002) (to be codified at 42 C.F.R. pt. 81).

¹⁷² James Robins, *Science for Judge II: the Practice of Epidemiology and Administrative Agency Created Science: Should Compensation Schemes be Based on the Probability of Causation or Expected Years of Life Lost?*, 12 J. L. & POL’Y 537, 544 (2004).

¹⁷³ Relative risk or rate ratio is calculated from epidemiologic data comparing the disease rate in a cohort of individuals exposed to the hazard to that in an unexposed cohort. Robins, *supra* note 172, at 538.

¹⁷⁴ See, e.g., Goldstein, *supra* note 4, at 569–70; Steven N. Goodman, *Science for Judges VII: Evaluating Evidence of Causation & Forensic Laboratories: Current Issues & Standards: Judgment for Judges: What Traditional Statistics Don’t Tell You About Causal Claims*, 15 J. L. & POL’Y 93, 102–04 (2007); David W. Barnes, *Too Many Probabilities: Statistical Evidence of Tort Causation*, 64 L. & CONTEMP.

erroneous, some experts in court have equated a relative risk of two to a fifty percent probability of causation.¹⁷⁵ Apparently, the main justification for setting a cutoff point at fifty percent is not science but the legal concept, “more likely than not.”¹⁷⁶ As Bernard D. Goldstein has argued, a strictly applied bright-line rule is inappropriate because the determination of relative risk in an epidemiological study is far from precise.¹⁷⁷ Consequently, it would affect the probability of causation, which is calculated based on the relative risk.

As an alternative to the probability of causation, commentators have suggested that compensation awarded should be in proportion to the claimants’ expected years of life lost,¹⁷⁸ or quality-years of life lost.¹⁷⁹ As commentators have argued, a just compensation scheme should be sensitive to incidence time, such as awarding damages in proportion to years of life lost, while the probability of causation is insensitive to the impact of exposure on disease timing.¹⁸⁰ In addition, “a payment scheme with awards proportional to the probability of causation is sensitive to both misspecification of exposure interaction with other risk factors and heterogeneity of the background rates.”¹⁸¹

PROBS. 191, 205–07 (2001). “The law appears willing to accept no more than a forty-nine percent chance of error while science appears willing to accept no more than a five percent chance of error. This perception is incorrect, but hard to change.” *Id.* at 191.

¹⁷⁵ Sander Greenland, *Relation of Probability of Causation to Relative Risk and Doubling Dose: a Methodologic Error that has Become a Social Problem*, *Am. J. Pub. Health* 89(8): 1166, 1166–67 (1999).

¹⁷⁶ *See, e.g.*, Robins, *supra* note 172, at 537; Guidelines for Determining the Probability of Causation Under the Energy Employee Occupational Illness Compensation Act of 2000, 67 Fed. Reg. 22,296, 22,296 (May 2, 2002) (to be codified at 42 C.F.R. pt. 81).

¹⁷⁷ Goldstein, *supra* note 4, at 570.

¹⁷⁸ *See, e.g.*, Robins, *supra* note 172, at 537; Sander Greenland & James M. Robins, *Epidemiology, Justice, and the Probability of Causation*, 40 *JURIMETRICS* 321, 323 (2000).

¹⁷⁹ Robins, *supra* note 172, at 537.

¹⁸⁰ Greenland & Robins, *supra* note 178, at 323.

¹⁸¹ James Robins & Sander Greenland, *The Probability of Causation Under a Stochastic Model for Individual Risk*, 45 *BIOMETRICS* 1125, 1131 (1989). Unmeasured genetic and environmental factors may lead to large between-subject

It is true that the probability of causation has limitations. James Robins argued that awarding compensation in proportion to the probability of causation raises a serious problem with fairness: under such a payment scheme, the estate of a young man and of an old man would be equally compensated for the same probability of causation, even if the young man has suffered a greater loss.¹⁸² Nevertheless, awarding payment in proportion to expected years of life lost raises serious problem with unfairness as well. Specifically, defendants may be charged with a huge liability disproportional to their culpability and be driven out of the nuclear industry, which is what the PAA sought to prevent.

Moreover, at present the probability of causation is used in determining causation, rather than the amount of damages. Without first establishing causation, there is no issue of compensation.

Therefore, this article argues that the award of damages, either in court or under an administrative compensation scheme, should be in proportion to the defendants' culpability. When the substance for the rule of causation changes, such as the adoption of the probability of causation, the rule for damages should change as well. Otherwise, the scale would tip in favor of the plaintiffs against the defendants. This is especially true when plaintiffs cannot exclude other probable causes for their injury and have to rely on the probability of causation to infer a causal link.

A legal decision cannot wait for a complex scientific issue to become clarified.¹⁸³ It is a policy choice between awarding a large sum of compensation to fewer claimants but wrongly excluding claimants who should have been eligible for the compensation, and awarding less compensation to more claimants by eliminating an arbitrary cutoff point for eligibility. In light of the inherently imprecise nature¹⁸⁴ of the probability of causation and relative risk, the article suggests choosing the latter.

Nevertheless, as discussed in Part II, dose reconstructions in radiation-exposure class litigations where the claimants are

heterogeneity in background hazards. *Id.* at 1126.

¹⁸² Robins, *supra* note 172, at 544–45.

¹⁸³ Goldstein, *supra* note 4, at 571.

¹⁸⁴ See *Kennedy v. S. Cal. Edison Co.*, 268 F.3d at 771 (2001).

residents rather than workers at the nuclear plant, are much more complicated and difficult to estimate reliably enough to convince the court. Alternatively, claimants were compelled to explore other causes of action, such as the infliction of mental distress.

III. REMEDY FOR MENTAL ANGUISH

As the President's Commission on the Accident at Three Mile Island has acknowledged, the most serious health effect of the accident was severe mental stress, especially for families with preschool children, although the Commission believed that the mental stress was short lived.¹⁸⁵ The knowledge of unnecessary and excessive radiation exposure, in and of itself, may cause mental anguish.¹⁸⁶ It is especially so when there is deception or concealment about the exposure involved, such as in the Taiwanese case, *Wang Yu-Lin*, and an American case, *Rainer v. Union Carbide Corp.*¹⁸⁷ Alleging physical harm in the absence of manifestation of diseases, as seen in *Wang Yu-Lin*,¹⁸⁸ is usually insufficient for a court to find damages. Though the Taiwanese court was reluctant to find the existence of physical harm in this case, it did in some way relax the requirement for finding mental anguish and grant damages to the residents. Specifically, the court answered the question whether AEC's inaction is the direct cause of the residents' mental anguish.¹⁸⁹

The court reasoned that, though the residents had not shown cancerous effects or other genetic effects, the "factors" that would cause abnormality in health had been inside the residents' body because of their long-term excessive exposure to radiation, as demonstrated by the results of clinical tests.¹⁹⁰ The abnormality

¹⁸⁵ PRESIDENT'S COMMISSION ON THE ACCIDENT AT THREE MILE ISLAND, THE NEED FOR CHANGE: THE LEGACY OF TMI 13 (1979).

¹⁸⁶ See *Rainer v. Union Carbide Corp.*, 402 F.3d 608, 613 (6th Cir. 2005). One of the lead plaintiffs in this case testified that his main fear was not present injury, but that he was "worried to death" what the radiation was doing to him. *Id.*

¹⁸⁷ 402 F.3d 608 (6th Cir. 2005).

¹⁸⁸ *Wang Yu-Lin et al. v. AEC*, 2002 87-chong-shang-kuo-tze-1 at 49 (Civ. Judgment of Taiwan App. Ct., Jan. 30, 2002).

¹⁸⁹ *Id.*

¹⁹⁰ *Id.* at 74. Laboratory studies suggested that the residents' physical health may

in health would eventually emerge, after a latency period whose duration varies.¹⁹¹ Therefore, it cannot be said that the residents' health was not harmed simply because there was no manifestation of symptoms.¹⁹² Compared to ordinary people, "factors" that would affect the residents' health were already inside their body.¹⁹³

Nevertheless, it appeared that the court's granting of damages was predominantly based on the finding of mental anguish the residents suffered, rather than the physical harm to the residents' body. The court's reasoning continued that because the residents have higher incident rates of cancers, as well as blood-cell abnormality, genetic damage, and higher chance of incurring other diseases than the ordinary population, it has become a heavy psychological burden for the residents.¹⁹⁴ Therefore, it is evident that the residents' mental health was harmed.¹⁹⁵

On the other hand, the plaintiffs in *Rainer* were not so lucky. The plaintiffs in *Rainer* were current and former workers at a uranium-enrichment plant and their family members.¹⁹⁶ The workers were exposed over many years to dangerous radioactive substances without their knowledge, but were not yet suffering from any symptoms of a clinical disease at the time they filed the lawsuit.¹⁹⁷ Company documents also revealed that the management hesitated to have workers' health examined because of the union's alleged use of this as an excuse for hazard pay.¹⁹⁸ Moreover, workers

have been affected by the exposure to radiation including the significant increases in chromosomal aberration frequencies. The residents' ratio of thyroid gland enlargement was four times higher than the reference group, and the ratio of T-lymphocyte function abnormality was two times higher. *Id.* at 68. In addition, two out of nine newborns born in the radioactive contaminated building had congenital heart diseases. The ratio is 22.2%, which is higher than 0.8%, the ratio among normal populations. *Id.* at 67.

¹⁹¹ *Id.* at 74.

¹⁹² *Id.*

¹⁹³ *Id.*

¹⁹⁴ *Id.* at 75.

¹⁹⁵ *Id.*

¹⁹⁶ *Rainer v. Union Carbide Corp.*, 402 F.3d at 611, 613–14.

¹⁹⁷ *Id.* at 611.

¹⁹⁸ *Id.* at 612.

at the plant were not required to wash their hands and not required to use respirators until the late 1970s.¹⁹⁹

In the workers' situation, as a lead plaintiff testified in *Rainer*, what made them worried to death was not present injury but what the radiation was doing to them,²⁰⁰ especially in light of the company's concealment.²⁰¹ Similar to the plaintiffs in *Wang Yu-Lin*, laboratory tests showed a significantly higher ratio of structural chromosome abnormalities within the workers' cells in *Rainer*.²⁰² Nevertheless, contrary to the Taiwanese court in *Wang Yu-Lin*, the *Rainer* court reasoned that the plaintiffs' "DNA damage is harmful only insofar as it is predictive of future harm" and the injuries claimed "have caused no financial losses or impairments."²⁰³ The court dismissed workers' claims as "premature."²⁰⁴

It is worth noting that the fear of developing cancer and the increased risk of cancer are compensable outside the PAA context. For instance, the Fifth Circuit in *Smith v. A.C. & S., Inc.*²⁰⁵ opined that a plaintiff seeking recovery for fear of cancer is compensable if he can present evidence of his specific fear of the condition as a threshold matter,²⁰⁶ rather than a general statement that he is concerned about his health,²⁰⁷ and if the jury finds that the plaintiff's fear of cancer is both reasonable and serious.²⁰⁸ A plaintiff can recover for the increased risk of cancer if he can prove that his toxic exposure will more probably than not lead to cancer.²⁰⁹ The U.S. Supreme Court in *Norfolk & Western Railway. v. Ayers*²¹⁰ took a

¹⁹⁹ *Id.*

²⁰⁰ *See id.* at 613.

²⁰¹ *See id.* at 611–12.

²⁰² *Id.* at 613.

²⁰³ *Id.* at 622.

²⁰⁴ *Id.*

²⁰⁵ *Smith v. A.C. & S., Inc.*, 843 F.2d 854 (5th Cir. 1988). The plaintiff was a former industrial sheet metal worker who sustained extensive exposure to asbestos dust. *Id.* at 855.

²⁰⁶ *Id.*

²⁰⁷ *Id.* at 859.

²⁰⁸ *Id.*

²⁰⁹ *Id.* at 859 n.3.

²¹⁰ *Norfolk & Western Ry. v. Ayers*, 538 U.S. 135 (2003).

step back from *Smith* and held that a plaintiff can recover damages for fear of cancer without proof of physical manifestations only if the plaintiff has asbestosis and he can prove that the fear is genuine and serious, but the opinion is limited to claims brought under the Federal Employers' Liability Act.²¹¹

Unlike asbestosis, exposure to low-dose radiation does not leave an identifiable marker in the victim's body before cancer can be detected.²¹² The lack of an identifiable marker adds difficulty to the award of damages for mental anguish in the radiation-exposure context. The district court in *Berg v. E.I. Dupont De Nemours & Co.*²¹³ sought to devise a bright-line test and held that plaintiffs who were not ill could proceed with their emotional-distress claims if they can prove that the median of the probability-of-causation estimates exceeds fifty percent.²¹⁴ However, on appeal, the Ninth Circuit concluded that allowing purely emotional-distress claims would be inconsistent with the PAA's "bodily injury" requirement; although Washington state law permits such claims in the absence of physical injury.²¹⁵ Therefore, in essence, the PAA has deprived victims of damages for mental anguish available under certain state law.

The discrepancy between the PAA and state law has generated a legal fiction that plaintiffs, who were exposed to materials possessing both radioactive and nonradioactive properties, can recover damages for mental anguish caused by the exposure to the non-radioactive property but not the radioactive property of the same material. For instance, in *Golden v. CH2M Hill Hanford Group, Inc.*,²¹⁶ the plaintiff was exposed to toxic liquid containing

²¹¹ *Id.* at 157. Asbestosis is a noncancerous scarring of the lungs by asbestos fibers. It is a chronic disease that is fatal only in rare instances. *Id.* at 142 n.2.

²¹² *See In re TMI Litig.*, 193 F.3d at 643.

²¹³ *Berg v. E.I. Dupont De Nemours & Co. (In re Berg Litig.)*, 293 F.3d 1127 (9th Cir. 2002).

²¹⁴ *Id.* at 1129, 1131. "The [fifty percent] level corresponds to a probability that an individual has a disease caused by radiation that is twice the probability of such disease in the population as a whole." *Id.* at 1129.

²¹⁵ *Id.* at 1131.

²¹⁶ *Golden v. CH2M Hill Hanford Group, Inc.*, 528 F.3d 681 (9th Cir. 2008).

radioactive materials and nonradioactive heavy metals.²¹⁷ The Ninth Circuit held that the plaintiff cannot recover for psychic harm without proving that the exposure to radioactive materials caused his physical injuries.²¹⁸ However, if the plaintiff can show emotional distress arising out of separately identifiable fears from heavy metal, rather than a general fear for his future health intertwined with his exposure to radioactive materials, his claim for such damages would not be preempted by the PAA.²¹⁹

As the *Rainer* court has pointed out, an important reason that courts are reluctant to grant damages for fear of cancer or damages for enhanced risk of developing a dreaded disease in the future is because courts do not know how the damages should be calculated.²²⁰ Indeed, losses resulting from salient physical diseases such as cancer or asbestosis are at least quantifiable, and courts are familiar with methods of computing costs associated with medical care, absence from work, and physical pain, but not purely mental distress.²²¹

However, medical monitoring, as a form of recovery rather than a cause of action, may well serve the purpose of alleviating mental anguish caused by the fear of developing cancer or the increased risk of cancer. As Jamie A. Grodsky has suggested, instead of lump sum payment, medical-monitoring relief can be confined to reimbursement for specific diagnostic tests ordered by medical professionals.²²² Through regular checkups, plaintiffs not only know when an individual's condition is progressive, but when an individual's condition is static or self-reparable.²²³ The latter should be permitted to withdraw from the plaintiff class or to discontinue the monitoring regime.²²⁴

²¹⁷ *Id.* at 682.

²¹⁸ *Id.* at 683–84.

²¹⁹ *Id.* at 684.

²²⁰ *Rainer v. Union Carbide Corp.*, 402 F.3d at 622.

²²¹ *Id.*

²²² Grodsky, *supra* note 122, at 1715–16. The expenses can be deducted from a court-approved fund only as they are incurred. *Id.* at 1715.

²²³ *Id.* at 1717.

²²⁴ *Id.*

Nevertheless, Jamie A. Grodsky did not exclude the possibility that we may “need to consider complementary administrative or regulatory strategies to help strike the balance between deterrence and legal restraint” if the concerns of either “unbridled liability” or “risks without remedies” proved to be true.²²⁵ Taiwan adopted an administrative compensation scheme in redressing the property injury caused by radioactive-steel contamination. However, the compensation scheme apparently has neglected residents who are not property owners.

IV. REMEDY FOR PROPERTY INJURY

As Eric R. Pogue has stated, the real toll of a nuclear accident takes the form of property damage.²²⁶ The statement remains true when radiation contamination is caused by sources other than a nuclear accident, such as buildings contaminated with radioactive steel. Taiwan established a compensation scheme to redress the economic loss arising from buildings contaminated with radioactive steel after the government found that Ming-Sheng Villa was not a special case, but the tip of an iceberg.

The AEC in Taiwan issued the Regulations for Prevention and Handling of Radiation Contaminated Buildings (“RPHRCB”) in 1994. The scheme grants compensation predominantly based on the value of the property at issue, and is less concerned with the residents’ health. The only provisions concerning the residents’ health under the regulations are that residents exposed to radiation in excess of five mSv in any particular year are provided with a free medical checkup in the same year.²²⁷

²²⁵ *Id.* at 1733.

²²⁶ Eric R. Pogue, *The Catastrophe Model of Risk Regulation and the Regulatory Legacy of Three Mile Island and Love Canal*, 15 PENN. ST. ENVTL. L. REV. 463, 470 (2007).

²²⁷ Regulation for Preventive Measures and Management Plans for the Incident of Radioactivity Contaminated Buildings, ch. 3, art. 9, AEC-083-01-202 (1994). Though the regulations provides that the Department of Health may continue to monitor the residents’ health if the medical examination shows signs of injury caused by the exposure, the government is not obliged to do so. *Id.*

Under the RPHRCB, property owners have two options: first, they may sell the properties to the authorized agency at a reasonable price if the radiation doses detected are in excess of fifteen mSv per year, and the agency has the discretion to decide whether the buildings should be demolished after the transfer of ownership to the agency;²²⁸ or second, the owners of the contaminated buildings may receive a one-time payment at the amount of five percent of the property's reasonable value, if the radiation doses detected are in excess of fifteen mSv per year and the property owner chooses to maintain his ownership.²²⁹ However, in no situation should the payment be in excess of 500,000 N.T.D. (New Taiwan Dollar), or less than 200,000 N.T.D.²³⁰

For owners of buildings where the radiation doses detected are in excess of five but less than fifteen mSv per year, they do not have the option selling the buildings to the agency, but they are eligible for a one-time payment in the amount of 200,000 N.T.D.²³¹ If owners of contaminated buildings wish to reconstruct the buildings at their own expenses, the agency should reimburse half of the expenses actually incurred.²³² Nevertheless, in no situation should the reimbursement exceed 500,000 N.T.D. if the radiation doses detected are in excess of fifteen mSv per year; or 400,000 N.T.D. if the radiation doses are in excess of five but less than fifteen mSv per year.²³³

The compensation provided under the Taiwanese scheme is based on the monetary value of the buildings, rather than the diagnosis of listed diseases the residents have suffered. Therefore, there is a possibility that residents who contracted the most severe diseases may be granted compensation in an amount less than other residents because the buildings they owned are worth less than

²²⁸ Regulation for Preventive Measures and Management Plans for the Incident of Radioactivity Contaminated Buildings, ch. 3, art. 10 AEC-083-01-202 (1994).

²²⁹ Regulation for Preventive Measures and Management Plans for the Incident of Radioactivity Contaminated Buildings, ch. 3, art. 11, AEC-083-01-202 (1994).

²³⁰ *Id.*

²³¹ *Id.*

²³² Regulation for Preventive Measures and Management Plans for the Incident of Radioactivity Contaminated Buildings, ch. 3, art. 12, AEC-083-01-202 (1994).

²³³ *Id.*

others'. It is even worse if the residents are not the owners of any building, such as lessees. In such a situation, lessees are only eligible for a free medical checkup if they are exposed to radiation doses exceeding the threshold level. Other than that, they are not eligible for any monetary compensation or medical monitoring under the scheme, even if they have suffered some of the most severe adverse health effects.

Contrary to the RPHRCB's approach focusing on the value of properties at issue rather than the increased risk to the residents' health, courts in the U.S. continued to tie plaintiffs' property tort claims closely to the estimates of increased risk to health caused by radiation exposure. For instance, in *Cook v. Rockwell Int'l Corp.*,²³⁴ the court suggested that the plaintiffs may pursue the claims for loss of use of their properties under the PAA.²³⁵ However, whether plaintiffs can prevail in such claims remains dependent on whether they can reliably estimate the particular risk to the residents' health.²³⁶ In January 1990, the owners of property near the Rocky Flats Weapons Plant ("Rocky Flats") filed a class action suit alleging the release of plutonium particles at Rocky Flats resulted in the contamination of the class members' properties.²³⁷ The suit is a public liability action under the PAA involving trespass and nuisance claims.²³⁸ The plaintiffs sought compensatory damages measured by the diminution of property values and punitive damages.²³⁹

At trial, the plaintiffs' expert testimony indicated that plutonium exposure, no matter how small, increases the risk of

²³⁴ 618 F.3d 1127 (10th Cir. 2010).

²³⁵ *Id.* at 1141–42.

²³⁶ *Id.* at 1142.

²³⁷ *Id.* at 1131. The Rocky Flats Weapons Plant manufactured components for the United States' nuclear weapons program from 1952 to 1989. *Id.* The U.S. government contracted with Dow Chemical Company to operate the facility from 1952 to 1975 and then with Rockwell International Corporation. *Id.* In June 1989, the operations at Rocky Flats ceased after the Federal Bureau of Investigation and the Environmental Protection Agency searched the facility. *Id.* Rockwell was charged with and later pleaded guilty to certain environmental crimes at the site. *Id.*

²³⁸ *Id.*

²³⁹ *Id.*

cancer.²⁴⁰ Despite the expert's acknowledgment that the increased risk is small and unquantifiable,²⁴¹ the jury found in favor of the plaintiff class on both the trespass and nuisance claims.²⁴² Later, the defendants appealed the district court's judgment and the class members filed a cross-appeal.²⁴³

On appeal, the Tenth Circuit relied on its reasoning earlier in *June*, which is a case involving the increased risk of developing radiation-related illness in the absence of bodily injury,²⁴⁴ and concluded that, by analogy, neither the mere presence of radioactive source on the plaintiffs' properties²⁴⁵ nor the diminution of the plaintiffs' property values is sufficient to establish actual damage to property under the PAA.²⁴⁶ In *Cook*, the plaintiffs did not argue any claim involving bodily injury. Instead, they pursued classic property tort claims, trespass,²⁴⁷ and nuisance, to seek recovery for injuries to a property interest.²⁴⁸ Nevertheless, analogous to *June*, the court in *Cook* held that an existing physical injury to property at the time the PAA claim is asserted is necessary to establish "damage to property" under 42 U.S.C. § 2014(q).²⁴⁹ Neither the mere presence

²⁴⁰ *Id.* at 1134.

²⁴¹ *Id.*

²⁴² *Id.* The litigation continued for over 15 years. Eventually, in June 2008, the district court entered a judgment for over \$926 million to the plaintiff class. *Id.* at 1133–34.

²⁴³ *Id.* at 1134.

²⁴⁴ *June v. Union Carbide Corp.*, 577 F.3d at 1237, 1248–49.

²⁴⁵ *Cook v. Rockwell Int'l Corp.*, 618 F.3d at 1141.

²⁴⁶ *Id.* at 1141 n. 12.

²⁴⁷ *Id.* at 1148–49. The court recognized that radioactive particles have mass and are physically present on the land, but the particles are impalpable, therefore the trespass alleged must be tried as an intangible trespass. *Id.* As to the intangible trespass claims, the *Cook* court concluded that the plaintiffs need to prove actual physical damage to their properties to prevail. *Id.* The court first reasoned that the deposit of radioactive materials is impalpable therefore the intangible trespass theory, rather than the traditional trespass theory, should apply in this context. *Id.* The court held that the district court erred in failing to require the plaintiff to prove that the intrusion of radioactive materials caused physical damage to their properties. *Id.*

²⁴⁸ *Id.* at 1140 n. 11.

²⁴⁹ *Id.* at 1140.

of radioactive source on the plaintiffs' property²⁵⁰ nor the diminution of the plaintiffs' property values is sufficient to establish actual damage.²⁵¹

In essence, the *Cook* court was declaring that virtually no radiation contamination would meet the requirement of "damage to property" under the PAA. Regardless of the extent and dosage of radiation contamination, even in the most severe cases, the mere presence of radioactive source on the plaintiffs' property is not sufficient to sustain a public liability action under 42 U.S.C. § 2014 (q). It is highly doubtful Congress intended to create a damage list where virtually no damage would be sufficient, no matter how severe the contamination.

However, the court noted that damage to property is not the only property injury that a plaintiff can prove to establish a claim under 42 U.S.C. § 2014 (q).²⁵² A plaintiff may claim a "loss of use of property instead."²⁵³ The *Cook* court suggested that "more than a mere interference with an owner's use is necessary" and "a particular use of the property must actually be lost."²⁵⁴

For a plaintiff to prevail in a nuisance claim, the interference must be both "substantial" and "unreasonable."²⁵⁵ The *Cook* court agreed that the presence of radioactive contamination that creates an actual risk to health may interfere with a plaintiff's use or enjoyment of land.²⁵⁶ The plaintiffs' anxiety from an increased risk to their health may constitute unreasonable and substantial interference with their use and enjoyment of their property only if the anxiety is arising from "scientifically verifiable evidence regarding the risk."²⁵⁷

The court in *Cook* suggested that the plaintiffs could have presented evidence sufficient to establish a loss of use,²⁵⁸ but they

²⁵⁰ *Id.* at 1141.

²⁵¹ *Id.* at 1141 n. 12. Diminution of value is traditionally utilized "as a measurement of damages rather than proof of the fact to damage." *Id.*

²⁵² *Id.* at 1141.

²⁵³ 42 U.S.C. § 2014 (q) (2011).

²⁵⁴ *Cook v. Rockwell Int'l Corp.*, 618 F.3d at 1141.

²⁵⁵ *Id.* at 1145.

²⁵⁶ *Id.*

²⁵⁷ *Id.*

²⁵⁸ *Id.* at 1141–42.

did not.²⁵⁹ The court agreed with the plaintiffs' argument and stated "when the presence of radioactive materials creates a sufficiently high risk to health, a loss of use may in fact occur."²⁶⁰ Nevertheless, the plaintiffs must estimate or calculate "the particular level of risk" created by the defendants' conduct.²⁶¹ A scientifically unfounded risk can never be unreasonable and substantial interference.²⁶² Similarly, a mere statement that "any exposure to plutonium whatsoever increases the risk of health problems to some degree" is not enough.²⁶³

Though it may be coincident, after analysis this article found that both the Taiwanese administrative compensation scheme and the U.S. federal courts relatively favor finding the claimants' property injury, as opposed to adverse effect to health. For instance, the compensation scheme in Taiwan awards payment basically in proportion to the value of the claimants' property. For residents without property ownership, including the lessee, the only benefit mandated under the scheme is a medical examination free of charge.

As to the U.S. federal courts, a line of cases have found that the plaintiffs' increased risk of developing cancer or other dreaded diseases, in and of itself, is insufficient to claim bodily injury or mental anguish under the PAA. However, as noted in *Cook*, the court suggested that a sufficiently high risk to health may have constituted a loss of use of the property under the PAA.²⁶⁴ As a result, similar to the Taiwanese approach, only property owners may reasonably expect recovery from excessive exposure to radiation.

The social injustice caused by systemic bias in favor of property owners is evident under the Taiwanese administrative compensation scheme and the U.S. federal courts' interpretation of the PAA. Residents without property ownership, such as the lessee or the poor, are essentially remediless. The systemic bias needs to be redressed.

²⁵⁹ *Id.* at 1142.

²⁶⁰ *Id.* at 1141.

²⁶¹ *Id.* at 1142.

²⁶² *Id.* at 1145.

²⁶³ *Id.* at 1142.

²⁶⁴ *Id.* at 1141.

CONCLUSION

Courts frequently raise public policy considerations to justify the denial of relief for plaintiffs who have not developed diseases after exposure to excessive radiation. For instance, one court decided to “deny relief to those without symptomatic, diagnosed ailments so that scarce resources can be directed to compensate those who have suffered more serious harms.”²⁶⁵ Nevertheless, the public policy considerations are simply misguided because plaintiffs, even those who have suffered serious bodily injury, would eventually fail on causation issues and be left remediless.

The Taiwanese administrative compensation scheme and U.S. federal courts’ interpretation of the PAA both favor finding property injury to claimants, as opposed to adverse effects to their health. For the latter, the increased risk of developing cancer is never sufficient to establish bodily injury or mental anguish under the PAA. Nonetheless, it may be sufficient in proving the loss of use of property. Residents without property ownership, such as lessees or the poor, are virtually remediless. The social injustice caused by unintended systemic bias should be redressed.

However, the award of compensation, either in court or under an administrative compensation scheme, should be in proportion to the defendants’ culpability, as opposed to solely based on the claimant’s loss. Otherwise, the scale would tip in favor of the plaintiffs against the defendants. It is especially so in situations where the plaintiffs cannot exclude other probable causes of their injury and have to rely on the probability of causation to infer causal link. One example is awarding payment in proportion to the probability of causation and at the same time eliminating the arbitrary cutoff point to avoid excluding claimants who should have been eligible for compensation. For claimants who have not developed diseases, medical monitoring, as a form of recovery rather than a cause of action, may well serve the purpose of alleviating mental anguish caused by the fear of developing cancer or the increased risk of cancer.

²⁶⁵ June v. Union Carbide Corp., 577 F.3d at 1251.